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*Published in:*  
Europe's Journal of Psychology

*DOI:*  
[10.5964/ejop.v10i4.776](https://doi.org/10.5964/ejop.v10i4.776)

Published: 01/11/2014

[Link to publication](#)

*Citation for published version (APA):*  
CHUNG, P.-K., & ZHANG, C. (2014). Psychometric validation of the toronto mindfulness scale - Trait version in Chinese college students. *Europe's Journal of Psychology*, 10(4), 726-739.  
<https://doi.org/10.5964/ejop.v10i4.776>

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## Research Reports

# Psychometric Validation of the Toronto Mindfulness Scale – Trait Version in Chinese College Students

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## Abstract

The Toronto Mindfulness Scale (TMS; Lau et al., 2006) has been widely used to assess the state mindfulness of participants after practicing mindfulness. Recently, a trait version of the Toronto Mindfulness Scale was developed and initially validated (TMS-T; Davis et al., 2009). We further examined the psychometric properties of TMS-T using three hundred and sixty-eight Chinese college students (233 females and 135 males) from a public university in Hong Kong. We found that factor analyses failed to support the existence of two-dimensional structure of the Chinese version of the TMS-T (C-TMS-T). The model fit indices indicated a marginal model fit, and the concurrent and convergent validities of the C-TMS-T were not confirmed. The moderate item-to-subscale fit of the decentering subscale indicated that its structural validity was not satisfactory. In addition, the internal consistency coefficient of the decentering subscale using composite reliability ( $p = .61$ ) was under the acceptable level. Based on the results, we concluded that the application of the C-TMS-T to the Chinese population is premature. Further validation of the C-TMS-T using another sample of participants is recommended, in particular, individuals with meditation experiences.

*Keywords:* Toronto Mindfulness Scale, mindfulness, reliability, validity, meditation

Europe's Journal of Psychology, 2014, Vol. 10(4), 726–739, doi:10.5964/ejop.v10i4.776

Received: 2014-03-24. Accepted: 2014-07-27. Published (VoR): 2014-11-28.

Handling Editor: Andrew P. Allen, University College Cork, Cork, Ireland

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## Introduction

Mindfulness is a key concept in Buddhist teachings concerning the significance of consciousness (R. P. Hayes, 2003). During the past decade, a surge of interest in mindfulness-based applications has been witnessed in Western psychology (Williams & Kabat-Zinn, 2011), particularly in clinical psychology research and practice. Mindfulness has been integrated into several mindfulness and acceptance based therapies which closely resemble the Buddhist traditions of mindfulness (Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008), including mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1982, 1990), mindfulness-based cognitive therapy (MBCT; Segal, Williams, & Teasdale, 2002), dialectical behavior therapy (DBT; Linehan, 1993a, 1993b), acceptance and commitment therapy (ACT; S. C. Hayes, Strosahl, & Wilson, 1999), as well as variations of these approaches. Although methodological rigor varies in applied practice (Baer, 2003; Bishop, 2002; Grossman, Niemann, Schmidt, & Walach, 2004), mindfulness-based interventions have received increasing support in research related to improving positive aspects of psychological functioning, such as mindfulness, emotion intelligence, acceptance, subjective

well-being, empathy, and hope, as well as reducing a variety of medical and psychological symptoms, including depression, depressive relapse, anxiety, substance abuse, chronic pain, disordered eating, psychosis, panic disorder, borderline personality disorder, suicidal behavior, and so on (see Baer, 2003; Choi, Vickers, & Tassone, 2014; Grossman et al., 2004; S. C. Hayes, Luoma, Bond, Masuda, & Lillis, 2006; Hofmann, Sawyer, Witt, & Oh, 2010; Keng, Smoski, & Robins, 2011; Soons, Brouwers, & Tomic, 2010).

