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Psychometric Properties of the Mindful Attention Awareness Scale (MAAS) in a First-Episode Psychosis Sample

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Despite the considerable growth in mindfulness-based research in the field of psychosis, few attempts have been made to validate mindfulness instruments in this population. This study aimed to evaluate the factorial structure, internal consistency, construct validity, and longitudinal measurement invariance of the Mindful Attention Awareness Scale (MAAS) in a sample of individuals with first-episode psychosis (FEP). In a sample of 150 individuals with remitted FEP, the present study explored the factor structure, measurement invariance, reliability, convergent and discriminant validity of the MAAS. Confirmatory factor analysis supported a single-factor solution, which showed temporal stability, excellent internal consistency reliability (Cronbach's $\alpha = .92$; McDonald's $\omega = .93$), and theoretically coherent convergent and discriminant validity with measures of well-being, satisfaction with life, savoring, self-compassion, depression, anxiety, stress, and positive symptoms. Overall, the psychometric properties of the MAAS were similar to those described in previous validation studies, thus supporting the value of this instrument to assess the dimension of attention and awareness to the present moment in individuals with FEP.

Public Significance Statement

There is a growing interest in mindfulness-based interventions in psychosis. The present study provides evidence of the adequate psychometric properties of one of the most widely use scales to assess the ability to attend to and remain aware of present-moment experiences in a sample of individuals with first-episode psychosis. This validation is important due to the metacognitive deficits known to exist in this population.

Keywords: Mindful Attention Awareness Scale, mindfulness, psychosis, measurement invariance, psychometric properties

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Mindfulness is widely defined as the ability to be purposefully aware of the present moment and to relate to thoughts, feelings, and sensations in an open, nonjudging, and accepting manner (Kabat-Zinn, 1990). Mindfulness-based interventions (MBIs) are increasingly used to ameliorate various forms of psychological distress and treat mental disorders (Keng et al., 2011), including psychotic disorders (Jansen et al., 2020), and to improve quality of life (Goldberg et al., 2018). A growing number of studies on MBIs for psychotic disorders have found mindfulness to reduce symptoms and prevent relapse, with moderate to large effect sizes (Jansen et al., 2020). However, this research is hampered by the lack of instruments validated for individuals with psychotic disorders. To our knowledge, only a few attempts have been performed to validate mindfulness scales in this population, most notably the Southampton Mindfulness Questionnaire (SMQ), which was specifically designed to assess mindful response to distressing psychotic symptoms (Chadwick et al., 2008).

To date, mindfulness has predominantly been assessed through self-report instruments (Park et al., 2013). The Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) is the most used and validated (Park et al., 2013). The MAAS is a 15-item self-report questionnaire that assesses trait mindfulness. Compared to other mindfulness scales, the MAAS has several advantages, including its brevity, the simple unidimensional structure (i.e., mindful awareness), and the fact that it can be applied to a wide range of clinical and nonclinical populations, regardless of previous experience with meditation. In addition, the MAAS is available in more languages than any other mindfulness measure. While the SMQ was developed to measure mindfulness in psychosis, it is only weakly to moderately correlated with the MAAS (Baer et al., 2006; Chadwick et al., 2008), indicating that even though both measures are related, they capture different facets of mindfulness states.

Furthermore, there is evidence supporting the internal consistency (Cronbach α values ranging from 0.78 to 0.92), 4-week test–retest reliability (intraclass correlation coefficient, ICC = 0.81), construct validity (scores are positively correlated with theoretically-related constructs such as openness, internal state awareness, positive affect, and well-being, and negatively correlated with neuroticism, anxiety, stress, and rumination), and responsiveness of the MAAS (Park et al., 2013).

Nearly all of the studies performed to date support the unidimensionality of the MAAS. However, a few studies have partially questioned the appropriateness of a single-factor structure. For example, McCracken and Thompson (2009), who evaluated patients seeking treatment for chronic pain, suggested that the single-factor model may not represent an ideal fit to the data. That said, those authors did not confirm whether the four-factor solution found in an exploratory factor analysis (EFA) was a better fit. Ghorbani et al. (2009), in a sample of university students from Iran and the United States, failed to confirm the single-factor model. Rather, those authors found, via EFA, that the ideal fit in terms of the number of factors was different in these two countries. However, it is important to note that they used a 5-point Likert scale instead of the original and commonly used 6-point scale. MacKillop and Anderson (2007) reported that the confirmatory factor analysis supported the unidimensional-factor structure in a sample of university students, but this factor structure was not confirmed in the subsample of men, probably due to power limitations. Finally, two studies (Cebolla et al., 2013; Galiana et al., 2017) found that both the one and two factor models of the MAAS yielded appropriate fit to the data. Due to the high correlation between the two factors of the bi-dimensional model, the one-factor model was preferred in both of those studies. In short, although a few studies have proposed alternatives to the original structure of the MAAS, the inconsistent results provide no clear advantages over the single-factor model, which is strongly supported by data in both clinical and nonclinical samples (see Park et al., 2013, for a review).

