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# Mood and personality predict improvement in creativity due to meditation training

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ABSTRACT

Studies have shown a mean improvement of creative performance following meditation, however, differences among individuals have been neglected. We examine whether short-term integrative body–mind training (IBMT), can improve creative performance and seek to determine which people are most likely to benefit. In a randomized study using short-term IBMT or a control given same amount of relaxation training (30 min/day for 7 days), mood, personality and creative performances were assessed before and after training. The results indicated that the IBMT group had significantly greater creative performance than the relaxation control. A linear regression showed that five predictors in pre-tests including depression, anger, fatigue, introversion × vigor, and emotional stability × vigor accounted for 57% of the variance in the change in creativity before vs. after IBMT. Mood and personality may be useful tools to predict individual variation in the improvement of creative performance following meditation training.



## 1. Introduction

Creativity is commonly defined as work that is both novel (i.e., original and unexpected) and appropriate (i.e., valuable and adaptive concerning task constraints) (Sternberg & Lubart, 1999). Creativity is essential to the development of human civilization and plays a crucial role in cultural life (Hennessey & Amabile, 2010). Hence, various fields of research are interested in the potential for fostering creative performance through technology and training. It has been the contribution of cognitive psychology to understand mental processes in terms of component operations (Posner, 1978). Our choice of tests to measure creative performance including the Torrance Test of Creative Thinking (TTCT) is based on that theoretical perspective. Of special important is the ability to measure aspects of creative performance particularly as it relates to divergent thinking as measured by the TTCT (Torrance, 1972). Divergent thinking pertains primarily to information retrieval and the call for a number of varied responses to a certain item (Guilford & Paul, 1967). Prior study demonstrated that divergent thinking as a key aspect of creative performance has the validity to predict creative ability (Kim, 2008).

For the past four decades, the popularity of meditation in the Western world has led to extensive research into both its physiological and behavioral effects, including creative performance (Murphy, Donovan, & Taylor, 2004). For example, transcendental meditation training enhances creative performance as assessed by TTCT (Ball, 1980). Moreover, maintaining a mindful and alert state during meditation results in better creative thinking (solving insightful problem) (Ren et al., 2011). In addition, Zen practitioners who meditated in the laboratory performed better on the creative thinking (as measured by Remote Associate Test) than those who did not meditate (Strick, Van Noorden, Ritskes, De Ruiter, & Dijksterhuis, 2012). The open-monitoring meditation, in which an individual is open to perceive and observe any sensation, promotes creative thinking (Colzato, Ozturk, & Hommel, 2012). Our recent work also suggested that short-term IBMT can enhance the creative thinking including divergent thinking (Ding, Li, & Tang, 2011; Ding, Tang, Tang, & Posner, 2014b) and insightful problem solving (Ding et al., 2014a).

It should be noted that research into a connection between creative performance and meditation has shown a mean improvement of creative performance following meditation training (Ball, 1980; Colzato et al., 2012; Ding et al., 2011; Ding, Tang, Cao, et al., 2014a; Ding, Tang, Tang, & Posner, 2014b; Ren et al., 2011; Strick et al., 2012), but there were individuals who showed the opposite effects (O'Haire & Marcia, 1980; Otis, 1974). One study revealed no improvement in creative performance proceeding three months meditation training,

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though many individuals reported an increase in their creative ability (Otis, 1974). Another study tested creative thinking skills with the TTCT—Form B and found an unsupportable relationship between three years meditation experience and creative performance, although some meditators scored highest on figural originality (O'Haire & Marcia, 1980). These differences could be due to error of measurement in the TTCT or other factors such as the aspects of the individuals' personality and mood.

Mental state and personality have been associated with creative performance. For example, people with more positive emotion had more flexible and original responses (Brand & Opwis, 2007; Davis, 2009; De Dreu, Baas, & Nijstad, 2008). Moreover, creative people in general are more autonomous, introverted, mood stable, and energized (Barron & Harrington, 1981; Feist & Barron, 2003; Furnham & Bachtiar, 2008). Similarly, both mental state and temperament are related to individual differences in meditation. For example, anxiety and neuroticism are negatively related to the ability to achieve an appropriate meditative state (Lykins & Baer, 2009; Murata et al., 2004). These findings suggest that mood states and temperament may be indicative of an individual's capacity to benefit in creative ability from meditation training.

