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Measuring mindfulness? An Item Response Theory analysis of the Mindful Attention Awareness Scale

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ABSTRACT

The Mindful Attention Awareness Scale (MAAS) is one of the most popular measures of mindfulness, exhibiting promising psychometric properties and theoretically consistent relationships to brain activity, mindfulness-based intervention (MBI) outcomes, and mediation of MBI effects. The present study investigated the response patterns and scale properties in a large sample of undergraduate students ($N = 414$) using Item Response Theory analyses. The findings suggest that general statements of “automatic inattentiveness” or “automatic pilot” confer greater statistical information about the underlying latent trait. Evidence of limited abilities to report on mindlessness and of response bias to “mindfulness-absent” items suggests challenges to the construct validity of the MAAS. The current findings, along with pre-existing data, suggest that reverse-scoring the scale may be inadequate to represent intentional attention or awareness. Further research is needed to determine which variations, components, and correlates of the numerous operationalizations of mindfulness are theoretically consistent and most salient to positive outcomes, especially in psychopathology.

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1. Introduction

Mindfulness has become an increasingly popular construct with diverse clinical and scientific applications (Bishop et al., 2004). Despite efforts at achieving operational definitions and corresponding measurement, disagreement seems the rule rather than the exception (see *Psychological Inquiry*, 2007, Vol. 18, 4). Traditionally, mindfulness involves the active engagement of cognitive-perceptual processes manifest in two broad phases. “The initial phase of mindfulness is the cultivation of sustained bare attention resulting from the practice of non-forgetful attention, followed by... introspective awareness to understand the moment to moment workings of adaptive and maladaptive thoughts and feelings” (Rapgay & Bystrisky, 2009, pp. 153–154). Clinical scientists have attempted to define mindfulness in a way that makes the construct amenable to training and measurement. Bishop and colleagues (2004) provided one of the most integrative and theoretically consistent definitions of the construct.

The first component involves the self-regulation of attention so that it is maintained on immediate experience, thereby allowing for increased recognition of mental events in the present

moment. The second component involves adopting a particular orientation towards one's experiences in the present moment, an orientation that is characterized by curiosity, openness, and acceptance (Bishop et al., 2004, p. 232).

Some have argued that even this elaborate definition fails to represent the true character of mindfulness and has led to miscomprehension of how mindfulness is developed (Leary & Tate, 2007; Rosch, 2007). Rapgay and Bystrisky (2009) emphasize that mindfulness is an active skill developed by a combination of concentrative and analytical insight-based meditation practices. They also provide an important distinction between attention (a particular cognitive faculty) and awareness (a directable, but broader aspect of consciousness) stating that mindfulness practice entails “...the ability to flexibly apportion...between primary attention to the foreground and secondary awareness to the background...” (p. 155).

There is also debate about therapies related to the construct (e.g., Hofmann & Asmundson, 2008). While many treatments claim a theoretical reliance on mindfulness, the construct has been defined and applied inconsistently (Kabat-Zinn, 2003). Some definitions are based on the Buddhist path towards well-being (e.g., Kabat-Zinn, 1990) while others rely on a reductionist notion of mindfulness (see Hofmann and Asmundson (2008)). Despite theoretical variations, MBIs have been shown to be efficacious treatments for physical and psychological symptoms and conditions (Grossman, Niemann, Schmidt, & Walach, 2004; Hofmann, Sawyer,

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Witt, & Oh, 2010). MBIs often improve health and stress, but change self-reported mindfulness inconsistently (Grossman, 2008). Dramatic variations in operationalizations of mindfulness have led some to question whether scales of “mindfulness” measure the same construct (Rosch, 2007).

Grossman (2008) emphasized several concerns with self-reported mindfulness, including issues of scale construction, potential bias, and item miscomprehension (see also Van Dam, Earleywine, and Danoff-Burg (2009)). Interrelationships among scales purportedly assessing state versus trait mindfulness (e.g., Thompson & Waltz, 2007), as well as behavioral versus self-report mindfulness and predicted outcomes (Frewen, Evans, Maraj, Dozois, & Partridge, 2008) have been inconsistent. Recent evaluation of two of the most popular self-report measures across a Thai and US sample exhibited serious psychometric complications, including no latent mean difference between groups on the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) despite large differences in meditation and endorsement of Buddhist ideology (Christopher, Charoensuk, Gilbert, Neary, & Pearce, 2009). Further, a recent examination of meditators and non-meditators on the Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) showed large differential item functioning (Van Dam et al., 2009). While self-report mindfulness scales often have well-established nomothetic span (appropriate correlations with related and unrelated construct measures), they lack construct representationalism (psychological processes underlying responses to a task), an important component of establishing construct validity (Strauss & Smith, 2009).