Importantly, most of the MAAS validation studies have been performed in nonclinical populations, mainly university students (e.g., Ghorbani et al., 2009; Hansen et al., 2009; MacKillop & Anderson, 2007; Osman et al., 2016; Van Dam et al., 2010), which limits the generalization of the findings to clinical samples. In fact, only a few psychometric replication studies have been conducted in patients with cancer (Carlson & Brown, 2005), fibromyalgia (Cebolla et al., 2013), chronic pain (McCracken & Thompson, 2009), and emotional disorders (Inchausti et al., 2014), as well as some studies including both clinical and nonclinical samples (Barajas & Garra, 2014; Soler et al., 2012). To our knowledge, none of the MAAS validation studies performed to date have included individuals with psychotic spectrum disorders, thus limiting the use of this scale for research and clinical purposes in that population.

The validation in individuals with psychotic disorders is particularly relevant because mindfulness is linked to metacognitive abilities (Solem et al., 2015), and the latter are related to symptoms and functioning in psychosis (Vohs et al., 2014). There is consistent evidence of greater levels of metacognitive impairments in people with psychotic disorders in both early and later phases of illness as compared with other clinical and community groups (Lysaker et al., 2015). In addition, it is well-established that individuals with psychotic disorders, even at early stages of the illness, have pervasive neurocognitive impairments, including deficits in the attention and memory domains (Mesholam-Gately et al., 2009) that are likely to limit their ability to maintain focus or achieve a mindful state. Indeed, MAAS scores have been highly correlated with attention lapse and memory failure (Cheyne et al., 2006). Therefore, it is uncertain whether the psychometric properties of mindfulness scales with other samples can be reliably generalized to first-episode psychosis (FEP) samples.

Therefore, the purpose of the present study was to evaluate the psychometric properties of the MAAS in a sample of individuals with FEP. Specifically, we aimed to (a) test the single-factor structure, (b) temporal stability and test measurement invariance across time, and (c) examine the internal consistency and construct validity. Specifically, based on previous conceptualizations, we expected mindfulness to be convergent with measures of self-compassion, savoring, and well-being (Brown & Ryan, 2003; Bryant, 2003; Wilson et al., 2020), whereas divergent with measures of psychopathology (Hayes & Hofmann, 2017). We expect, however, the magnitude of these associations to be modest, as an indication that the MAAS is not redundant with these related measures.

Method

Participants and Procedure

The present study was based on data obtained in the HORYZONS randomized controlled trial (RCT), which was conducted to evaluate the effectiveness of adding an online intervention to treatment as

usual (TAU) to extend the benefits of specialized FEP services (Alvarez-Jimenez et al., 2021). In brief, participants were randomly assigned, following discharge from 2 years of specialized FEP service, to either TAU or TAU coupled with a moderated online social therapy intervention (HORYZONS) for 18 months. HORYZONS integrates interactive online therapy, peer-to-peer online social networking, peer moderation, and expert support. Moderators supported the autonomy, self-competence, and relatedness needs of participants when using the platform. Participants requiring vocational support received individualized online support from vocational counselors. TAU comprised a range of treatment options delivered by general medical or mental health services typically available to young people (see Alvarez-Jimenez et al., 2021, for a detailed description).

We evaluated the baseline data from that study, which we considered as a single cohort. The study inclusion criteria in the HORYZONS trial were as follows: (a) a first episode of a psychotic disorder or a mood disorder with psychotic features according to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) criteria; (b) age 16–27 years, inclusive; (c) ≤6 months of treatment with an antipsychotic medication prior to registration with an Early Psychosis Prevention and Intervention Centre (EPPIC); (d) remission of positive symptoms of psychosis, defined as ≥4 weeks of scores ≤3 (mild) on items P2 (conceptual disorganization) and G9 (unusual thought content) on the Positive and Negative Syndrome Scale (PANSS), and scores ≤4 (moderate) with no functional impairment on items P3 (hallucinatory behavior) and P1 (delusions). Exclusion criteria were (a) severe intellectual disability and (b) inability to speak or read English. Additional exclusion criteria to ensure safety within the online system included a DSM-IV diagnosis of antisocial or borderline personality disorder. All participants provided written informed consent. The trial was approved by the Melbourne Health Research and Ethics Committee (No. 2013.146).

