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Psychometric Assessment of the Mindful Attention Awareness Scale (MAAS) Among Chinese Adolescents

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Abstract

The Mindful Attention Awareness Scale (MAAS) has the longest empirical track record as a valid measure of trait mindfulness. Most of what is understood about trait mindfulness comes from administering the MAAS to relatively homogenous samples of Caucasian adults. This study rigorously evaluates the psychometric properties of the MAAS among Chinese adolescents attending high school in Chengdu, China. Classrooms from 24 schools were randomly selected to participate in the study. Three waves of longitudinal data (N = 5,287 students) were analyzed. MAAS construct, nomological, and incremental validity were evaluated as well as its measurement invariance across gender using latent factor analyses. Participants' mean age was 16.2 years (SD = 0.7), and 51% were male. The 15-item MAAS had adequate fit to the one-dimensional factor structure at Wave 1, and this factor structure was replicated at Wave 2. A 6-item short scale of the MAAS fit well to the data at Wave 3. The MAAS maintained reliability (Cronbach's α = .89–.93; test–restest r = .35–.52), convergent/discriminant validity, and explained additional variance in mental health measures beyond other psychosocial constructs. Both the 15- and 6-item MAAS scales displayed at least partial factorial invariance across gender. The findings suggest that the MAAS is a sound measure of trait mindfulness among Chinese adolescents. To reduce respondent burden, the MAAS 6-item short-scale provides an option to measure trait mindfulness.

Keywords

Mindful Attention Awareness Scale (MAAS); latent factor analysis; construct validity; Chinese; adolescents

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From what the human mind can perceive and articulate with language, consciousness appears to consist of awareness and attention, with *awareness* being a continual background monitoring process and *attention* being a function of focusing awareness on a limited range of experience to heighten sensitivity to that experience (Westen, 1999). All humans, except those with certain types of brain damage, have an inherent capacity to attend to and be aware of ongoing experience. However, there is substantial variability in these faculties of consciousness both within and between individuals. Because some degree of consciousness is carried with us wherever we go, it is a process that has often been taken for granted and

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understudied in Western science. However, consciousness and its relationship to the human condition have recently blossomed as a new frontier in Western science. More specifically, interest has developed regarding the human capacity for *enhanced* attention to and awareness of life’s experiences, which has been termed *trait mindfulness*. Trait mindfulness, also referred to in some literature as *day-to-day* mindfulness or *dispositional* mindfulness, is defined by Brown and Ryan (2003) as an inherent state of consciousness varying between and within humans that is characterized by the presence or absence of attention to or awareness of what is occurring in present experience.

Using a series of psychometric development studies, Brown and Ryan (2003) operationalized trait mindfulness by the 15-item unidimensional Mindful Attention Awareness Scale (MAAS). In the Brown study, the MAAS had good internal consistency ($\alpha \geq .82$) and 4-week test–retest reliability (interclass $r = .81$) and was positively correlated with number of years of meditation practice ($r = .36$, $p < .05$), which is a specific technique aiming to increase mindfulness. MAAS scores were also significantly higher among meditation practitioners relative to nonpractitioners (Cohen’s $d = .50$; Brown & Ryan, 2003), and a different study reported MAAS scores to be significantly correlated with other psychometrically sound measures of mindfulness (r with Freiburg Mindfulness Inventory = .31, $p < .01$; r with Kentucky Inventory of Mindfulness Skills = .51, $p < .01$; r with Cognitive Affective Mindfulness Scale = .51, $p < .01$; r with Mindfulness Questionnaire = .38; $p < .01$; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006).

By operationalizing the MAAS as a valid measure of trait mindfulness, new research has begun to uncover the relationship between trait mindfulness and human health. Initial findings in the field of mindfulness research suggest that trait mindfulness has important implications for human health and functioning. For example, studies have found the MAAS to be significantly and inversely associated, in medium-to-large magnitude, with a variety of mental health indicators (e.g., anxiety, hostility, depression, impulsiveness, somatization, disturbed mood, neuroticism, and negative affect) and positively associated with mental and physical health (e.g., self-esteem, optimism, positive affect, autonomy, self-control, perceived general health, physical functioning, and life satisfaction; Brown & Ryan, 2003; Fetterman, Robinson, Ode, & Gordon, 2010; Thompson & Waltz, 2007; Zvolensky et al., 2006). Moreover, the MAAS has maintained a significant relationship with well-being even after adjusting for other important psychosocial measures (e.g., Brown & Ryan, 2003), indicating its incremental validity as a unique mental health construct.

To date, the key limitation to the scientific literature on the MAAS is its use in relatively homogenous samples, which limits the measures generalizability to more diverse populations. For example, the inception of the MAAS by Brown and Ryan (2003) was based on data from mainly White college students and adults residing in the United States. Furthermore, psychometric replication studies assessing the MAAS have again focused on college students and adult community residents of mainly White ethnicity (Cordon & Finney, 2008; Hansen, Lundh, Homman, & Wangby-Lundh, 2009; MacKillop & Anderson, 2007; Thompson & Waltz, 2007; Van Dam, Earleywine, & Borders, 2010; Zvolensky et al., 2006).

