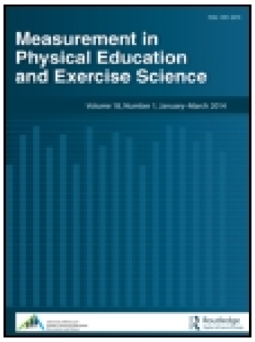

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Validity Evidence for the State Mindfulness Scale for Physical Activity

Anne E. Cox, Sarah Ullrich-French, and Brian F. French

Department of Educational Leadership, Sport Studies and Educational/Counseling Psychology, Washington State University, Pullman, Washington

ABSTRACT
Being attentive to and aware of one's experiences in the present moment with qualities of acceptance and openness reflects the state of mindfulness. Positive associations exist between state mindfulness and state autonomous motivation for everyday activities. Though this suggests that state mindfulness links with adaptive motivational experiences, no suitable measure of state mindfulness exists that would facilitate the examination of these relationships in a physical activity context. Thus, we revised the State Mindfulness Scale (Tanay & Bernstein, 2013) and provided score validity evidence for the measure in a physical activity context. A bi-factor model reflecting mindfulness of the mind and body as specific factors and a general mindfulness factor was supported. Validity evidence, such as positive relationships with intrinsic motivation, and a negative relationship with body surveillance support score use. The revised scale can facilitate investigations of the role of mindfulness in physical activity settings.

KEYWORDS
yoga; intrinsic motivation; body surveillance; physical activity

Engaging in regular physical activity is a vital contributor to positive mental and physical health (Physical Activity Guidelines Advisory Committee Report, 2008). Individuals are more likely to engage in physical activity and at a higher frequency, duration, and intensity (Duncan, Hall, Wilson, & Jenny, 2010) when they do so for autonomous reasons or choose to be active of their own volition (Ryan & Deci, 2007; Wilson, Rodgers, Fraser, & Murray, 2004). Though there are multiple forms of autonomous motivation (i.e., intrinsic, integrated, and identified regulations) defined in self-determination theory (Ryan & Deci, 2007), it is intrinsic motivation that is the best predictor of long-term adherence to physical activity behavior (Teixeira, Carraça, Markland, Silva, & Ryan, 2012). When intrinsically motivated, individuals choose to be active for the positive way physical activity makes them feel or for the intrinsic rewards they gain while participating. Enjoyment and satisfaction derived from the physical sensations of physical activity or the psychological feeling of accomplishment during physical activity all represent internal states that may be inherently rewarding characteristics of physical activity. On the other hand, more controlling forms of motivation such as exercising to alleviate negative feelings (e.g., anxiety, shame), or to lose weight, change appearance, or gain fitness (Ryan & Deci, 2007), despite their prevalence, are poor predictors of long-term adherence (Teixeira et al., 2012). Thus, adults who are the most successful in maintaining long-term physical activity behaviors are motivated by the inherent rewards derived from the activity itself.

One factor that may distinguish those who are intrinsically motivated from those who are extrinsically motivated is the degree to which participants are mentally engaged in the experience of the physical activity itself instead of attending to external factors such as anticipated outcomes (e.g., appearance change), what they look like while exercising (i.e., body surveillance), elements of distraction (e.g., music, television) or irrelevant thoughts. Research on the concept of mindfulness supports this contention (Brown & Ryan, 2003). Mindfulness has been defined as awareness and attention to the present moment with elements of non-judgment, curiosity, acceptance, and openness (Bishop et al., 2004; Brown & Ryan, 2003). Mindfulness reflects awareness of stimuli in the here and now, which can include mental states (e.g., thoughts and emotions), physical sensations in the body, and the environment. However, mindfulness is distinct from attentional focus in that it includes the specific qualities of openness and non-judgment. Thus, attention that is directed toward a stimulus (e.g., feelings in the body) with judgment or criticism would not represent mindfulness. A rapidly growing body of research has clearly established trait mindfulness as a predictor of general well-being

CONTACT Anne E. Cox anne.cox@wsu.edu Department of Educational Leadership, Sport Studies and Educational/Counseling Psychology, Washington State University, PEB 106, Pullman, WA 99164-1410.

through its positive associations with positive affect, autonomy, life satisfaction, self-esteem, and physical well-being and negative associations with anxiety, depression, self-consciousness, and negative affect (Brown & Ryan, 2003; Brown, Ryan, & Creswell, 2007; Keng, Smoski, & Robins, 2011).