The ratings were made at baseline in a single occasion by research assistants who were trained in the administration of these measures and supervised by a registered psychologist. Self-report measures were completed either at the time of the assessment or returned/collected up to 1 month after the assessment (Alvarez-Jimenez et al., 2019).

Measures

Mindful Attention Awareness Scale (Brown & Ryan, 2003)

The MAAS is a 15-item scale designed to assess dispositional (or trait) mindfulness, the ability to attend to and remain aware of present-moment experiences. Each item is presented as a declarative statement (e.g. "I find it difficult to stay focused on what is happening in the present") and rated on a 6-point Likert scale ranging from 1 (*almost always*) to 6 (*almost never*). A mean score is computed for all items, with higher scores indicating greater mindfulness. Most studies have confirmed a single-factor structure for the MAAS (Park et al., 2013).

Scales of Psychological Well-Being (Ryff, 1989)

The Scales of Psychological Well-Being (SPWB) is a 42-item scale assessing six distinct components of positive psychological functioning including autonomy, mastery of the surrounding environment, personal growth, positive relations with others, purpose in life, and self-acceptance. The SPWB rated on a 6-point Likert scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). The overall score is calculated by adding the items in each subscale, which yields scores ranging from 42 to 252. Higher scores indicate greater physiological well-being. In the HORYZONS sample, the SPWB scores had a Cronbach α coefficient of .92.

Satisfaction With Life Scale (Diener et al., 1985)

The Satisfaction With Life Scale (SWLS) is a 5-item scale designed to measure global cognitive judgments of life satisfaction (rather than the affective component of subjective well-being). Responses are rated on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Diener et al. (1985) reported satisfactory internal structure, 2-month test–retest reliability, and internal consistency for the scale's psychometric properties. In the HORYZONS sample, the SWLS scores had a Cronbach α coefficient of .84.

Savouring Beliefs Inventory (Bryant, 2003)

The Savouring Beliefs Inventory (SBI) is a 24-item self-assessment measure of individuals' beliefs about their capacity to savour positive experiences in three different temporal orientations (past, present, and future), each assessed by eight items. Each item is rated on a 7-point Likert scale ranging from 1 (*strongly agree)* to 7 (*strongly disagree)*. The total SBI score is calculated by summing responses to the 12 positively-worded items and subtracting responses to the 12 negatively-worded items. The SBI has robust psychometric properties, with very good internal consistency for the total score (Cronbach's α between 0.88 and 0.94); 3-week test–retest correlations indicate strong temporal reliability ($r = 0.84$; Bryant, 2003). In the HORYZONS sample, the SBI scores had a Cronbach α coefficient of .92.

Self-Compassion Scale Short Form (Raes et al., 2011)

Self-Compassion Scale Short Form (SCS-SF) is a 12-item self-report measure used to assess self-compassion. SCS-SF items are rated on a 5-point response scale ranging from 1 (*almost never*) to 5 (*almost always*). Higher total scores reflect greater self-compassion. The SCS-SF has demonstrated adequate internal consistency. This scale has a near perfect correlation with the 26-item SCS for total scores (Raes et al., 2011). In the HORYZONS sample, the SCS-SF scores had a Cronbach α coefficient of .81.

Depression, Anxiety and Stress Scale (Lovibond & Lovibond, 1995)

The Depression, Anxiety and Stress Scale (DASS) is a self-report questionnaire that evaluates symptoms of depression, anxiety, and stress over the previous week. Each subscale contains 14 items rated from 0 (*did not apply to me at all*) to 3 (*applied to me very much or most of the time*). In the present study, we used only the anxiety and stress subscales. The DASS has proven to be a highly reliable measure, with high convergent validity and good internal consistency; the factor structure is consistent with the allocation of the items to the subscales (Antony et al., 1998). In the HORYZONS

sample, the Cronbach α coefficient for the Anxiety subscale scores was .93 and for the Stress subscale scores was .95.