Only four studies identified to date have assessed the MAAS among other populations using relatively stringent psychometric assessment methods. Carlson and Brown (2005) assessed the validity of the MAAS using latent factor analysis with factorial invariance procedures, and they found the MAAS functioned comparably among Canadian adult cancer patients in a clinical setting relative to demographically matched Canadians in the local community. In the Carlson study, higher MAAS scores among cancer cases were associated with lower mood disturbance and stress. Jermann et al. (2009) assessed a French version of the MAAS among volunteering adults in the community, and the results suggested the MAAS had a valid one-factor structure among this population. Hansen et al. (2009) surveyed Swedish youth aged 19 to 20 years who had just begun military service as well as a second sample of adolescents (mean age = 16.2, $SD = 1.4$) from five Swedish high schools. Internal consistency reliability was adequate in the military sample ($\alpha = .77$) and good in the school sample ($\alpha = .85$). MAAS scores were inversely correlated with trait anxiety ($r = -.35$, $p < .05$) in the military sample and inversely correlated with self-harming behavior in the adolescent sample attending school ($r = -.31$, $p < .01$). Finally, Christopher, Charoensuk, Gilbert, Neary, and Pearce (2009) assessed measurement invariance of the MAAS between students attending a private university in Thailand and American students attending a Pacific Northwestern university in the United States. Data supported the MAAS to have configural, metric, and latent mean invariance but not scalar invariance across these populations, indicating at least partial support for the stability of the MAAS among Thai college students.

Scientific evidence to date suggests that the MAAS is a sound measure of trait mindfulness among a relatively homogenous population, with initial evidence for stability across some heterogeneous populations. Psychometric validation studies in new populations are needed prior to examining theoretical relationships between trait mindfulness and other constructs in these new populations. Such validation studies are needed specifically among adolescents as interest in cultivating mindfulness among this group is burgeoning and initial reports suggest that programs aiming to enhance mindfulness can improve adolescent health (Black, Milam, & Sussman, 2009). Moreover, it has recently been reported that the MAAS may best be represented by fewer than 15 items (Van Dam et al., 2010); thus, research exploring shorter versions of the MASS is warranted to reduce respondent burden and possibly improve the validity of its measurement. The current study assesses the psychometric validity of the MAAS in a Chinese adolescent population attending high school in Chengdu, China. This study applies rigorous statistical methods to assess multiple dimensions of construct validity of the MAAS in this population. This study adds to the current literature by being the first to assess the psychometric validity of the MAAS among Chinese adolescents.

Method

Participants and Procedures

Data were collected as part of a larger longitudinal study conducted by collaborating researchers from the Pacific Rim Transdisciplinary Tobacco and Alcohol Use Research Center (TTAURC). The objective of the TTAURC project was to investigate the determinants of health behavior among adolescents in Chengdu, China. All consent procedures and survey instruments for this study were approved by the institutional review boards of the University of Southern California and Chengdu, China, Centers for Disease Control and Prevention. A total of 24 schools ($N = 24$) in Chengdu, China, enrolled in the study. Within the 24 schools that participated, there were a total number of 1,060 classes. A total of 338 classes were randomly selected to participate in this study, and a very high percentage (98.12%) of students within these classrooms participated in the study.

Parental consent forms were distributed to students within the selected classrooms, and those students acquiring written or verbal parental consent and giving personal assent completed a self-reported paper-and-pencil questionnaire in their classroom during school hours. The students whose parent did not sign the parental participation permission form and/or who did not assent were excluded from the study. Participants voluntarily took part in the study and were informed that they could discontinue their participation at any time. Classroom teachers were not present during the survey period so that participating students would feel confident about the confidentiality of their responses. The same participants completed surveys in their respective classroom from 10th to 12th grade for a total of five waves of data collection. This study examines the data specifically from Wave 2, Wave 3, and Wave 5 because the measures of interest were collected during these waves. For clarity purposes, these waves of data collection are referred to as Time 1, Time 2, and Time 3, respectively, in the current study.

Measures

Demographic data included respondent self-reported age, gender, and parent education (see Table 1). Parent education was assessed as the highest educational status of either the mother or father on a 7-point scale ranging from 1 (*did not graduate from elementary school*) to 7 (*university graduate or higher*). All measures used in this study were translated, and back-translated for accuracy, from English to Chinese by a native Chinese speaker. Because of the large-scale nature of the project, many of the following valid measures had to be shortened and not all measures were assessed at all time points to reduce respondent burden.

Mindful Attention Awareness Scale—The MAAS (Brown & Ryan, 2003) is a 15-item single-dimension measure of trait mindfulness. The MAAS measures the frequency of open and receptive attention to and awareness of ongoing events and experience. Response options ranged from 1 (*almost never*) to 6 (*almost always*). Example items include “I find it difficult to stay focused on what’s happening in the present,” “I could be experiencing some emotion and not be conscious of it until some time later,” and “I rush through activities without being really attentive to them.” One item was modified to make it appropriate for adolescents: we changed the item “I *drive* places on ‘automatic pilot’ and then wonder why I went there” to “I *go* places on ‘automatic pilot’ and then wonder why I went there.” Item scores were reverse-coded making higher scores indicate a greater degree of mindfulness. To control for social desirability, respondents are instructed to respond to the MAAS in a way that reflects their actual experience rather than in a way they think their experience should be. At Time 1 and Time 2, the full 15-item MAAS measure was used. At Time 3, a 6-item short form of the MAAS was used to reduce respondent burden. These six items were selected because they had the highest factor loadings based on confirmatory factor analysis (CFA) at Time 1 and Time 2.