In addition to the associations between trait mindfulness and many indicators of well-being, Brown and Ryan (2003, 2007) demonstrated the motivational relevance of being mindful in the moment. Brown and Ryan (2003) prompted participants three times daily to record the degree of autonomy (measured with an index of state autonomous motivation) in their current behavior as well as their state mindfulness. A positive association between state autonomous motivation and state mindfulness was observed, as was a positive relationship between trait mindfulness and average state autonomous motivation across situations. Furthermore, the effects of trait and state mindfulness on autonomous motivation were independent, with the latter having a stronger effect on autonomous motivation. Though Brown and Ryan did not analyze intrinsic motivation specifically, these findings suggest that more internalized motivation is associated with being more mindful.

Although initial evidence supports positive associations between state mindfulness and autonomous motivation (Brown & Ryan, 2003), the relationship between state mindfulness and motivation has yet to be examined in a physical activity context. State mindfulness of both mental and physical events may be a key mechanism that supports positive psychological experiences during physical activity, such as intrinsic motivation, and may contribute to longer-term behavior change through the development of intrinsic reasons for physical activity. In order to test these possibilities, a measure of state mindfulness is needed to capture this construct in a physical activity setting.

Few measures of state mindfulness have been developed and most do not assess mindfulness of one's physical experience (e.g., Brown & Ryan, 2003; Lau et al., 2006). In a physical activity context, it may be particularly relevant to be able to assess mindful attention and awareness to one's physical experience since intrinsic motivation can be derived from the physical sensations of the movement itself. The State Mindfulness Scale (SMS; Tanay & Bernstein, 2013) was developed to address some of the shortcomings of the existing state measures including assessing mindfulness of physical sensations. Using both traditional and contemporary views, Tanay and Bernstein (2013) conceptualized mindfulness as both the self-regulation of attention to the present and an attitude of openness, acceptance, and curiosity. Therefore, the SMS was developed to include both the objects of mindfulness (i.e., physical and mental events) and the qualities of mindfulness (e.g., attention, awareness, openness). Both levels of mindfulness were intended to be fully integrated within each of the mindfulness items on their scale.

Tanay and Bernstein (2013) provided support for a higher-order two-factor structure reflecting the two factors of mindfulness of mental (i.e., emotions, thoughts) and physical or bodily experience (see Table 1 for items) as well as an overall, higher-order factor reflecting global state mindfulness. Tanay and Bernstein recommended using the mind and body subscales or the total scale score in future work. However, there is a lack of internal structure validity evidence to support such use. The higher-order model poses methodological problems in this instance in terms of being statistically unidentifiable without several constraints placed on the model and hence becomes an untestable model compared to the two-factor first-order model. This second-order (higher-order) model with only two first-order factors is statistically identical to a two-factor model. However, a bi-factor model could be tested which would allow for a general factor as well as domain specific factors. This bi-factor model has not been tested with the SMS. If such a model fits, it allows for examining how domain specific factors relate to external variables while accounting for general mindfulness (e.g., Brown, 2015). Additionally, our content mapping of the items of the SMS to the constructs suggested that the physical experiences captured in the items did not provide full content coverage of one's experience during physical activity. None of the items, for example, assess attention to physical exertion, muscular engagement, or the movement of one's body, which all comprise the definition of physical activity (Caspersen, Powell, & Christenson, 1985). Therefore, in order to measure state mindfulness during physical activity a measure that adequately covers these components of physical activity is needed.

The purposes of this study were to (a) identify a concise set of items capturing elements of state mindfulness that are contextually relevant to a broad range of physical activity settings, and convenient to administer immediately following physical activity, and (b) provide validity evidence for the scale's scores using adult samples. We hypothesized that the items would support both a general mindfulness factor and two domain specific factors reflecting state mindfulness of mental and physical events

Table 1. Two-factor EFA pattern coefficients and communalities with Sample 1 (N = 184).