The current study focuses on individual differences of meditation training on divergent thinking as an aspect of creativity using TTCT. In previous work (Ball, 1980; Colzato et al., 2012; Ding et al., 2011; Ding, Tang, Cao, et al., 2014a; Ding, Tang, Tang, & Posner, 2014b; Ren et al., 2011; Strick et al., 2012), it has been established that creative performance increases following meditation, but not all persons improve in creative performance, we hypothesize that those with specific personality and/or mood will improve more than those without these characteristics.

Many studies of meditation compare long term meditators with a control group. However, integrative body–mind training (IBMT), one form of meditation, has been shown in just five days to improve many aspects of cognition including attention (Tang et al., 2007). IBMT originates from ancient eastern contemplative traditions (e.g., traditional Chinese medicine and Zen) and incorporates key components of meditation training including body relaxation, mental imagery and mindfulness (Tang & Posner, 2009; Tang et al., 2007). IBMT is designed to facilitate the achievement of a meditative state with a balance and optimization between mind and body (Tang et al., 2007). On the other hand, relaxation training (RT) involves the relaxing of different muscle groups over the head to the abdomen and forces one to concentrate on the feelings of warmth and heaviness (Bernstein & Borkovec, 1973). This progressive muscle training helps a participant achieve physical (body) and mental (mind) relaxation and calmness (Tang et al., 2007, 2009). Since both RT and IBMT effort to achieve their desired states through regulating the body and the mind, RT matches IBMT in the training and thus we chose RT as an active control condition. Recent studies have shown IBMT to be effective with a U.S. population (Tang et al., 2009, 2007; Tang, Tang, & Posner, 2013). We have found that a few hours IBMT significantly improved creative performance including divergent thinking (Ding et al., 2011; Ding, Tang, Tang, & Posner, 2014b) and insightful problem solving (Ding, Tang, Cao, et al., 2014a). Hence, IBMT is being used as a meditation intervention to test our hypothesis.

Taken together, we hypothesize that compared to RT (i) IBMT will produce greater creative performance (as measured by TTCT) (ii) There will be a relation between pre-test score (Profile of Mood States (POMS) or Eysenck Personality Questionnaire (EPQ)) and improvement (post-test TTCT score minus pre-test TTCT score) following IBMT.

## 2. Method

### 2.1. Participants

Eighty-four healthy undergraduates (49 males, aged 21 ± 1.5 years old) at Dalian University of Technology (DUT) without any meditation or relaxation experiences were recruited. They were evenly randomly assigned to an IBMT group or an RT group (42:42). Forty-two participants in the IBMT group completed the whole training of 30 min/day for 7 days (3.5 h in total) and 42 participants in the RT group were given the same amount and length of RT (Tang et al., 2007). The study was approved by DUT Institutional Review Board and informed consent was obtained from each participant. The consent form explained that participants would complete the POMS and the EPQ before training, and complete the TTCT before and after training.

### 2.2. Profile of Mood States (POMS)

The POMS (Spinella, 2007) is a psychological rating scale used to assess transient and distinct mood states. Previous studies have shown improved moods measured by POMS following IBMT (Tang et al., 2007). Validation studies have reported internal consistency (alpha) coefficients for the POMS subscales ranging from .84 to .95 and test–retest reliability coefficients ranging from .65 to .74 (McNair, Lorr, & Droppleman, 1971). It applies to people over the age of 18 and its administration time is 5 to 10 min. The respondent rates each item on a five-point scale ranging from 1 'very slightly or not at all' to 5 'very much'. Factor analytic replications provide evidence of the factorial validity of the six mood factors: T (tension/anxiety), D (depression/dejection), A (anger/hostility), F (fatigue/inertia), C (confusion/bewilderment) and V (vigor/activity), and an examination of the individual items defining each mood state supporting the content validity of the factor scores (Shacham, 1983). The first five mood factors represent negative mood and the sixth factor stands for positive mood.