Diagnostic Interview Schedule for Children (DIS-C)—The DIS-C (Costello, Edelbrock, & Costello, 1985) is a comprehensive measure of childhood psychopathology, which is inclusive of attention deficit hyperactivity disorder (ADHD). Inattention is defined as a lack of attention or care to tasks at hand, and hyperactivity is defined as being abnormally or easily excitable. A total of six items from the DIS-C were used to measure ADHD. An example inattention item is “I have difficulty keeping my attention on tasks or activities,” and an example hyperactivity item is “I have feelings of restlessness.” Response options range from 1 (*never*) to 5 (*very often*). Higher scores reflect a higher degree of ADHD symptoms. The DIS-C was measured at Time 3. The DIS-C has been reported as psychometrically sound in previous research (e.g., Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000), and internal consistency reliability was good in the current study ($\alpha = .86$).

Perceived Social Self-Efficacy (PSSE)—The PSSE (Smith & Betz, 2000) scale measures confidence in the respondent’s ability to engage in the social interaction skills necessary to initiate and maintain interpersonal relationships. The directions that introduce the item set are “Please tell us how much confidence you have that you could perform each of these activities successfully. How much confidence do you have that you could . . .” Examples of the six items measured include “Share with a group of people an interesting experience you once had” and “Find someone to spend a weekend afternoon with.”

Response options ranged from 1 (*no confidence at all*) to 5 (*complete confidence*). Higher scores indicate higher social self-efficacy. The PSSE scale has shown good reliability in previous research (Cronbach's α = .94; 3-week test–retest *r* = .82; Smith & Betz, 2000) and among Chinese youth (Lin & Betz, 2009). A comparable estimate of internal consistency was found in our sample (α = .96). PSSE was measured at Time 1 and Time 2.

Self-Control Scale (SCS)—The SCS (Tangney, Baumeister, & Boone, 2004) is a measure of self-control, defined as the respondents' ability to override or change their inner responses as well as to interrupt undesired behavioral tendencies and refrain from acting on them. The directions introducing the item set are "Please indicate how much each of the following statements reflects how you typically are." Examples of the eight items measured include "Sometimes I can't stop myself from doing something, even if I know it is wrong" and "I often act without thinking through all the alternatives." Response options range from 1 (*not at all like me*) to 5 (*completely like me*). Higher scores are coded to indicate higher self-control. The SCS has shown good reliability in previous research (Cronbach's α = .89; 3-week test–retest *r* = .89; Tangney et al., 2004) and among youth (Frijns, Finkenauer, Vermulst, & Engels, 2005). A comparable estimate of internal consistency was found in our sample (α = .82). SCS was measured at Time 1 and Time 2.

UPPS Impulsive Behavior Scale (UPPS-IBS)—The UPPS-IBS (Whiteside, Lynam, Miller, & Reynolds, 2005) measures impulsivity, defined as the tendency to engage in impulsive behavior under conditions of negative affect in order to alleviate negative emotions despite the potentially harmful longer-term consequences. It signifies a difficulty in controlling or coping with urges to act in response to unpleasant emotions and is associated with giving into cravings and temptations. The directions introducing the six-item set include "Mark the answer which best describes how you generally feel or react." Example items include "I have trouble controlling my impulses" and "When I get upset I often act without thinking." Response options range from 1 (*strongly agree*) to 4 (*strongly disagree*). Higher scores indicate higher impulsivity. The UPPS-IBS has shown good internal consistency reliability in previous research (α = .89; Whiteside et al., 2005) and among youth (Xiao, Bechara, Grenard et al., 2009). A comparable internal consistency was found in our sample (α = .93). The UPPS-IBS was measured at Time 3.

Mental ailment measures—Three measures of mental ailment were assessed to determine the nomological and incremental validity of the MAAS. These well-recognized measures are often used among adolescents and include the Center for Epidemiologic Studies Depression Scale (CESD; Gunning, Sussman, Rohrbach, Kniazev, & Masagutov, 2009; Radloff, 1977), Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983; Siqueira, Diab, Bodian, & Rolnitzky, 2000), and Aggression Questionnaire (AQ; Ang, 2007; Buss & Perry, 1992). In the current study, three items from the CESD (α =.87), six items from the PSS (α =.86), and three items from the AQ (α =.81) were assessed and upheld internal consistency reliability. All three mental ailment measures were assessed at Time 1, Time 2, and Time 3.

Analyses

Data cleaning and descriptive statistics were conducted using SAS 9.1 software. Data were imported into Mplus Version 5 and frequencies were cross-examined between Mplus and SAS to assure correctness of transferred data. Construct validity was assessed following the sequential procedures outlined by O'Leary-Kelly and Vokurka (1998). First, *unidemensionality*, which refers to the existence of a single factor underlying a set of measures, was tested using CFA to assure that the measured indicators of the MAAS represented a single latent factor. We hypothesized the MAAS to have a one-factor structure

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because research validating the adult version of the MAAS (Brown & Ryan, 2003) as well as the adolescent version of the scale (Brown, West, Loverich, & Biegel, 2011) found a clear single factor structure. Unidimensionality is supported when all factor loadings are relatively large and statistically significant in a model having good fit to the data.

Model fit was assessed via the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA) with its 90% confidence interval, and standardized root mean square residual (SRMR). *Good-fit* criteria for this study is similar to previous work (Cordon & Finney, 2008) and includes CFI and TLI values of .90 to .94, RMSEA estimates of .08 to .10, and SRMR estimates of .06 to .08. *Well-fit* criteria included CFI and TLI values of .95 and above, RMSEA estimates of .01 to .07, and SRMR estimates of .01 to .05. Because the MAAS measured indicators were normally distributed (all MAAS indicators had skewness <1.3 and kurtosis <1.1), the maximum likelihood estimation default in Mplus was used to produce fit indices and model parameters. To provide a metric for latent factors, the path from the first factor loading was set at a value of 1.0, which is the default in Mplus.