Calgary Depression Scale for Schizophrenia (Addington et al., 1993)

The Calgary Depression Scale for Schizophrenia (CDSS) is a 9-item clinician-rated outcome measure that assesses the level of depression in people with schizophrenia spectrum disorders. It provides a total depression severity score, which is obtained by summing the scores in each item (rated from 0 to 3). Total scores range from 0 to 27, with higher scores indicating greater severity. The scale has excellent psychometric properties, including strong internal consistency, interrater reliability, sensitivity, specificity, and discriminant and convergent validity (Lako et al., 2012). In the HORYZONS sample, the CDSS scores had a Cronbach α coefficient of .83.

Positive and Negative Syndrome Scale (Kay et al., 1987)

The Positive and Negative Syndrome Scale (PANSS) is a clinician-rated scale assessing psychotic symptoms. Based on a meta-analysis of the results of 45 factor analyses of the PANSS (Shafer & Dazzi, 2019), we used the five main factors of that scale, as follows: (a) Positive Symptoms (delusions, unusual thought content, hallucinatory behavior, suspiciousness and persecution, grandiosity); (b) Negative Symptoms (emotional withdrawal, blunted affect, passive apathetic social withdrawal, lack of spontaneity, poor rapport, motor retardation, active social avoidance); (c) Disorganization (conceptual disorganization, poor attention, difficulty in abstract thinking, disturbance of volition, stereotyped thinking, mannerisms/posturing, preoccupation, disorientation); (d) Depression-Anxiety (anxiety, depression, guilt feelings, tension, somatic concern); and (e) Resistance (hostility, poor impulse control, excitement, uncooperativeness).The scale has demonstrated adequate psychometric properties including temporal stability, internal consistency, and discriminant validity (Bryson et al., 1999). In the HORYZONS sample, the PANSS scores had a Cronbach α coefficient of .85.

Seventeen cases were selected at baseline to check interrater reliability on the clinician-rated measures—PANSS and CDSS—with the ratings made by an independent research assistant. The ICC were 0.89 for PANSS and 0.94 for CDSS, indicating good to excellent interrater reliability.

Data Analysis

An initial analysis of the data was performed to examine assumptions of linearity, normality, and multicollinearity for the items. Given the categorical-ordered nature of the MAAS scores, internal consistency was assessed by the omega coefficient ω, which estimates reliability more accurately than Cronbach's α for Likert-type item scores (Trizano-Hermosilla & Alvarado, 2016). However, for comparison purposes, we also calculated Cronbach's α, as this is the coefficient most commonly reported in previous MAAS studies. The factorial structure of the MAAS was assessed through a confirmatory factorial analysis (CFA). The model was estimated with the weighted least squares mean and variance (WLSMV), which is indicated for ordinally scaled items (Li, 2016). Model fit was assessed by means of the following fit indices: Chi-square statistic (χ^2); comparative fit index (CFI); Tucker–Lewis index (TLI); root mean square error of approximation (RMSEA); and the weighted root mean square residual (WRMR). Values >0.95 for the CFI and TLI indices indicate an optimal adjustment, while values >0.90 represent an acceptable adjustment. For the RMSEA, values <0.05 are considered optimal and those <0.08 acceptable. For the WRMR, values <1.0 are indicative of adequate model fit (Yu & Muthen, 2002). In a subsample of participants assessed 6 months after baseline, analyses of longitudinal measurement invariance were conducted to examine whether the scale remains structurally stable over time. For this analysis, we followed the measurement invariance procedures outlined by Brown (2014). Different levels of measurement invariance were sequentially tested (weak, strong, and strict invariance). Weak factorial invariance examines the equivalence of factor loadings (i.e., items assess the latent variable in the same way across time). Strong factorial invariance examines the equality of latent means, implying that any differences in means on the scale are due to true differences in means across time. Finally, strict invariance—the most restrictive level of factorial invariance—examines the invariant factor loadings, intercepts, and unique factor variances across time, this implies that differences in variances of scale scores are due only to differences in mindfulness variances, since error variances are constant across time. Invariance between groups over time was considered to be present when, after imposing a constraint, there was no significant decrease of model fit in terms of $\Delta\chi^2$ and ΔCFI < .01. To examine temporal stability over a 6-month time period, the ICC values with 95% confident intervals (CI) were calculated based on a single measurement, absolute agreement, two-way mixed-effects model. Reliability was classified as follows: Poor (ICC values <0.5), moderate (0.5–0.75), good (0.75–0.9), and excellent (>0.9) (Koo & Li, 2016). Finally, to assess convergent and discriminant construct validity, Pearson's correlations between the MAAS and the other scales (SPWB, SWLS, SBI, SCS-SF, CDSS, DASS, and PANSS) were calculated. Finally, semipartial correlations were calculated to examine the unique contributions of the variables of interest (SPWB, SWLS, SBI, SCS-SF, CDSS, DASS, and PANSS) to the variance in MAAS scores, after controlling for the potential confounding effects of emotional disturbances (as measured by the Depression-Anxiety subscale of the PANSS). All statistical analyses were performed with the statistical package SPSS v23, except for the CFA, which was performed with the Mplus v6.12 software. This study was not preregistered. The data used for this study are available from the corresponding author upon request.