### 2.3. Eysenck Personality Questionnaire

The 101-item EPQ is a questionnaire to assess the personality traits of a person (Eysenck & Eysenck, 1994). The Revised Eysenck Personality Questionnaire in Chinese has been demonstrated to be reliable and valid for Chinese participants (Chen, 1998). The respondent rates each item on "Yes" or "No". It applies to people over the age of 16. The inventory contains four personality trait subscales: Psychoticism/Socialization (P), Extraversion/Introversion (E), Neuroticism/Stability (N), and Social Desirability (L). The L scale contains questions on which individuals tend to lie for social desirability, and the scoring standard is the same for everyone. If a participant received a score of one instead of zero on an L scale question, then this response was recorded as a lie. In each subscale, high score is on behalf of the former traits and low score is on behalf of the latter traits.

### 2.4. Creativity assessment

The subject's performance of creativity was assessed through TTCT (Torrance, 1972), which has been translated into Chinese language version and standardized for the use in China (Wu, Gao, Wang, & Ding, 1981). The TTCT—Verbal and the TTCT—Figural are two versions of the TTCT (Torrance & Ball, 1984; Torrance, Ball, & Safter, 1981). The creative scalogram in this study consists of two activities (Product Improvement, and Unusual Uses) from TTCT—Verbal and two activities (Picture Completion, and Repeated Figures of Lines) from TTCT—Figural. All participants answered the same questions. Ten minutes were required to complete each activity to generate as many answers as possible.

The four subscales, with descriptions about scoring and the content measured, are listed as following: (a) Fluency, which is the number of relevant responses to the questions, shows the ability to produce and consider many alternatives; (b) Flexibility, which is the (total) number of categories that answers are assigned based on a criteria table or an almost equivalent judgment, shows the ability to produce responses from a wide perspective; (c) Originality, which is the number of statistically infrequent ideas, shows the ability to produce ideas that differ from others'. The scoring procedure counts the most common responses as 0 and all other legitimate responses as 1. The originality lists are

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prepared for each item on basis of normative data, which are readily memorized by scorers. (d) Elaboration, which is the amount of detail in the responses, shows the ability to produce ideas in detail (Torrance & Ball, 1984; Torrance et al., 1981). Elaboration did not seem critical to divergent thinking and its scoring may be more subjective and biased than the scoring of fluency, flexibility and originality. For these reasons, elaboration will not be discussed in this article.

The raw score (fluency, flexibility, originality) in each activity is converted to T-scores according to a formula in TTCT manual (Wu et al., 1981). Each total scale score is the sum of its T-scores in the corresponding scale of the four activities. A TTCT score is the sum of three subscales including fluency, flexibility and originality. Each subscale was rated by a single proficient scorer who was blind to the conditions of the participants. Since both groups took the same test before and after training we can use differences between the IBMT and RT groups which holds constant any changes due to taking the test twice.

### 2.5. Procedures

The experimental sessions include the following: pre-test session, training session, and post-test session.

(i) Pre-test session. Before training, the POMS, EPQ and TTCT were administered in a group format. First, all the participants completed the POMS and then the EPQ. Second, to avoid interference between the two tasks a thirty minute break was given after EPQ. The break included a 15-min rest and then 15-min explanation of the following TTCT tasks. Third, the TTCT was administered. The administration was performed blind by one psychology Ph.D. familiar with giving the POMS, EPQ and TTCT (Torrance & Ball, 1984; Torrance et al., 1981; Wu et al., 1981). Each participant completed the tests in a partition type desk.