As mindfulness and mindfulness-based interventions gain more and more attention, a widely recognized definition and operationalization of the mindfulness construct is urgently needed (Bishop et al., 2004; Brown & Ryan, 2004; Kabat-Zinn, 2003). The most cited definition of mindfulness is “paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment” (Kabat-Zinn, 2003, p. 145), which is built on Buddhist philosophy. Alternatively, rooted in the theories and research of social psychology, Langer (2000) defined mindfulness as “a flexible state of mind in which we are actively engaged in the present, noticing new things and sensitive to context” (p. 220). Compared to the nonreactive awareness and nonjudgmental acceptance of the present-moment experiences emphasized by Kabat-Zinn (1990, 2003), Langer’s (1989, 2000) definition of mindfulness is focused on active processing of present-moment new information from multiple perspectives, which is to understand various points of view that are situation dependent. Although Langer’s (1989, 2000) definition of mindfulness is not associated with meditation, a common base for these two different perspectives is that both of them include the component of paying attention to the present moment on purpose.

Given that various definitions have been developed from a variety of theoretical and applied backgrounds, consensus on a definition of mindfulness, among a variety of descriptions, is difficult to achieve (Bishop et al., 2004; Brown, Ryan, & Creswell, 2007). Brown and Ryan (2004) argued that mindfulness consists of a single factor described as attention to, and awareness of, what is taking place in the present. People who are high in mindfulness are believed to be aware of and attentive to present-moment experiences in daily life (Brown & Ryan, 2003). However, some researchers support the view that mindfulness is a multidimensional construct (e.g., Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Bishop et al., 2004; Cardaciotto et al., 2008; Chadwick et al., 2008). Based on varying but similar definitions, reliable and valid measures for examining the process and effectiveness of mindfulness-based training have also been developed accordingly, including the Freiburg Mindfulness Inventory (FMI; Buchheld, Grossman, & Walach, 2001; Walach, Buchheld, Buttenmüller, Kleinknecht, & Schmidt, 2006), the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003), the Kentucky Inventory of Mindfulness Skills (KIMS; Baer, Smith, & Allen, 2004), the Cognitive and Affective Mindfulness Scale–Revised (CAMS-R; Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2007), the Southampton Mindfulness Questionnaire (SMQ; Chadwick et al., 2008), the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006), and the Philadelphia Mindfulness Scale (PMQ; Cardaciotto et al., 2008). These scales have been translated and validated in many languages (e.g., Catak, 2012; Deng, Liu, Rodriguez, & Xia, 2011).

Although mindfulness is described more often as a trait-like or dispositional variable (i.e., a general tendency to be mindful in daily life), Bishop and colleagues (2004) view mindfulness as a mode or state-like quality, namely, an intentionally cultivated attention to experience with an open, nonjudgmental orientation. They proposed an operational definition of mindfulness that focuses on two components: sustained attention to present experience, and an attitude of openness, curiosity, and acceptance. This definition has been adopted and supported by many researchers (e.g., Cardaciotto et al., 2008; Lau et al., 2006; Thienot et al., 2014) when developing their own mindfulness measures. Based on this definition, the Toronto Mindfulness Scale (TMS; Lau et al., 2006) was developed to include curiosity and decentering as two separate factors. While curiosity is defined as “awareness of

present moment experience with a quality of curiosity”, decentering is conceptualized in line with Teasdale et al. (2002) as “awareness of one’s experience with some distance and disidentification rather than being carried away by one’s thoughts and feelings” (Lau et al., 2006, p. 1452). Unlike most self-report mindfulness measures which were originally designed to assess the trait-like or dispositional mindfulness, the TMS was designed to examine state mindfulness immediately after a meditation practice (Lau et al., 2006). Although the TMS has been widely used in mindfulness-based interventions and training, it has not been translated and validated in other languages. This may be due to the fact that TMS was originally designed to measure state mindfulness after meditation practice (Lau et al., 2006); it would be difficult for researchers to recruit enough qualified participants (i.e., meditators) who would meet the testing requirements. In addition, assessing the single-function role of state mindfulness might limit its application to non-meditation and non-mindfulness practice context. Recently, a trait version of the Toronto Mindfulness Scale (TMS-T) was developed and initially validated by Davis, Lau, and Cairns (2009), in which they converted the original state version (i.e., items described things that people just experienced) of the TMS (Lau et al., 2006) to a trait measure of people’s day-to-day experiences through rewording each item from the past tense into the present tense. This work has extended the use of TMS from a measure of state mindfulness to a measure of trait-like general tendency mindfulness, making the TMS-T a useful tool to be further translated and validated, and applied to non-meditators without mindfulness experiences.