Results

Descriptive and Exploratory Analysis

Of the 170 participants, 150 with available baseline MAAS data were included in the analysis. At intake, the mean age was 20.8 years (range, 16–27; $SD = 2.9$) and 83 (55.3%) were male. The mean years of education was 11.0 years ($SD = 1.1$). Most of the participants ($n = 118$; 78.7%) were born in Australia. The other participants were born in New Zealand ($n = 4$; 2.6%), Asia ($n = 12$; 8%), Africa ($n = 9$; 6%), and for 7 (4.7%) place of birth was not specified. Of these 150 participants, 87 (58%) had a diagnosis of nonaffective psychosis and 63 (42%) affective-psychosis. No significant differences between these two groups were found in the baseline MAAS scores, $t(148) = 1.08$, $p = .281$. The most common diagnoses were psychotic disorder not otherwise specified ($n = 28$),

schizophrenia ($n = 27$), and bipolar disorder ($n = 26$). Regarding the clinical profile, although the participants were clinically stable overall, they were not asymptomatic, as evidenced by the mean (*SD*) scores for the PANSS factors: 7.3 (2.9) for Positive symptoms, 11.0 (4.0) for Negative symptoms, 11.3 (3.0) for Disorganization symptoms, 9.5 (3.7) for Depression-Anxiety symptoms, and 5.2 (1.6) for Resistance symptoms.

Based on the criteria proposed by George and Mallery (2010), items of the MAAS scores presented a distribution that was close to normal (asymmetry and kurtosis values below +1.5 and above −1.5; Table 1). Multivariate normality testing revealed a Mardia index of 41.71, indicating no substantial deviations from a normal distribution. To test the linearity assumption of the relations, linear and curvilinear estimates were calculated between pairs of items. In all cases, the linear function was superior to the curvilinear function, thus confirming the linearity assumption. Item–total correlations, in which an item is correlated with the total scale score (excluding that item), ranged from .47 (Item 6) to .79 (Item 14). The mean total score for the MAAS was 3.74 ($SD = .98$). Mean scores for the items are shown in Table 1.

Confirmatory Factor Analysis and Internal Consistency

The one-factor model had 90 free parameters and met all preestablished criteria for an adequate fit, $\chi^2(90) = 235.68$, $p < .001$, CFI = .95, TLI = .94, WRMR = .90, although the values obtained in the RMSEA index were somewhat high (RMSEA = .09; 90% CI [0.08, 0.11]). Factor loadings for the one-factor model are summarized in Table 1.

To compare with previous publications, we estimated the internal consistency reliability according to α and omega coefficients of the MAAS scores. Cronbach's α was .92 (95% CI [.91–.93]) and McDonald's omega was .93 (95% CI [.92 –.94]).

Temporal Stability and Longitudinal Measurement Invariance

Data obtained from a subsample of participants ($n = 94$) who completed the MAAS at the 6-month follow-up was used to test temporal stability and longitudinal measurement invariance. As the sample was part of a RCT, we tested for differences between the study arms (control vs. experimental) in the MAAS scores, finding no significant differences between groups in the MAAS scores at baseline, $t(148) = 0.44$, $p = .661$, or at 6-month follow-up, $t(92) = 0.47$, $p = .643$.

Longitudinal measurement invariance is important to ensure that the instrument measures the same latent constructs in a consistent manner over time. We evaluated whether the measurement model was invariant across time (i.e., from the baseline measures to the 6-month follow-up assessment). Increasing constraints are estimated, and each model is compared with the previous one. If this condition was met, invariance testing proceeded to the application of the next equality constraint. In the weak factorial invariance item loadings were constrained to be equal across time. The strong factorial invariance additionally constrains thresholds to be equal across time; and the strict invariance constrains all residual variances to be equal on top of all previous constraints. The analyses supported weak ($\Delta\chi^2 = 4.7$, $\Delta df = 14$, $p = .98$; ΔCFI < .01), strong ($\Delta\chi^2 = 0.31$, $\Delta df = 15$, $p = .99$; ΔCFI < .01), and strict invariance ($\Delta\chi^2 = 12.85$, $\Delta df = 30$, $p = .99$; ΔCFI < .01) across time.