(ii) Training session. The training sessions are intended to help each participant to increase the meditation or relaxation experience. Both IBMT and RT group completed the 7 consecutive days of training with 30 min/per day respectively, total is 3.5 h. The first training day occurred on a different day after finishing the pre-test session. Every day the training details were as follows (Tang et al., 2007, 2009). Firstly, a qualified coach provided participants a free question-and-answer meeting about (IBMT or RT) practice. Secondly, the coach guided the participants to practice in a harmonious and relaxed atmosphere. The practice was 30 min. The IBMT group followed the practice instructions with body relaxation, mental imagery, and mindfulness training and concentrated on achieving a balanced state of body and mind (Tang et al., 2007). The RT group followed the practice instructions with relaxing of different muscle groups and concentrated on the feelings of warmth and heaviness (Bernstein & Borkovec, 1973). During the practice, the coach observed facial and body cues and gave proper feedback immediately to those who were struggling with the method. Thirdly, 30 min later, each participant filled out a questionnaire and evaluated the practice. The coach gave short responses to subjects as required.

(iii) Post-test session. This session occurred on the next day after the final training day. Participants were given the TTCT. This study involved a RT control group in order to control for taking the test twice and concluded that increase in creative performance of IBMT group was not due solely to familiarity with the test.

### 2.6. Statistical analysis

Analysis of variance (ANOVA), t tests and linear regression were applied for analysis. All analyses were performed using SPSS 13.0.

To examine the homogeneity in TTCT between IBMT group and RT group before training, an independent t-test was used to compare the differences between two groups in mean values. We then conducted preliminary analyses using a repeated-measures ANOVA method between groups on TTCT with time as a factor. When statistically significant effects were found, a paired t-test was used to compare differences in mean values from pre to post within the groups. In addition, the independent t-test was used to compare differences in mean values between the groups after training.

To explore differences between individuals on the amount of improvement in creative performance following IBMT, a linear regression model was constructed with average number of TTCT change (before and after IBMT). The main predictor variables in model were T (tension/anxiety), D (depression/dejection), A (anger/hostility), F (fatigue/inertia) and V (vigor/activity) in POMS and P (Psychoticism/Socialization), E (Extraversion/Introversion), and N (Neuroticism/Stability) in EPQ respectively.

All data are expressed and plotted as mean ± SE. $p < .05$ was considered statistically significant.

## 3. Results

### 3.1. The effects of short-term meditation on improving creative performance as measured by TTCT

The data are shown in Fig. 1. ANOVAs revealed a group (IBMT vs. RT) × session (pre-test vs. post-test) interaction effect [$F(1, 82) = 37.572$; $p < .01$] and a session (pre-test vs. post-test) main effect [$F(1, 82) = 65.722$; $p < .01$]. The follow-up paired t-test indicated the IBMT group from pre to post obtained significantly higher scores ($t(41) = 9.495$; $p < .01$). However, the RT group showed a relatively better performance but not significant ($t(41) = 1.494$, $p > .05$). After training, an independent t-test indicated the IBMT group obtained significantly higher scores in TTCT ($t(82) = 3.773$; $p < .01$) in comparison with the RT group (Fig. 1). These results indicate that short-term IBMT can yield a better creative performance than RT.

### 3.2. Inter-individual differences in the improvement of creative performance induced by short-term meditation

Fig. 1 shows an overall improvement in TTCT scores following training. Fig. 2 (left panel) shows better creative performance following IBMT. However, this averaging ignores a large variation in individual responses (Fig. 2, right panel). Some participants showed consistent trends with the mean responses (gray lines), some participants showed opposite trends (hollow circles and black lines) and others showed much higher responses (solid circles and black lines). Such inter-individual differences are masked by averaging but could be attributed to variability of short-term IBMT outcomes of creative performance.

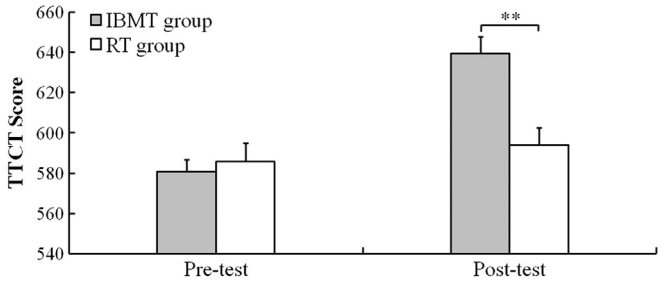


**Fig. 1.** Comparison of TTCT scores of IBMT group and RT group before and after 7 days of training. IBMT group (gray bars). RT group (white bars). $^{**}p < .01$. Error bars indicate 1 SE. A higher vertical axis shows better creative performance.