Although the feasibility of TMS-T in college students has been examined, the initial validation of the TMS-T (Davis et al., 2009) has only confirmed the internal consistency reliability and convergent validity, but not the structural and concurrent validities (Davis et al., 2009). Thus, a further examination of structural and concurrent validities of the TMS-T is warranted. Secondly, although participants without meditation experiences were mixed with experienced meditators in Davis et al. (2009), the results from this study did not distinguish the contribution of the college students from the experienced meditators.

Considering the growing interest of mindfulness in a Chinese context, validation of the TMS-T (Davis et al., 2009) that is based on a widely-accepted theoretical framework can make significant contributions to the area. A validated TMS-T could help researchers make better choices when investigating the relationship of trait-like mindfulness with other key concepts (e.g., well-being, emotion regulation, and emotion adjustment), and evaluate the effectiveness and mechanisms of mindfulness-based training. The purpose of the current study was to investigate the psychometric properties of the TSM-T in a sample of Chinese college students in Hong Kong who are without meditation experiences. The structural validity was tested by conducting confirmatory factor analysis while the convergent and concurrent validities were tested by examining the relation between trait mindfulness and its criteria-related variables. To be in line with previous studies (Davis et al., 2009; Lau et al., 2006), both the subscales of curiosity and decentering were expected to be positively associated with mindfulness and subjective well-being, but negatively correlated with anxiety.

## Method

### Participants and Procedure

The participants were 368 Hong Kong Chinese college students (233 females and 135 males) who attended Physical Education (PE) classes at a public university in Hong Kong. The average age of the students was 20.3 years ( $SD = 1.2$ ; range = 18–25).

With permission of the researchers who developed the TMS-T (Davis et al., 2009), the instrument was translated into Chinese by two bilingual experts through a committee approach. A back translation from Chinese to English was completed by another two bilingual experts. The steps for the transcultural validation of psychometric instruments were followed (Hambleton, 2001, 2005). Six Hong Kong native Chinese college students were invited to complete the Chinese translated TMS-T (C-TMS-T), and minor modifications were made based on the suggestions of the students on the wording and syntax to enhance item clarity.

The packages of questionnaires were administered in classrooms of PE classes which took approximately 15 minutes to complete. The students were given a written introduction to the study and informed of their voluntary role in completing the questionnaires. Four PE classes, with 85 participants, were randomly selected from 17 PE classes to repeat the C-TMS-T after a one-month interval in the same classrooms under similar conditions to assess test–retest reliability.

### Measurements

The Chinese Toronto Mindfulness Scale – Trait Version (C-TMS-T) consists of 13 items under a two-factor structure, namely curiosity (6 items) and decentering (7 items). All the items are rated on a 5-point Likert scale, from 0 (*not at all*) to 4 (*very much*).

Given its wide application as a multidimensional mindfulness measure with satisfactory reliability and validity, the 39-item Five Facet Mindfulness Questionnaire (FFMQ; Baer et al. 2006) was selected to examine the convergent validity of C-TMS-T. The FFMQ includes five facets: observing (8 items, e.g., “When I’m walking, I deliberately notice the sensations of my body moving”), describing (8 items, e.g., “I’m good at finding words to describe my feelings”), acting with awareness (8 items, e.g., “When I do things, my mind wanders off and I’m easily distracted”[reversed]), non-judging (8 items, e.g., “I criticize myself for having irrational or inappropriate emotions”[reversed]), and non-reactivity (7 items, e.g., “I perceive my feelings and emotions without having to react to them”). Items are scored on a 5-point Likert scale ranging from 1 (*never or very rarely true*) to 5 (*very often or always true*). The internal consistency (Cronbach’s alpha) of the subscales of FFMQ ranges from .75 to .91. A Chinese translated version of the FFMQ demonstrated satisfactory validity and marginal and acceptable reliability among a Chinese student sample (Deng et al., 2011), with internal consistency reliabilities (Cronbach’s alpha) of the subscales ranges from .45 to .84. In the current study, the internal consistency reliabilities of all the subscales are above .75, except for the non-reactive subscale which is .56.

The Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985) is selected to examine the concurrent validity of C-TMS-T. The SWLS is a 5-item measure which is widely used to represent the cognitive evaluation of subjective well-being. All items on the SWLS are scored on 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*). The SWLS was translated into Chinese and validated in a Chinese community population (Xiong & Xu, 2009). The internal consistency reliability (Cronbach’s alpha) of the Chinese version SWLS is .78.

Lastly, the State-trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) is also selected to examine the concurrent validity of C-TMS-T. The STAI is a 40-item self-report instrument which consists of a 20-item state anxiety scale and a 20-item trait anxiety scale. It has long been used to measure both state and trait anxiety using a 4-point Likert scale (1 = *not at all* to 4 = *very much so*). A Chinese translated version of the STAI demonstrated adequate reliability and validity in a sample of Chinese college students (Li & Qian, 1995). Given that we were aiming to examine the relation between trait mindfulness and its criteria-related variables,

only the trait anxiety scale (TAI) was used in the current study. The internal consistency reliability (Cronbach's alpha) of the TAI is .88.

## Data Analysis

Descriptive and standard psychometric analyses were performed using SPSS 18 to evaluate the structural and substantive validity of the C-TMS-T. A confirmatory factor analysis (CFA) was conducted to test the factor structure of the C-TMS-T using Mplus 7 (Muthén & Muthén, 1998-2012). To evaluate the model fit, the following fit indices were assessed: (1) chi-square to *df* ratio ( $\chi^2/df$ ), wherein a value of no more than 3 indicates a good fit (Carmines & McIver, 1981); (2) the comparative fit index (CFI); (3) the Tucker-Lewis index (TLI); (4) the root-mean-square error of approximation (RMSEA); and (5) the standardized root mean square residual (SRMR). Generally, values of the CFI and TLI exceeding .90 indicate a good fit (Hu & Bentler, 1999). For the SRMR and RMSEA, the criterion for a good model fit is  $< .05$ , and  $.05 \leq \text{RMSEA} < .08$  indicates a reasonable fit (Browne & Cudeck, 1993; Hu & Bentler, 1999). The intraclass correlation coefficient (ICC) was used to estimate the test–retest reliability index of each C-TMS-T subscale score.

## Results

### Structural Validity

Explorative factor analysis, using principal component analysis and promax rotation, was conducted on the 368 cases. Although four latent factors with eigenvalues greater than 1.0 were revealed, scree-plot analysis clearly suggested a two-factor solution (see Figure 1).