ICC was used to assess 6-month test–retest reliability. The results suggest that test–retest reliability was moderate (ICC = .53, 95% CI [.35–.66]).

Convergent and Discriminant Validity

Table 2 shows the Pearson's correlations between the MAAS scores and the other constructs that were measured, demonstrating theoretically coherent results. Specifically, the MAAS scores showed significant positive zero-order correlations with measures of well-being, satisfaction with life, savouring, and self-compassion (convergent validity). An inverse relationship between measures of depression, anxiety, stress and four of the subscales of the PANSS was observed. No statistically significant correlations were observed between the MAAS scores and disorganization symptoms (discriminant validity). To further explore the association between positive, negative and resistance symptoms and MAAS scores, we performed semipartial correlations controlling for the potential confounding

Table 1
MAAS Item Means, Standard Deviation, Skewness, Kurtosis, CITC, and Factor Loadings

Item	General item content	*M*	*SD*	Skewness	Kurtosis	CITC	Factor loading
1	Experiencing emotion and not conscious	3.77	1.36	0.04	−0.67	0.58	.65
2	Spill things because of carelessness	4.07	1.47	−0.32	−0.83	0.64	.70
3	Difficult to stay focused	3.67	1.50	−0.11	−0.99	0.74	.81
4	Tend to walk quickly	3.60	1.53	−0.16	−0.98	0.61	.70
5	Tend not to notice feelings of discomfort	3.83	1.42	−0.11	−0.85	0.53	.60
6	Forget a person's name soon	3.05	1.53	0.34	−0.94	0.47	.53
7	"Running on automatic"	3.75	1.50	−0.06	−1.02	0.76	.84
8	Rush through activities	3.87	1.39	−0.04	−0.84	0.70	.77
9	Lose touch with what I'm doing	3.74	1.36	−0.04	−0.67	0.71	.77
10	Do tasks automatically	3.65	1.27	0.13	−0.70	0.63	.70
11	Listening while doing something else	3.36	1.36	0.27	−0.72	0.55	.61
12	Drive places on "automatic pilot"	4.49	1.55	−0.76	−0.44	0.57	.62
13	Preoccupied with the future or the past	3.37	1.40	0.12	−0.74	0.55	.62
14	Doing things without paying attention	3.58	1.38	0.07	−0.72	0.79	.85
15	Snack without being aware	4.36	1.61	−0.58	−0.88	0.47	.55

Note. MAAS = Mindful Attention Awareness Scale; CITC = corrected item-total correlation.

Table 2
Bivariate and Semipartial Correlations Between MAAS Scores and Other Measures of Interest

Measures	*r*	*sr*
Scales of Psychological Well-being	.49***	.38***
Satisfaction with Life Scale	.25**	.08
Savouring Beliefs Inventory	.42***	.30***
Self-Compassion Scale Short Form	.51***	.39***
Calgary Depression Scale for Schizophrenia	−.37***	−.14
Depression Anxiety and Stress Scale-Anxiety subscale	−.45***	−.33***
Depression Anxiety and Stress Scale-Stress subscale	−.46***	−.35***
PANSS-positive	−.38***	−.27**
PANSS-negative	−.19*	−.03
PANSS-disorganization	−.05	.03
PANSS-depression-anxiety	−.36***	—
PANSS-resistance	−.24**	−.13

Note. Semipartial correlations (*sr*) reflect the unique association of a variable of interest with MAAS over and above the effect of the emotional distress (PANSS-Depression-Anxiety) on the corresponding variable. MAAS = Mindful Attention Awareness Scale; PANSS = Positive and Negative Syndrome Scale.
* $p < .05$. ** $p < .01$. *** $p < .001$.

effects of emotional disturbances as measured by the Depression-Anxiety subscale of the PANSS. In this analysis, MAAS scores and positive symptoms remained significantly negatively correlated ($sr = -.27$, $p < .001$), unlike negative, disorganized and resistance symptoms, which were not significantly correlated with MAAS scores after controlling for the effect of emotional disturbances on those symptoms (see Table 2).