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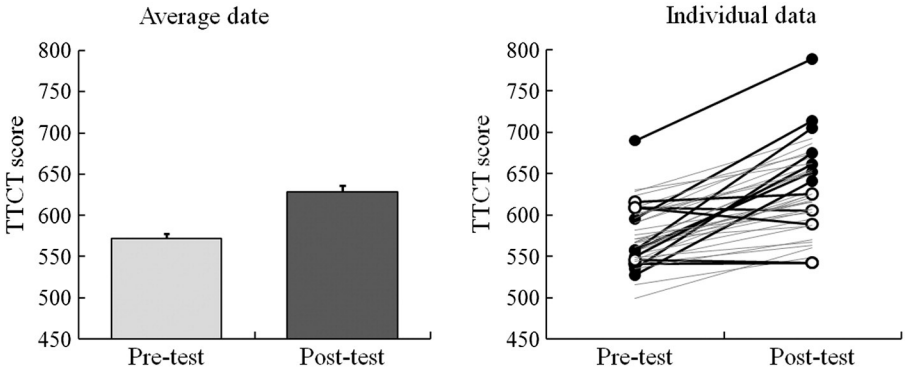


**Fig. 2.** The average and individual TTCT responses of IBMT group across pretest and posttest. The mean TTCT score for pretest and posttest is illustrated in the left panel. Individual data comprising the mean responses are shown by lines in the right panel.

### *3.3. Mood and temperament as predictors of inter-individual differences in creative improvement*

To forecast which people benefit from short-term IBMT, a prediction model is conducted with mood subscales (pretest), personality subscales (pretest) and mood subscale (pretest) × personality subscale (pretest) interactions as independent variables, using the changed TTCT score as a dependent variable. The linear regression showed that five significant predictors accounted for 57% of the variance in the changed TTCT score [$F(11,30) = 5.856$; $p < .001$; Adj. $R^2 = 0.566$] in this model (see Table 1.).

This regression showed the results of main effects: (1) The IBMT individuals having lower depression/dejection levels (as measured by POMS) responded more favorably to the short-term IBMT in improving creative performance (as measured by TTCT). (2) The IBMT individuals having higher anger/hostility levels (as measured by POMS) responded more favorably to the short-term IBMT in improving creative performance (as measured by TTCT). (3) The IBMT individuals having lower fatigue/inertia levels (as measured by POMS) responded more favorably to the short-term IBMT in improving creative performance (as measured by TTCT).

The results of interaction effects analysis are shown: (4) The IBMT individuals having lower extraversion levels (as measured by EPQ) and higher vigor/activity levels as well (as measured by POMS) responded more favorably to the short-term IBMT in improving creative performance (as measured by TTCT). (5) The IBMT individuals having lower neuroticism (as measured by EPQ) and higher vigor/activity levels as well (as measured by POMS) responded more favorably to the short-term IBMT in improving creative performance (as measured by TTCT).

To explore whether in the RT group there is a same effect of mood and personality on TTCT scores as in the IBMT group, a prediction model is also conducted with mood subscales (pretest), personality subscales (pretest) and mood subscale (pretest) × personality subscale (pretest) interactions as independent variables, using the changed TTCT score as a dependent variable in RT group. The linear regression showed that five significant predictors accounted for 25% of the variance in the changed TTCT score [$F(9,32) = 2.536$; $p < .05$; Adj. $R^2 = 0.252$] in this model (see Table 2.).

This regression showed the results of main effects: (1) The RT individuals having lower extraversion level (as measured by EPQ) responded more favorably to the short-term RT in improving creative performance (as measured by TTCT). The results of interaction effects analysis are shown: (1) The RT individuals having lower extraversion levels (as measured by EPQ) and higher tension/anxiety levels as well (as measured by POMS) responded more favorably to the short-term RT in improving creative performance (as measured by TTCT).