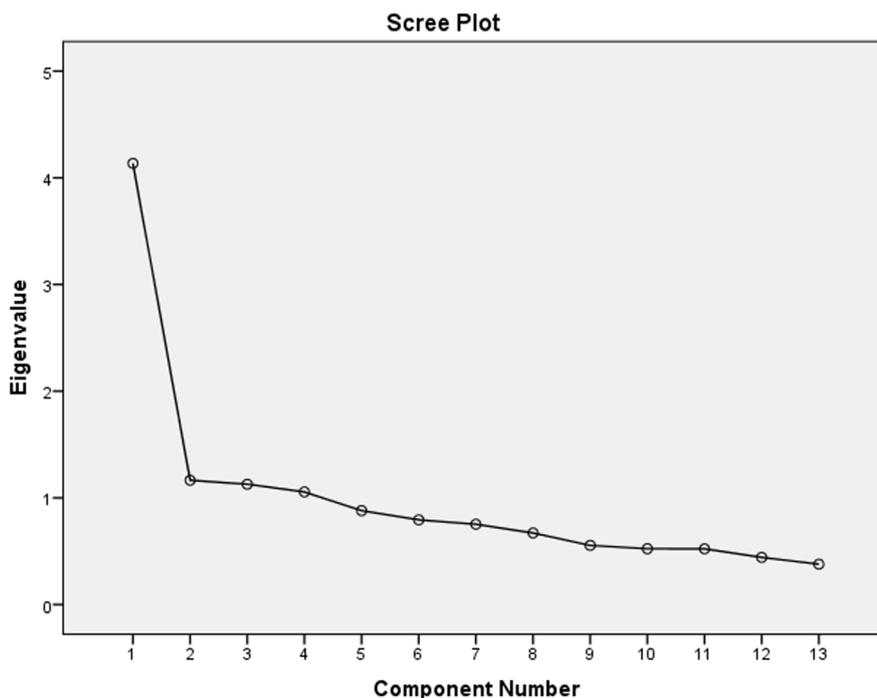


Figure 1. Factor components for the Chinese Toronto Mindfulness Scale – Trait Version (n = 368).

To confirm the number of latent factors, we further employed the parallel analysis maximum likelihood method (PA-ML) using Mplus 7. Based on the average eigenvalue, the two-factor solution was confirmed, but only a single-factor structure could be confirmed based on the 95% eigenvalue. A two-factor solution was preferred by adopting a less strict method. Subsequently, a second analysis was conducted, which specified two factors to be identified using principal component analysis and promax rotation. The total variance explained by this two-factor solution was 40.82%. The results of the Kaiser–Meyer–Olkin measure of sampling adequacy and Bartlett’s test of sphericity were .859 and 1090.21 ( $df = 78, p < .001$ ), respectively. Table 1 summarizes the factor loadings of the 13 items categorized according to the latent factors and the C-TMS-T item–subscale structure. Items 4 and 7 (under the decentering subscale) were found to load on to Factor 1 (the curiosity factor). Items 1 (under the decentering subscale), 3 and 10 (under the curiosity subscale) appeared to be cross loading onto both scales, although Items 3 and 10 still primarily loaded onto Factor 1.

Table 1

Factor loadings obtained from Exploratory Factor Analysis (EFA) Results

Items	Factor loadings	
	Factor 1	Factor 2
<b>Curiosity</b>		
3	.40	.32
5	.83	-
6	.87	-
10	.43	.35
12	.68	-
13	.70	-
<b>Decentering</b>		
1	.21	.21
2	-	.66
4	.48	-
7	.42	-
8	-	.37
9	-	.72
11	-	.72

Note. Curiosity refers to Factor 1 and decentering refers to Factor 2.

Skewness and kurtosis ranged between  $-1$  and  $1$ , indicating that the data were univariately, normally distributed. Therefore, we conducted a further confirmatory factor analysis using Mplus maximum-likelihood to confirm the existence of the two-factor structure of the C-TMS-T. Model fit indices indicated a marginal fit, where  $\chi^2(64) = 170.53$ ,  $\chi^2/df = 2.66$ , CFI = .90, TLI = .87, SRMR = .049, RMSEA(90%CI) = .067(.055, .079). The standardized factor loadings of each item from the original TMS (Lau et al., 2006), and 13-item C-TMS-T are included in Table 2. Curiosity subscale factor loadings were statistically significant, and moderately large in magnitude, ranging from .54 to .72, and composite reliability (CR) was  $p = .82$ . However, the decentering subscale factor loadings were not satisfactory, ranging from .34 to .53, with composite reliability of .61. With the purpose of refining the C-TMS-T, we reviewed the contents of the three items (1, 2 and 4) with factor loadings below .40, and all three items were removed. Another confirmatory factor analysis was conducted. The revised two-factor structure of the C-TMS-T showed a much better model fit,  $\chi^2(34) = 87.97$ ,  $\chi^2/df = 2.59$ , CFI = .94, TLI = .92, SRMR = .041, RMSEA