Second, *reliability*, which pertains to the consistency and stability of a measure, was assessed with test–retest, internal consistency (i.e., Cronbach's α, item–total *r*, and interitem *r*) and parallel-forms estimates. Parallel-forms reliability was assessed by examining the 6-item MAAS at Time 3 in relation to the remaining eight items of the MAAS at Time 1 and Time 2 that were not measured at Time 3. Third, *convergent/discriminant validity*, the degree to which a measure is attributable to variations in the specified latent factor and not some other factor, was assessed using exploratory factor analysis (EFA) procedures outlined by Farrell and Rudd (2009). EFA allows for the determination of the number of latent factors underlying measured indicators and elucidates cross-loadings of measured indicators on two or more latent factors. A measured indicator that reflects a latent factor should load highest on its respective latent factor and relatively lower on latent factors that represent a different trait. Factor cross-loadings ≥.30 indicated lack of discriminant validity.

Factorial invariance of the MAAS was assessed across gender; this assessment indicates the MAAS has the same meaning for both males and females. The factorial invariance of the MAAS across gender was tested with the sequential constraint imposition procedures outlined by Dimitrov (2010). Measurement invariance was assessed by testing (1) *configural invariance*—invariance across the pattern of free and fixed model parameters; (2) *measurement invariance*—consisting of (a) metric invariance (i.e., equal factor loadings across gender), (b) scalar invariance (i.e., equal item intercepts across gender), and (c) uniqueness invariance (equal item error variances/covariances across gender); and (3) *structural invariance*—invariance of factor variances/covariances across gender.

Invariance assessment begins with Model 0, which is the least constrained solution, indicating a total lack of invariance. Subsequent restrictions for equality of specific parameters across groups are imposed producing nested models that are compared using the χ^2 difference test. Model 1 constrains factor loadings (indicates weak measurement invariance). Model 2 constrains factor loadings and item intercepts (indicates strong measurement invariance). Model 3 constrains factor loadings, item intercepts, and residual item variances/covariances (indicates strict measurement invariance). Model 4 constrains factor loadings, item intercepts, and factor variances/covariances (indicates structural invariance). Each model has more constraints than the previous model, thus each model is nested within its previous model (e.g., Model 1 is nested within Model 0). If the fit of the nested model is not worse than that of the previous model according to a χ^2 differences test, then statistical invariance is supported for the relevant parameters. Because the χ^2 difference test may be overly restrictive, especially when sample size is large (Quintana &

Maxwell, 1999), practical differences in CFI were also compared between models. Previous research has suggested that CFI reductions of ≤.01 indicate a change in fit that is not practically significant (Cheung & Rensvold, 2002).

Nomoligical validity, the degree to which the MAAS behaves as it should within a system of related constructs, was assessed by examining the interrelationships between the MAAS and other latent factors. According to the construct behavior of mindfulness in previous research among youth, we expected the MAAS to have a positive correlation with self-control (Singh, Wahler, Adkins, & Myers, 2003), an inverse correlation with ADHD symptoms and impulsivity (Singh et al., 2010; Zylowska et al., 2008), and a small or zero correlation with social self-efficacy. Although previous research has not yet examined the relationship between social self-efficacy and mindfulness, it appears on a conceptual basis that confidence in one's ability to engage in the social interaction would not be strongly associated with mental orientation to the present moment. *Incremental validity* was assessed by examining the relationship between the MAAS and mental ailment constructs after adjusting for other psychosocial covariates.

Considering that ad hoc procedures for handling missing data such as listwise deletion or mean substitution often result in biased parameter and/or standard error estimates, our modeling procedures used full information maximum likelihood estimation as implemented in Mplus to yield more accurate estimates while adjusting for the uncertainty associated with the missing data (Little & Rubin, 2002). The full information maximum likelihood estimation does not impute missing values but directly estimates model parameters and standard errors using all available raw data. Attrition analyses were also conducted to determine the baseline differences in demographic characteristics between completers and noncompleters at 13-month follow-up (N at Time 3 = 3,500). These tests showed that completers were slightly younger (mean age completers = 16.17, noncompleters = 16.24, t = 3.37, $p < .001$) and had slightly higher socioeconomic status (SES; mean SES completers = 4.18, noncompleters = 3.99; t = 4.64, $p < .001$).

Results

Demographics

At Time 1, participant ages ranged from 14 to 20 years (M = 16.2, SD = 0.7; see Table 1) and proportions of males and females were equivalent.

Unidimensionality Assessment

Table 2 provides the CFA results for the 15-item MAAS at Time 1 and Time 2. Results for the 6-item MAAS are reported at Time 3. Measurement errors were allowed to correlate between the 6-item MAAS at Time 1 and Time 2 for the 15-item MAAS (i.e., Item 1 with 2, Item 4 with 5, and Item 12 with 14) to improve model fit. The 15-item MAAS at Time 1 and Time 2 had large and significant standardized factor loadings and good model fit after correlating the specified errors. The 6-item MAAS at Time 3 fit well without correlated measurement errors. The 6-item MAAS at Time 3 had large and significant standardized factor loadings and fit well to the data. The 6-item MAAS had a larger mean of factor loadings relative to the 15-item MAAS measured at either Time 1 or Time 2. The amount of variance explained in a single measured indicator by the latent factor is estimated by R^2. R^2 is an estimate of the total amount of variance explained in the measured indicators by the latent factor. The MAAS latent factor explained more total variance in the six items measured at Time 3 (R^2 = .58) relative to the 15 items measured at either Time 1 (R^2 = .42) or Time 2 (R^2 = .47).