## 4. Discussion

Consistent with our hypotheses, the IBMT group outperformed the RT group in TTCT scores after training. TTCT is used to evaluate creative performance through divergent thinking (Kim, 2008), which is a key aspect of creative performance and predicts creative ability (Guilford & Paul, 1967). Whether this improvement would also be found in the real world activity of creative performance, it remains unclear.

We found that there were substantial inter-individual differences in the IBMT group's TTCT scores. Some scores were greatly improved, other improved only slightly and some actually declined. Since mood and personality were associated with creative performance and meditation, we hypothesize that mood or personality prior to training could predict the relative efficacy of short-term IBMT in improving TTCT scores.

A linear regression model was constructed to predict TTCT change. The regression analysis showed that the IBMT individuals having lower depression levels and fatigue levels responded had a stronger effect of IBMT in improving creative performance. Further, neuroticism was negatively related to meditation experience (Lykins & Baer, 2009), and meditation was associated with higher levels of experience of positive affect. Overall the regression showed that the IBMT individuals with more emotional stability (meaning lower neuroticism) and

**Table 1**
Linear regression yielded three pre-test mood factors and two personality × mood interaction factors contributing to the difference of TTCT scores in IBMT group.

| Model | | | | Predictor variable | | | |
|---|---|---|---|---|---|---|---|
| Adjusted $R^2$ | F | *df* | *p* | Variable | Beta | t | *p* |
| 0.566 | 5.856 | 11.30 | 0.000 | D (depression/dejection) | −0.980 | −4.590 | 0.000 |
| | | | | A (anger/hostility) | 0.777 | 4.203 | 0.000 |
| | | | | F (fatigue/inertia) | −0.326 | −2.259 | 0.031 |
| | | | | E (extraversion) × V (vigor/activity) | −0.591 | −4.001 | 0.000 |
| | | | | N (neuroticism) × V (vigor/activity) | −0.423 | −2.907 | 0.007 |

**Table 2**
Linear regression yielded one pre-test mood factors and one personality × mood interactions factors contributing to the difference of TTCT scores in RT group.

| Model | | | | Predictor variable | | | |
|---|---|---|---|---|---|---|---|
| Adjusted $R^2$ | F | *df* | *p* | Variable | Beta | t | *p* |
| 0.252 | 2.536 | 9.32 | 0.025 | E (extraversion) | −0.783 | −3.579 | 0.001 |
| | | | | E (extraversion) × T (tension/anxiety) | −0.519 | −2.863 | 0.007 |

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higher vigor levels responded more favorably to the short-term IBMT in improving creative performance. Since there was no similar effect for RT, we speculate that these results indicate that lower negative mood may facilitate meditation training and then to improved creative performance, consistent with our previous studies (Ding et al., 2011; Ding, Tang, Cao, et al., 2014a; Tang et al., 2007). However, it is possible that more negative individuals for some other reason fail to improve creative performance.

Our results based on interaction effect analysis show that the percentage of variance accounted for by mood and personality is twice as high in the IBMT group as in the RT group. In the RT group the only predictor of improved creative performance is lower extraversion either by itself or in interaction with tension/anxiety. While in the IBMT group several negative moods alone or in interaction with lower extraversion influence TTCT score. The IBMT individuals having both higher introversion levels and higher vigor levels responded more favorably to the short-term IBMT in improving creative performance. Better response to training by more introverted individuals may be a common effect since it is found in both groups. We speculate that introversion may be a personality trait indicating readiness to engage in training that influences creative performance. Future research should explore this relationship.

Our results support previous findings that meditation improves creative performance more than RT does. We obtained substantial differences between individuals which were correlated with aspects of their mood and personality. This indicates that differences among people are not due only to error of measurement but are also predicted by their personality and mood. Taken together, our study may open up an important avenue for research into the individual differences of the relationship between meditation and creative performance.

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