(90%CI) = .065 (.049, .082). The standardized factor loading with items of the revised C-TMS-T (item 1, 2 and 4 deleted) are included in Table 2 (10-item model). Although the model fit improved in the revised 10-item C-TMS-T model, the reliability of the decentering subscale decreased below .60. The composite reliability for the curiosity and decentering subscales, in the 10-item C-TMS-T, were .82 and .56, respectively. Taken all of this into consideration, we decided to retain these three items in order to keep it consistent with the original 13-item scale.

Table 2

Comparisons of the Standardized Factor Loadings Obtained from Lau et al. (2006) With the Confirmatory Factor Analysis (CFA) Results of the Current Study

C-TMS-T Factors and items	Lau et al. (2006)	Current Study	
		13-item model	10-item model
<b>Curiosity</b>			
3 I am curious about what I might learn about myself by taking notice of how I react to certain thoughts, feelings or sensations.	.76	.54	.53
5 I am curious to see what my mind is up to from moment to moment.	.77	.67	.66
6 I am curious about each of my thoughts and feelings as they occur.	.62	.72	.73
10 I remain curious about the nature of each experience as it arises.	.77	.63	.63
12 I am curious about my reactions to things.	.77	.68	.68
13 I am curious about what I might learn about myself by just taking notice of what my attention gets drawn to.	.82	.69	.69
<b>Decentering</b>			
1 I experience myself as separate from my changing thoughts and feelings.	.56	.34	-
2 I am more concerned with being open to my experiences than controlling or changing them.	.72	.39	-
4 I experience my thoughts more as events in my mind than as a necessarily accurate reflection of the way things 'really' are.	.69	.36	-
7 I am receptive to observing unpleasant thoughts and feelings without interfering with them.	.59	.53	.57
8 I am more invested in just watching my experiences as they arise, than in figuring out what they could mean.	.76	.44	.48
9 I approach each experience by trying to accept it, no matter whether it is pleasant or unpleasant.	.78	.49	.49
11 I am aware of my thoughts and feelings without overidentifying with them.	.63	.42	.42

Note. Adapted from Toronto Mindfulness Scale – Trait Version, Davis et al. (2009). The 10-item model refers to two-factor TMS-T model with Items 1, 2 and 4 deleted.

## Substantive Validity

Descriptive statistics for the subscales of curiosity and decentering of the C-TMS-T are shown in Table 3. The correlations between the items and subscale scores were moderate for the curiosity subscale and low for the decentering subscale. The internal consistency reliabilities derived from the exploratory factor analysis (EFA) using Cronbach's alpha were high at .82 for the curiosity subscale, and low (at .60) for the decentering subscale, suggesting good and moderate item homogeneity, respectively.

Table 3

Subscale Statistics of the Chinese Translated Toronto Mindfulness Scale – Trait Version (C-TMS-T) and Test-Retest Reliability

Subscale	$M^a$	$SD$	Item-subscale correlations	Cronbach's $\alpha^b$	Test-retest reliability <sup>c</sup>	95%CI
Curiosity	2.09	.80	.47 - .65	.82	.73	.587, .826

Subscale	<i>M</i> <sup>a</sup>	<i>SD</i>	Item-subscale correlations	Cronbach's $\alpha$ <sup>b</sup>	Test-retest reliability <sup>c</sup>	95% <i>CI</i>
Decentering	2.06	.66	.25 - .38	.60	.66	.479, .781

Note. *CI* = confidence interval.

<sup>a</sup>There are 6 items in the Curiosity subscale, 7 items in the Decentering subscale; mean of all item scores. <sup>b</sup>The alpha coefficients were derived from exploratory factor analysis. <sup>c</sup>Intraclass correlation coefficient.

### Test-Retest Reliability

The test–retest reliability of C-TMS-T using intraclass correlations (ICC) is presented in Table 3. The reliability coefficient was .73 for the curiosity subscale and .66 for the decentering subscale, indicating adequate test-retest reliability for both of these two subscales.