Reliability assessment—Table 3 provides measure reliability estimates for the MAAS at Time 1, Time 2, and Time 3. The interval between Time 1 and Time 2 was 3 months, 10 months between Time 2 and Time 3, and 13 months between Time 1 and Time 3. Test–retest reliability correlations between the repeated MAAS measures were all of medium-to-large magnitude and statistically significant. As expected, these correlations were stronger for shorter time intervals and relatively weaker for longer time intervals. Parallel-forms reliability was assessed by estimating the correlation between the Time 3 6-item MAAS and the Time 1 and Time 2 remaining nine items not measured at Time 3. Parallel-forms correlations were all of medium-to-large magnitude and statistically significant. As with the test–retest reliability results, parallel-forms correlations were stronger for shorter time intervals and relatively weaker for longer time intervals.

MAAS internal consistency reliability estimates were of good quality (α range across time = .89–.93). Mean item–total correlation estimates of internal consistency were all of large magnitude and statistically significant (i.e., *r* range across time = .61–.71, all *p*s < .01). Mean interitem correlation estimates of internal consistency were of medium-to-large magnitude and statistically significant (i.e., *r* range across time = .42–.58, all *p*s < .01). Item 15 consistently had the weakest correlation with the remaining items and was the only item to have correlations within the .21 to .30 range with other items.

Convergent/discriminant validity assessment—The EFA model for Time 1 included the 15-item MAAS, 8-item SCS, and 6-item PSSE (EFA tables for Time 1 and Time 2 not shown due to space limitations; contact corresponding author for details). Promax (oblique) rotated loadings from the three-factor model indicated that latent factors loaded appropriately on their respective indicators, and there were no MAAS measure indicator cross-loadings ≥.30, suggesting discriminant validity. The 15-item convergent factor loadings of the MAAS ranged from .49 to .75 at Time 1. The EFA model for Time 2 included the 15-item MAAS, 8-item SCS, and 6-item PSSE. Rotated loadings from the three-factor model indicated that latent factors loaded appropriately on their respective indicators, and there were no MAAS factor cross-loadings ≥.30, suggesting discriminant validity. The 15-item convergent factor loadings of the MAAS ranged from .56 to .76 at Time 2. The EFA model for Time 3 included the 6-item MAAS, 6-item DIS-C, and 6-item UPPS-IBS. Promax (oblique) rotated loadings from the three-factor model and indicated that latent factors loaded appropriately on their respective indicators and there were no MAAS factor cross-loadings ≥.30, suggesting discriminant validity (see Table 4). The six-item convergent factor loadings of the MAAS ranged from .53 to .85 at Time 3.

Gender invariance assessment—Table 5 provides gender invariance results for the MAAS at Time 1. The good fit for the gender stratified models indicated that the 15-item MAAS displayed *configural* invariance at Time 1. Model 0 was the baseline model consisting of the total sample. Measurement invariance results indicated the 15-item MAAS showed partial *metric* invariance (i.e., most, but not all, factor loadings were equal across gender; noninvariant loadings = Items 6, 7, 10, 11, 12, 13, 15), partial *scalar* invariance (i.e., most, but not all, intercepts were equal across gender; noninvariant intercepts = Items 6, 7, 10, 11, 12, 13, 15), and partial *uniqueness* invariance (i.e., most, but not all, error variance/covariances were equal across gender; correlated measurement errors = Item 4 with 5, Item 1 with 2, and Item 2 with 14). The 15-item MAAS lacked evidence for *structural* invariance (i.e., noninvariant factor variances and covariances). Although the $\Delta\chi^2$ test indicated that Model 1, Model 2, and Model 3 had only partial invariance, ΔCFI indicated that the quantifiable differences between these models were not of practical significance.

Table 6 provides gender invariance results for the 6-item MAAS at Time 3. The well-fit male and female models indicated that the 6-item MAAS displayed *configural* invariance at

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Time 3. Measurement invariance results indicate that the 6-item MAAS showed full *metric* invariance (all factor loadings were equal across gender), partial *scalar* invariance (most, but not all, intercepts were equal across gender; non-invariant intercepts included Items 2, 3, 4, and 5), and full *uniqueness* invariance (all error variance/covariances were equal across gender). Results indicated that the 6-item MAAS had *structural* invariance at Time 3 (invariant factor variances and covariances). Although the $\Delta\chi^2$ test indicated that M2 had only partial invariance, ΔCFI indicated that this lack of model fit was not of practical significance. CFA analyses for the 6-item MAAS short scale were repeated with the Time 2 data (table not shown) to replicate the gender invariance findings at Time 3. Factorial invariance methods indicated that same pattern of invariance results as Time 3 as indicated in Table 6.

Nomological validity assessment—Table 7 provides the latent factor intercorrelations between the MAAS latent factor and other psychosocial latent factors to assess nomological validity produced from a CFA model. Both the 15-item and 6-item version of the MAAS were assessed to verify that each version of the measure correlated comparably with other factors. Results indicated that the two versions of the MAAS had equivalent or highly comparable correlations with other factors. The MAAS factor was positively and significantly correlated with the SCS factor at Time 1 and Time 2. The MAAS factor was inversely and significantly correlated with the CESD, PSS, AQ, UPPS-IBS, and DIS-C factors. The MAAS factor correlation with the PSSE factor was either nonsignificant or significant but of small magnitude across time, likely an artifact of large sample size.