The MAAS (Brown & Ryan, 2003) is a possible exception to the construct representation problem, with a specific cognitive theory related to scale development. Brown and Ryan (2003) specifically chose items representing *mindlessness* because “. . . states reflecting less mindlessness are likely more accessible to most individuals, given that mindless states are much more common than mindful states. . .” (p. 826). The MAAS has also shown theoretically consistent relationships to brain activity (e.g., Creswell, Way, Eisenberger, & Lieberman, 2007), treatment outcome in MBIs (e.g., Michalak, Heidenreich, Meibert, & Schulte, 2008), mediation of targeted MBI outcomes (e.g., Nykliček & Kuijpers, 2008), and salutary non-targeted benefits resulting from MBIs (Frewen et al., 2008). The MAAS has a strongly supported unidimensional factor structure and good nomothetic span (e.g., Brown & Ryan, 2003; MacKillop & Anderson, 2007), making it a seemingly good candidate to represent mindfulness.

Unfortunately, the assumption regarding the accessibility of mindless states is challenged by empirical investigation in cognitive neuroscience. Recent studies in meta-awareness and attention suggest that mind wandering (typically a mindless state) is associated with a lack of meta-awareness (awareness that one is not aware). Further, attention is decoupled from task engagement during a mind-wandering episode (Smallwood, McSpadden, & Schooler, 2007). These findings suggest that one’s ability to accurately report about mindless states may be limited without specific training. Lack of meta-awareness regarding mindless states (or mindfulness-absent states) suggests that responses on the MAAS are likely not the result of the proposed cognitive process. Further, a recent examination of mindfulness-absent items on the FFMQ suggests a general response bias to reject items suggesting higher prevalence of *mindlessness* (Van Dam et al., 2009), revealing construct-inconsistent response processes.

1.1. Applying Item Response Theory

Given direct challenges to construct validity and the underlying response processes, Item Response Theory (IRT) is well suited to provide information potentially not available via Classical Test

Theory analyses (see de Ayala, 2009; Embretson & Reise, 2000). The psychometric properties obtained from IRT analyses are theoretically sample invariant, a potentially important consideration in measuring mindfulness given known sample differences (e.g., Christopher et al., 2009; Van Dam et al., 2009). One important psychometric property is the item information estimate. An item’s information provides an index of how useful it is in discriminating between participants at specified trait levels. Another important aspect of IRT is the detailed prediction of responses based on estimated latent trait level. The relationship of an individual’s estimated trait level (θ) and the probability of choosing a given response is exemplified on an item-by-item basis by a category response curve (CRC) (see Fig. 1).

The MAAS has a polytomous response format (e.g., a six-point rating scale), with graded response options. A theoretically appropriate IRT model to explore this item response format is the Graded Response Model (GRM; see de Ayala (2009), Embretson and Reise (2000), Ostini and Nering (2006), Samejima (1969) and Samejima (1996)). The GRM entails cumulative response distributions for each item, computing thresholds between each response option and all options ordinal higher (Samejima, 1969). Each CRC predicts the probability of all response options, anchored at a given trait level by b_i (the threshold parameter). The threshold parameter, b_i , is that point along the trait continuum where the probability of selecting a given response option is 50%. The GRM also permits estimation of an item discrimination parameter (a_i) for each item. The item discrimination parameter provides an estimate of how well the item differentiates between individuals of varying trait levels. Values of a_i from 0.01 to 0.24 are considered very low, 0.25–0.63 low, 0.65–1.34 moderate, 1.35–1.69 high, and >1.7 , very high (Baker, 2001).

1.2. Goodness of fit

Empirical and simulation studies exploring model fit in IRT have provided no evidence of a “gold standard”, however several statistical indices have been proposed (Drasgow, Levine, & Williams, 1985; Hambleton, Swaminathan, & Rogers, 1991; Ostini & Nering, 2006). Hambleton and colleagues (1991) suggest an exploration of model assumptions followed by cautious use of statistical tests. All basic IRT models assume data unidimensionality, which can be examined with confirmatory factor analysis based on previously specified scale factor structure. The GRM also assumes invariant trait (θ) parameter estimates as well as invariant item parameter estimates (a_i, b_i). A cursory examination of these model features can be conducted by comparing trait estimates from even and odd items as well as parameter estimates from male and female participants, respectively (see Hambleton et al. (1991, p. 64)). If model assumptions are not violated, the relationship between model predictions and actual data can be explored using residual-based measures (e.g., Drasgow et al., 1985; Embretson & Reise, 2000). Simulations and empirical data suggest that the Z_i statistic developed by Drasgow and colleagues (1985) is a particularly robust estimator of person-fit and model-fit (Reise, 1990).

1.3. Current study

Data unidimensionality was assessed by confirmatory factor analysis (CFA) in LISREL v 8.8 (Jöreskog & Sörbom, 1993). Cutoff criteria were established for reasonable and good model fit based on recommendations (Brown, 2006; Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004). Standardized root mean residual (SRMR) $<.08$ was considered good, $<.10$ was considered reasonable; comparative fit index (CFI) $>.95$ was considered good, $>.90$ was considered reasonable; root mean square error of approximation $<.06$ was considered good, $<.08$ was considered reasonable. To explore the latent trait

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