### Concurrent and Convergent Validities

In addressing the concurrent and convergent validities, the correlations between the scores of the two subscales of C-TMS-T and both the FFMQ, TAI and the SWLS are summarized in Table 4. The curiosity was significantly and positively correlated with subjective well-being, however, the correlation between decentering and subjective well-being was not significant. Both the correlations between curiosity and trait anxiety as well as between decentering and trait anxiety were not significant. Both the curiosity and decentering were significantly and positively correlated with observe and non-reactive in the FFMQ. Although the curiosity was significantly and positively correlated with describe in the FFMQ, the correlation between decentering and describe was nearly zero. Both the curiosity and decentering were found to be negatively correlated with acting with awareness and non-judging in the FFMQ, and all of the correlations were significant except for the one between curiosity and acting with awareness, which was not significant.

Table 4

Correlations of the Chinese Translated Toronto Mindfulness Scale – Trait Version (C-TMS-T) with SWLS, TAI and the subscales of FFMQ

C-TMS-T subscale	SWLS	TAI	FFMQ				
			Observe	Describe	Actaware	Nonjudge	Nonreact
Curiosity	.123*	-.027	.404*	.104*	-.086	-.249**	.198**
Decentering	.071	.003	.261**	-.010	-.165**	-.217**	.257**

Note. SWLS refers to the Satisfaction with Life Scale; TAI refers to the trait subscale of the state-trait anxiety inventory; FFMQ refers to the Five Facet Mindfulness Questionnaire; Actaware refers to the Acting with awareness subscale.

\* $p < .05$ . \*\* $p < .01$ .

## Discussion

The aim of the current study was to examine the psychometric properties of the C-TMS-T using a sample of Chinese college students in Hong Kong. Factor analyses failed to support the existence of two-dimensional structure of C-TMS-T, with goodness-of-fit indexes marginal at best for the original 13-item C-TMS-T. Although a modified 10-item C-TMS-T reached an acceptable model fit, the reliability of the subscale of decentering decreased to an unacceptable level. The evidence for the substantive validity of the subscale of decentering indicates that

it retains poor to moderate item quality and internal consistency. Although both subscales were found to have moderate to good test-retest stability, they failed to receive support for concurrent and convergent validities.

Given the lack of support for the construct validity and reliability of the C-TMS-T, the current findings reflect that the understanding of the same mindfulness items may be different for experienced and naive meditation practitioners (Grossman, 2008, 2011), especially in the dimension of decentering. In other words, it is possible that differential item function issues exist between meditators and non-meditators (e.g., Van Dam, Earleywine, & Danoff-Burg, 2009). Although the Toronto Mindfulness Scale (TMS) was originally developed for experienced meditators, to assess state mindfulness after meditation practice, it may not be applicable to college students with no previous meditation experience, despite the trait version of TMS having been preliminarily supported in Western college students. The inconsistent item factor loadings, found as a result of the exploratory factor analysis, provide useful information in this respect. The findings of the current study corroborated a recent study by Belzer and colleagues (2013) demonstrating that individuals with no prior meditation experiences may have a different cognitive understanding of the items of the Freiburg Mindfulness Inventory. In addition, as the mean age of the total respondents in Davis et al. (2009)'s study was higher than the mean age of participants in the current study ( $M = 36.5$  vs  $M = 20.3$ ), and Davis et al. (2009) found better convergent validity values compared to the current study, it is possible that age may be instrumental in the understanding of these items to some degree. However, in order to contextualize this criticism more accurately, future studies should investigate the numbers or proportions of college students in Hong Kong who regularly engage in mindfulness meditation practice, as well as the influence of age difference.