Incremental validity assessment—Table 8 provides the cross-sectional structural regression estimates for two mental ailment measures, CESD and PSS, regressed on the MAAS and covariate factors. Results indicate that the MAAS explained additional variance in both mental ailments above and beyond the variance explained by SCS and PSSE at Time 1 and Time 2. Similarly, the MAAS explained additional variance in these mental health factors beyond DIS-C and UPPS-IBS factors at Time 3.

Discussion

The purpose of the current investigation was to assess the psychometric properties of the MAAS among Chinese adolescents to determine the generalizability of a trait mindfulness measure to this population. The 15-item single-dimension structure of the MAAS as reported by Brown and Ryan (2003) had adequate fit, and all measured indicators loaded significantly on the MAAS latent factor. The 15-item MAAS upheld good internal consistency, test–retest, and parallel forms reliability, and the MAAS factor loadings were all high and cross-loadings of indicators across factors were all low, indicating convergent/ discriminant validity. The MAAS was inversely related to mental health ailments, which replicates previous research (Brown & Ryan, 2003; Fetterman et al., 2010; Thompson & Waltz, 2007; Zvolensky et al., 2006); it had medium-to-large inverse correlations with depressive symptoms, perceived stress, and aggression and maintained a significant inverse relationship with mental ailments even after controlling for other psychosocial, attentional, and self-regulation constructs. Moreover, as predicted, very small correlations were found between the MAAS and PSSE, suggesting a lack of or weak relationship between self-confidence in social skills and mindfulness. Support for the above psychometric findings is relatively strong considering that they were replicated at a second wave.

The current study also indicated that a single-dimension 6-item short scale (i.e., consisting of Items 7, 8, 9, 10, 13, and 14 from Brown & Ryan, 2003) fit well to the data. The six measured indicators significantly loaded on the MAAS latent factor, and the average factor loading was higher for the 6-item short scale compared with the 15-item MAAS scale.

Moreover, based on model fit indices, the 6-item MAAS outperformed the 15-item MAAS. Previous research, based on an American college sample, showed that five out of the six items used in our 6-item short scale provided the majority of information collected by the MAAS (Van Dam et al., 2010). Thus, the current study replicates previous findings indicating the utility of a short-scale MAAS. It could be suggested that reducing the number of items of the MAAS restricts the nomological net of measures for which the latent factor represents. However, evidence is lacking for this substantive argument considering that the nomological and incremental associations between the MAAS and other theoretical constructs in the current study were of exact or almost exact magnitude and significance.

This study continues an important line of scientific inquiry that attempts to establish the generalizability of scales that operationalize trait mindfulness. To date, this appears to be the fourth study in a recent line of studies that aim to test the psychometric validity of the MAAS among a demographically diverse population. This is the second known study, besides Christopher et al. (2009), to rigorously assess the psychometrics of the MAAS among a population residing in East Asia. The current study adds to this literature by determining that the MAAS is psychometrically sound measure of trait mindfulness among the typical adolescents residing in China who attend high school. Moreover, nomological and incremental validity results from the current study indicate that the MAAS may have an important role in etiological and intervention studies that aim to address adolescent mental health and its behavioral sequelae in this region. Examination of mental illness constructs among this population is important given the high rates of harmful behaviors (e.g., cigarette smoking) and associated diseases among Chinese adolescents (Cheng, 1999).

This study is limited in that it lacked multiple methods to assess the MAAS, which did not allow for a formal multitrait–multimethod analysis of convergent/discriminant validity. Moreover, we found that those who completed the 13-month follow-up assessment were slightly younger and had slightly higher SES at baseline, which may reduce the generalizability of our findings to the original sample; however, the observed differences did not appear to be of practical significance. The lack of a comparable sample of American or European adolescents also limited our ability to test measurement invariance across these populations to gain further evidence for the generalizability of the MAAS. However, previous work has found the MAAS to be invariant across Thai and American college students (Christopher et al., 2009), perhaps allowing initial assumptions that the MAAS would remain invariant across Chinese and American adolescents. However, this conjecture requires statistical assessment in future studies.

Conclusions

Mindfulness continues to gain empirical support as an important construct in the field of mental and behavioral health. Because this study used rigorous methods to support the validity of the MAAS among the Chinese adolescents, research can now progress to examine the empirical relationships between mindfulness and mental and behavioral health among this population. The current study provided initial evidence that the MAAS was inversely correlated with mental health ailments and suggests that trait mindfulness has a promising future for etiological studies among this population. The current study also provided support for a 6-item short scale of the MAAS, which can be used to reduce respondent burden. Future research should use methods to replicate these findings to determine if the 15-item and 6-item MAAS remain sound measures among other adolescent populations.

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Table 1

Demographic Characteristics of Chinese Adolescents at Time 1 (*N* = 5,287)

Variable	*M*	*SD*	*N*	%	Range
Gender					
Female			2,583	48.9	
Male			2,704	51.1	
Age	16.2	0.7			14–20
Parent education	4.1	1.6			1–7
MAAS	4.4	0.9			1–6
SCS	3.4	0.8			1–5
PSSE	3.2	0.8			1–5
DIS-C	2.4	0.8			1–5
UPPS-IBS	2.4	0.7			1–4

Note. MAAS = Mindful Attention Awareness Scale; SCS = Self-Control Scale; PSSE = Perceived Social Self-Efficacy; DIS-C = Diagnostic Interview Schedule for Children; UPPS-IBS = UPPS Impulsive Behavior Scale.