Discussion

The aim of this study was to examine the psychometric properties of the MAAS in a sample of individuals diagnosed with FEP. This is the first study to perform this analysis, thus filling a major gap in the rapidly growing mindfulness literature. The results demonstrate that the psychometric properties of the MAAS in individuals with FEP are similar to those reported in the original study (Brown & Ryan, 2003) and with other clinical (e.g., Carlson & Brown, 2005) and nonclinical populations (e.g., Osman et al., 2016). Specifically, the CFA results support a single-factor solution, with temporal stability, excellent internal consistency reliability, and theoretically coherent convergent validity.

In agreement with the findings reported in most previous studies (Brown & Ryan, 2003; Carlson & Brown, 2005; MacKillop & Anderson, 2007; Osman et al., 2016; Soler et al., 2012; Van Dam et al., 2010), the CFA performed in this study clearly supported a single-factor structure for this scale, consistent with the theoretical framework (i.e., mindfulness defined as awareness of the present moment) proposed in the original study (Brown & Ryan, 2003). Importantly, all factor loadings for the items in the MAAS scale were >.50, and all corrected item-total correlations were >.45. The model also presented very good reliability in terms of internal consistency, a finding that is in line with previous evaluations in nonclinical samples (Baer et al., 2006; Brown & Ryan, 2003; Deng et al., 2012; MacKillop & Anderson, 2007; Osman et al., 2016), clinical samples (Cebolla et al., 2013; Rayan & Ahmad, 2018), and both clinical and nonclinical samples (Barajas & Garra, 2014; Carlson & Brown, 2005).

Longitudinal invariance must first be established to permit meaningful comparisons of factor means over time. However, published reports on the temporal stability of the MAAS are scant. The original study (Brown & Ryan, 2003), as well as other versions of the scale (e.g., Soler et al., 2012), have reported good test–retest reliability, defined as the stability of the scale scores across repeated measures. We found only moderate test–retest reliability scores, which might be due to the longer interval between assessments in our study (6 months) versus other studies (≤1 month). Our analyses supported strict invariance across time, a finding that indicates that the same scores observed at different points in time reflect the same level of the underlying latent variable, which needs to be established before test–retest reliability can be reliably evaluated (Gomez et al., 2018).

Evidence for construct validity was provided by consistent positive correlation between MAAS scores and measures of well-being, satisfaction with life, savouring, and self-compassion. This reflects one of the most firmly established findings in the published literature on mindfulness, namely the correlation between dispositional mindfulness and various well-being and life satisfaction outcomes (Baer et al., 2006; Brown et al., 2007; Brown & Ryan, 2003; Falkenström, 2010; Howell et al., 2008; Kabat-Zinn, 1990). This relationship has been attributed to the capacity of mindfulness to foster more positive self-evaluations (Kong et al., 2014) and psychological flexibility (Kashdan & Rottenberg, 2010). Furthermore, based on previous research (Baer et al., 2006), we expected to find moderate positive correlations between all facets of mindfulness and self-compassion, which is defined as a nonjudgmental relationship with of one's own suffering and the corresponding desire to treat oneself with a sense of warmth, connection, and concern (Neff & McGehee, 2010). In addition, savouring—paying deliberate conscious attention to pleasurable experiences—was expected to be associated with trait mindfulness (Bryant, 2003). Our findings support both of these associations in the expected directions. It is important to note that the small to medium effect sizes of the correlations found between mindfulness and the listed well-being, self-compassion, savoring and psychopathology constructs suggests that their relationship is far from being redundant.

Correlational analyses showed a negative association between MAAS scores and a range of emotional distress indicators such as depression, anxiety, and stress. This finding concurs with previous validation studies, which have consistently reported the association between MAAS scores and diverse measures of depression (Barajas & Garra, 2014; Brown & Ryan, 2003; Carlson & Brown, 2005; Jermann et al., 2009; Osman et al., 2016; Ruiz et al., 2016; Soler et al., 2012), anxiety (Barajas & Garra, 2014; Brown & Ryan, 2003; Carlson & Brown, 2005; Ruiz et al., 2016), and stress (Carlson & Brown, 2005; Ruiz et al., 2016) as well as several meta-analyses (Chiesa & Serretti, 2011; Fjorback et al., 2011; Hofmann et al., 2010). Interestingly, the positive effects of MBIs have been observed not only through self-reported measures but also biological measures such as cortisol levels, a major stress hormone (Marcus et al., 2003; Matousek et al., 2010).