As low to moderate item-to-subscale fit in the subscale of decentering was found, we speculate that possible reasons are based on the item contents. Three items were found to not load onto their original decentering factor (see Table 1). Specifically, although Item 1 is supposed to be in the decentering subscale, it was found to load on neither of these two factors. The wording "I experience myself as separate from my changing thoughts and feelings" could possibly be difficult for the students to follow, as they might not have relevant experience of clearly or purposely differentiating/separating the self from the changing thoughts and feelings. Accordingly, they may not be able to fully understand the meaning of experiencing themselves as separate from changing thoughts and feelings. Similarly, the wording of Items 4 "...thoughts more as events in my mind..." and 7 "...receptive to observing unpleasant thoughts and feelings..." could be considered more as a curiosity-oriented item by the students, as they may not have awareness of this frequently in their daily lives, and these two items are therefore rated more closely with other items in the curiosity subscale. This result is consistent with the results of the confirmatory factor analysis, in which the factor loadings of the decentering items were poor to moderate.

Concurrent and convergent validities were identified by calculating the correlations between mindfulness measured by the two subscales in the C-TMS-T, and subjective well-being measured by the SWLS, trait anxiety measured by the TAI and mindfulness measured by the FFMQ. However, the significance and direction of some correlations were not as expected. The insignificant correlations between decentering and subjective well-being implies that the concurrent validity of C-TMS-T cannot be established. Both the curiosity and decentering were negatively correlated with act with awareness and non-judging in the FFMQ, and the decentering was negatively correlated with describe in the FFMQ. Therefore, the convergent validity of the C-TMS-T cannot be confirmed as they were supposed to measure similar concepts. Correlations between state anxiety, subjective well-being and five subscales of FFMQ were further examined to exclude possible reasons for the poor concurrent and convergent validities caused by these criteria-related instruments. As a result, all subscales, except describe, in the FFMQ demonstrated

significant and positive correlations with subjective well-being, and significant and negative correlations with state anxiety. Taken all these into consideration, it can be concluded that the C-TMS-T also lacks concurrent and convergent validities.

This study has a few shortcomings, therefore, researchers should be cautious when interpreting and generalizing its results. Firstly, the cross-sectional design might limit interpretation of the results. Secondly, the participants in this study were college students whose age, living conditions and meditation experiences are different from the samples used in previous studies. It is therefore worthwhile to conduct further studies to explore this sample variability. Future studies could also involve individuals with various meditation experiences in interpretations of wording of the items so as to refine the C-TMS-T (e.g., Chinese meditators). Thirdly, the low factor loadings and cross-loadings of a few items revealed in this study suggest that the wording and content of these items may not be commonly used or easily understood by college students. Further studies should be conducted to review and revise these problematic items, and illustrate how these changes may improve item-to-factor loadings. Fourthly, we conducted the EFA and CFA using the same sample of participants. Ideally, the EFA and CFA should be tested in two different samples following a step-wise method. Further studies aiming to examine the psychometric properties of the C-TMS-T can adopt such an approach. Despite the abovementioned limitations, the current study has revealed some strength. The test-retest reliability of the scale has been examined beyond the test of internal consistency reliability. In addition, the concurrent and structural validities were examined beyond the test of convergent validity. Although we failed to support the psychometric properties of the scale, rigid translation and back-translation procedures were followed and feedback from some Chinese college students was sought. Furthermore, we compared the factor loadings and model fit indices of both the 13-item model and the 10-item model with the original model (Lau et al., 2006) for the purpose to generate the best solution.

To summarise, even though the current study failed to support the construct validity of the C-TMS-T, we cannot confirm that the C-TMS-T is an invalid instrument to measure the trait mindfulness of Chinese college students. Additional studies should be conducted to provide more validity and reliability evidence for the TMS-T by using different populations, especially to those who have meditation or similar meditative experiences. Researchers are reminded that future validation studies should be conducted before using the TMS-T in cross-sectional and longitudinal studies for the populations without meditation experiences.

## Funding

The authors have no funding to report.

## Competing Interests

The authors have declared that no competing interests exist.

## Acknowledgments

The contribution of colleagues at the Department of Physical Education, Hong Kong Baptist University during the data collection stage is gratefully acknowledged.

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