Table 2

Confirmatory Factor Analysis Results to Assess Unidimensionality of the MAAS at Three Points in Time

	MASS Time 1				MASS Time 2				MASS Time 3			
Measured Indicator	***M***	***SD***	**FL**	***r*²**	***M***	***SD***	**FL**	***r*²**	***M***	***SD***	**FL**	***r*²**
Item 1[a]	4.36	1.32	.55	.28	4.40	1.32	.61	.35				
Item 2	4.20	1.39	.56	.30	4.26	1.37	.64	.38				
Item 3	4.26	1.36	.60	.41	4.25	1.37	.69	.47				
Item 4	4.21	1.46	.59	.33	4.24	1.43	.64	.39				
Item 5	4.38	1.41	.62	.37	4.34	1.39	.68	.44				
Item 6	4.13	1.47	.59	.34	4.13	1.43	.60	.36				
Item 7	4.51	1.37	.73	.54	4.56	1.31	.75	.58	4.52	1.34	.71	.50
Item 8	4.55	1.41	.73	.55	4.62	1.38	.75	.57	4.46	1.40	.78	.61
Item 9	4.32	1.31	.74	.56	4.33	1.32	.76	.58	4.29	1.32	.81	.65
Item 10	4.59	1.28	.74	.55	4.58	1.26	.76	.58	4.54	1.26	.79	.63
Item 11	4.11	1.43	.62	.39	4.13	1.42	.65	.43				
Item 12	4.64	1.31	.65	.40	4.61	1.31	.70	.47				
Item 13	4.07	1.55	.67	.44	4.13	1.51	.70	.48	4.10	1.47	.73	.53
Item 14	4.43	1.33	.73	.52	4.45	1.32	.76	.57	4.33	1.31	.76	.57
Item 15	5.02	1.25	.52	.26	4.98	1.23	.58	.34				
Average FL			.64				.68				.76	
Factor R^2			.42				.47				.58	

Note. CFA = confirmatory factor analysis; FL = factor loading; r^2 = 1 − residual variance for the measured indicator; Factor R^2 = the sum of the standardized factor loadings/number of measured indicators; CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardized root mean square residual.

Fit statistics:

Time 1 CFA model fit: N = 5,272, χ^2 = 2166.40, df = 87, CFI = .94, TLI = .93, RMSEA = .07 (CI = .06, .07), SRMR = .04.

Time 2 CFA model fit: N = 4,885, χ^2 = 2944.28, df = 87, CFI = .93, TLI = .91, RMSEA = .08 (CI = .07, .08), SRMR = .04.

Time 3 CFA model fit: N = 3,500, χ^2 = 211.11, df = 9, CFI = .98, TLI = .97, RMSEA = .08 (CI = .07, .09), SRMR = .02.

[a]Items 1–15 are presented in the same order as in Brown and Ryan (2003).

Table 3

MAAS Reliability Estimates at Three Time Points

	MAAS Time 1	MAAS Time 2	MAAS Time 3
Factor correlations[a]			
MAAS Time 1	1	.52**	.32**
MAAS Time 2	.52**	1	.39**
MAAS Time 3	.35**	.41**	1
Reliability estimates			
Cronbach's α	.91	.93	.89
Mean ITC (range)	.61 (.48–.70)	.66 (.55–.72)	.71 (.66–.74)
Mean IIC (range)	.42 (.21–.61)	.47 (.29–.63)	.58 (.49–.66)

Note. MAAS = Mindful Attention Awareness Scale; ITC = item–total correlation; IIC = interitem correlation. Time interval between Time 1 and Time 2 = 3 months; Time interval between Time 2 and Time 3 = 10 months; Time interval between Time 1 and Time 3 = 13 months. All ITC *r*s significant at $p < .01$; all IIC *r*s significant at $p < .01$.

[a] Lower left of diagonal is test–retest correlations between 15-item and 6-item MAAS scales; upper right of diagonal are parallel-forms correlations between 8-item MAAS at Time 1/Time 2 and 6-item MAAS at Time 3.

** $p < .01$.

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Table 4

EFA Results for Convergent/Discriminant Validity of the MAAS at Time 3

	Three-Factor Solution		
Indicator	**1**	**2**	**3**
MAAS			
1	**.72**	−.02	.02
2	**.82**	.01	.04
3	**.85**	−.01	.05
4	**.74**	.02	−.05
5	**.63**	.01	−.14
6	**.53**	−.03	−.27
DIS-C			
1	−.01	.01	**.79**
2	.03	.03	**.74**
3	−.06	.04	**.56**
4	−.24	−.03	**.56**
5	.04	−.01	**.80**
6	.19	.02	**.49**
UPPS-IBS			
1	.02	**.67**	−.03
2	−.01	**.70**	−.03
3	−.04	**.76**	−.01
4	−.01	**.78**	.01
5	.02	**.76**	.04
6	.01	**.76**	.02

Note. EFA = exploratory factor analysis; MAAS = Mindful Attention Awareness Scale; DIS-C = Diagnostic Interview Schedule for Children; UPPS-IBS = UPPS Impulsive Behavior Scale. Eigenvalues ≥ 1 = 6.9, 3.4, 1.0; Bold values have factors loadings greater than or equal to .30. Time 1 and Time 2 tables not shown due to space limitations.