Given the clinical relevance of psychotic symptoms in FEP, we examined associations between the PANSS subscales and the

MAAS scores. We observed a significant inverse correlation with all factors (except Disorganization). The lack of correlation between Disorganization (also termed Cognitive) and MAAS scores was unexpected given previous studies indicating that MAAS scores are highly correlated with everyday cognitive failures (Cheyne et al., 2006). However, correlations between symptom dimensions and neurocognitive functioning are weak to nonexistent (Nieuwenstein et al., 2001).

We examined the positive, negative and resistance symptoms on MAAS scores (after controlling for emotional disturbances) to identify the unique contribution of these factors, finding that positive—but not negative or resistance symptoms—remained significantly correlated with MAAS scores. A possible explanation for this finding could be that mindfulness explicitly promotes disengagement from cognitive contents in general, including positive psychotic symptoms. Previous researchers have argued that it is not positive symptoms *per se* that cause psychopathology, but engagement with these (including both believing and acting upon delusions and auditory hallucinations, or reacting to them with fear or judgment), and used this to explain the positive effects of MBIs for positive symptoms (Chadwick et al., 2009). Conversely, after controlling for emotional disturbances, we did not find any association between MAAS scores and negative and resistance symptoms. One possible explanation for this may be that while mindfulness reduces engagement with positive symptoms, it may do little to address negative and resistance symptoms in which the presence of thoughts is less relevant. Indeed, it could be argued that mindfulness (particularly meditation) could even exacerbate these symptoms, as individuals retreat further into themselves and disconnect even more from those around them. However, we note that this pattern is the opposite of the pattern described in a meta-analysis by Khoury et al. (2013), who found MBIs to have greater effect on treating negative symptoms than positive symptoms. More research is clearly warranted in this area to further clarify these relationships.

This study has several limitations. First, the study data was derived from an RCT; therefore, the measures used were not selected for the purpose of a validation study. This drawback limited our analyses, as we could not examine potential associations between the MAAS and other self-report mindfulness scales, which tend to have small to moderate correlations (Baer et al., 2006). However, other properties of the scale validity, such as construct validity (defined as the degree to which relationships between the scale and other related measures conform to expectations) and structural validity (the unidimensionality of the scale), were supported in the present study. Second, it should be noted that the result of the RMSEA was not optimal. However, several studies have shown that models with a good fit may show inconsistent results between RMSEA and other fit indices (Lai & Green, 2016). Indeed, simulation studies indicate that when traditional cut-off values are used to assess the fit of correctly specified models with small sample sizes, the RMSEA often indicates a poorly fitted model (Kenny et al., 2015). Considering that the sample size of the present study was small to moderate for psychometric testing purposes, this may have negatively influenced the RMSEA performance. Alternatively, poor RMSEA values might be an indication of inter-item redundancy; however, several studies have reported optimal RMSEA values for the one-factor model of the MAAS, thus it is likely that RMSEA values in this study are due to the limited sample size rather than inter-item redundancy. Importantly, the RMSEA value did not exceed 0.10, which would be a clear indication of poor fit (Lai & Green, 2016). Third, the study sample included a broad range of DSM-IV affective and nonaffective psychotic disorders, but sample size precluded us from testing measurement invariance across various demographic and clinical groups. Similarly, while the sample size was relatively large for a FEP trial, it would be desirable to have a larger sample for measurement invariance testing ($n = 94$). However, the limited research available has documented measurement invariance testing accuracy in small samples; indeed, the results obtained in the simulation study performed by Finch et al. (2018) suggest that when the sample size per group is 50 or more, useful estimates can be obtained for metric invariance while maintaining control of Type I error. Nevertheless, a small sample size may limit the power to detect a lack of measurement invariance. Therefore, longitudinal invariance must be interpreted cautiously. Future studies should replicate this analysis with larger sample sizes of patients with psychosis and/or other populations. Additionally, although this study was the first (to our knowledge) to test the longitudinal invariance of the MAAS, we were unable to evaluate its responsiveness, defined as the ability of the scale to detect changes in mindfulness after training.

In conclusion, given the growing interest in the potential utility of mindfulness as a treatment for psychosis, there is a clear need to validate the available instruments for clinical and research purposes in FEP population. The MAAS is the most widely used measure of mindfulness and it has been previously applied in studies involving individuals with psychotic disorders (e.g., Alvarez-Jimenez et al., 2019). The present study provides empirical support for the reliability, validity, and longitudinal measurement invariance of the MAAS as a measure to assess the dimension of attention and awareness to the present moment in individuals with FEP. Future research should determine the criterion validity as well as the responsiveness of the scale in this population.

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