Table 5

CFA Goodness-of-Fit Indices to Assess Gender Invariance of the 15-Item MAAS at Time 1

							Nested Tests			
Model	χ^2	***df***	**CFI**	**TLI**	**SRMR**	**RMSEA (90% CI)**	**Models Compared**	$\Delta\chi^2$	Δdf	**ΔCFI**
Configural										
Females	1237.18	87	.936	.92	.04	.07 (.06, .07)				
Males	1012.86	87	.941	.93	.04	.06 (.06, .07)				
Measurement										
M0	2250.04	174	.938	.93	.04	.07 (.06, .07)				
M1	2288.78	188	.937	.93	.04	.07 (.06, .07)	M1-M0	38.74**	14	−.001
M1P	2262.89	184	.938	.93	.04	.07 (.06, .07)	M1P-M0	12.85	10	.000
M2	2430.30	198	.933	.93	.04	.07 (.06, .07)	M2-M1P	167.41**	14	−.005
M2P	2271.03	190	.938	.93	.04	.07 (.06, .07)	M2P-M1P	8.14	6	.000
M3	2374.20	205	.935	.93	.04	.06 (.06, .06)	M3-M2P	103.17**	15	−.003
M3P	2281.03	198	.938	.93	.04	.06 (.06, .07)	M3P-M2P	10.00	8	.003
Structural										
M4	2294.98	191	.937	.93	.05	.06 (.06, .07)	M4-M2P	23.95**	1	−.001

Note. CFA = confirmatory factor analysis; MAAS = Mindful Attention Awareness Scale; CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardized root mean square residual. MAAS correlated measurement errors: Items 1 with 2, 4 with 5, and 12 with 14; P indicates partial invariance for model; M1 = metric invariance; M2 = scalar invariance; M3 = uniqueness invariance; loadings constrained for M1P = Items 6, 7, 10, 11, 12, 13, 15; intercepts constrained for M2P = 6, 7, 10, 11, 12, 13, 15; correlated measurement errors for M3P = Item 4 with 5, Item 1 with 2, and Item 2 with 14.

** $p < .01$.

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Table 6

CFA Goodness-of-Fit Indices to Assess Gender Invariance of the 6-Item MAAS at Time 3

							Nested Tests			
Model	χ^2	***df***	**CFI**	**TLI**	**SRMR**	**RMSEA (90% CI)**	**Models Compared**	$\Delta\chi^2$	Δdf	**ΔCFI**
Configural										
Females	127.69	9	.978	.96	.02	.09 (.07, .10)				
Males	105.15	9	.981	.97	.02	.08 (.07, .09)				
Measurement										
M0	232.84	18	.980	.97	.02	.08 (.07, .09)				
M1	244.91	23	.979	.97	.03	.08 (.07, .08)	M1-M0	12.07	5	−.001
M2	308.10	28	.974	.97	.04	.08 (.07, .08)	M2-M1	63.19**	5	−.005
M2P	245.04	24	.979	.97	.03	.07 (.07, .08)	M2P-M1	.13	1	.005
M3	256.73	30	.979	.98	.04	.07 (.06, .07)	M3-M2P	11.69	6	.000
Structural										
M4	246.21	25	.979	.98	.04	.07 (.06, .08)	M4-M2P	1.17	1	.000

Note. CFA = confirmatory factor analysis; MAAS = Mindful Attention Awareness Scale; CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardized root mean square residual. No measurement errors are correlated; M1 = metric invariance; M2 = scalar invariance; M3 = uniqueness invariance; P indicates partial invariance for model; intercepts constrained for M2P = Items 2, 3, 4, 5.

** $p<.01$.

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Table 7

Intercorrelations Between the Full and Short MAAS and Other Factors to Asses Nomological Validity

	Time 1		Time 2		Time 3
Factor	**15-Item MAAS**	**6-Item MAAS**	**15-Item MAAS**	**6-Item MAAS**	**6-Item MAAS**
SCS	.54**	.55**	.53**	.53**	
PSSE	.02	.03	.12**	.13**	.08**
CESD	−.40**	−.41**	−.48**	−.47**	−.52**
PSS	−.54**	−.54**	−.53**	−.51**	−.59**
AQ	−.29**	−.29**	−.33**	−.33**	
DIS-C					−.65**
UPPS-IBS					−.22**

Note. MAAS = Mindful Attention Awareness Scale; SCS = Self-Control Scale; PSSE = Perceived Social Self-Efficacy; CESD = Center for Epidemiologic Studies Depression Scale; PSS = Perceived Stress Scale; AQ = Aggression Questionnaire; DIS-C = Diagnostic Interview Schedule for Children; UPPS-IBS = UPPS Impulsive Behavior Scale.

** $p < .01$.

Table 8

Incremental Validity[a] of MAAS in Relation to Mental Illness Measures

	CESD			PSS		
Factor	***B***	***SE B***	**β**	***B***	***SE B***	**β**
Time 1						
MAAS[b]	−.17	.01	−.23**	−.26	.01	−.33**
SCS	−.39	.02	−.37**	−.45	.02	−.40**
PSSE	−.11	.01	−.11**	.03	.01	.03*
Time 2						
MAAS[b]	−.20	.01	−.30**	−.25	.02	−.34**
SCS	−.31	.02	−.34**	−.40	.02	−.37**
PSSE	−.06	.01	−.07**	.01	.01	.01
Time 3						
MAAS[c]	−.23	.07	−.31**	−.32	.12	−.35*
DIS-C	.81	.08	.92**	1.11	.15	1.03**
UPPS-IBS	.10	.02	.08**	.12	.03	.08**

Note. MAAS = Mindful Attention Awareness Scale; CESD = Center for Epidemiologic Studies Depression Scale; PSS = Perceived Stress Scale; SCS = Self-Control Scale; PSSE = Perceived Social Self-Efficacy; DIS-C = Diagnostic Interview Schedule for Children; UPPS-IBS = UPPS Impulsive Behavior Scale.

[a] Structural regression estimate is adjusted for other factors in model.

[b] 15-Item MAAS.

[c] 6-Item MAAS.

** $p < .01$.

* $p < .05$.