	Item	Factor loadings Body	Mind	Communalities
M1	**I was aware of different emotions that arose in me.**	−.115	**.830**	.627
M2	I tried to pay attention to pleasant and unpleasant sensations.	.033	.700	.632
M3	I found some of my experiences interesting.	.213	.469	.568
M4	I noticed many small details of my experience.	.223	.455	.583
M5	I felt aware of what was happening inside of me.	.213	.558	.559
M6	**I noticed pleasant and unpleasant emotions.**	−.174	**.877**	.701
M7	I actively explored my experience in the moment.	.187	.484	.502
M8	I felt that I was experiencing the present moment fully.	.606	.153	.599
M9	**I noticed pleasant and unpleasant thoughts.**	−.139	**.877**	.783
M10	**I noticed emotions come and go.**	−.160	**.870**	.733
M11	I had moments when I felt alert and aware.	.540	.253	.680
M12	I felt closely connected to the present moment.	.554	.258	.748
M13	**I noticed thoughts come and go.**	.068	**.722**	.688
M14	I was aware of what was going on in my mind.	.113	.555	.513
M15	**It was interesting to see the patterns of my thinking.**	−.116	**.790**	.678
B1	I clearly physically felt what was going on in my body.	.524	.151	.582
B2	I changed my body posture and paid attention to the physical process of moving.	.718	.002	.606
B3	I noticed various sensations caused by my surroundings (e.g., heat, coolness, the wind on my face).	.245	.508	.669
B4	I noticed physical sensations come and go.	.362	.450	.742
B5	I felt in contact with my body.	.740	.056	.734
B6	I noticed some pleasant and unpleasant physical sensations.	.214	.451	.537
B7	**I focused on the movement of my body.**	**.927**	−.186	.767
B8	I paid attention to which parts of my body were working the hardest.	.842	−.146	.747
B9	**I felt present in my body.**	**.834**	−.022	.745
B10	**I listened to what my body was telling me.**	**.850**	−.089	.724
B11	I paid attention to how hard I was breathing.	.650	.017	.602
B12	**I was aware of how my body felt.**	**.802**	.008	.789
B13	**I noticed the sensations in my body.**	**.767**	.081	.777
B14	**I was in tune with how hard my muscles were working.**	**.841**	−.098	.719

Note. B7–B14 were developed by the authors and added to the previous items on the scale which represent the original SMS (Tanay & Bernstein, 2013). Final scale items appear in bold.

during physical activity in accordance with how the scale was originally constructed. Specifically, we expected a bi-factor model to fit the data best given the scale has a main general factor and 2 domain specific factors that capture body and mind state levels. We expected factors to correlate positively with another measure of state mindfulness. Based on the initial research by Brown and Ryan (2003), we also expected both factors to positively associate with state intrinsic motivation, and intrinsic reasons for exercise (i.e., mood/enjoyment and health/fitness). Conversely, we expected factors to correlate negatively with state body surveillance (i.e., thinking about the appearance of one's body from an observer perspective; Fredrickson & Roberts, 1997) and external reasons for exercise (i.e., appearance). Finally, we predicted that individuals would report greater state mindfulness during more mindful-based movement activities (i.e., yoga) compared to other forms of physical activity not specifically grounded in mindful practice (e.g., sport, aerobic, strength training) and when they reported greater skill or proficiency in mindful-based movement (i.e., yoga). We conducted these latter analyses for validity evidence on the observed scores, and not the latent factor scores, to align with how the majority of practitioners and researchers would conduct such analyses.

Method

Sample 1

Adults (N = 199) aged 18 to 77 years (M = 34.34, SD = 16.47; N = 199; 62.3% female; 82% Caucasian) from the northwestern region of the United States completed a questionnaire containing two measures of state mindfulness (i.e., the modified SMS; Toronto Mindfulness Inventory [TMI]) and state body surveillance immediately after engaging in physical activity. A general adult sample was used to be consistent with how the original SMS was developed. The activities included sport (11%), strength training (10%), aerobic activity (31%), combination of strength and aerobic training (15%), or yoga (34%). The duration of participation ranged from 20 to 120 minutes (M = 63.30, SD = 22.07) and participants reported having participated in that particular activity anywhere from 1 week to 28 years (M = 6.32 years, SD = 4.87 years). The sample size for EFA was sufficient with a ratio of six persons to one item, given the average communalities (see MacCallum, Widaman, Zhang, & Hong, 1999).

Sample 2

Individuals at a mid-size university in the northwestern region of the United States completed a series of surveys during their participation in an 8-week yoga course as part of a larger study. The data used here included general demographics, background information, and measures reflecting psychological outcomes (administered on the first day of class), as well as state mindfulness, state body surveillance, and state intrinsic motivation (administered within the first week of class immediately following their first yoga session (*N* = 185; 81% female, 26 did not report gender). Participants were mostly Caucasian (90.3%), ranged in age from 18 to 58 (*M* = 22.25, *SD* = 5.58) with most in their third (21.7%) or fourth (39.1%) year of college. Participants reported their yoga experience level as either beginning (*n* = 101), beginning–intermediate (*n* = 50), intermediate (*n* = 27), or intermediate–advanced (*n* = 7). No participants classified themselves as advanced.

Measures

Modified SMS (Samples 1 and 2)

The original 21 items from the SMS (Tanay & Bernstein, 2013) were included to measure both mental (15 items) and physical (6 items) objects of state mindfulness. Tanay and Bernstein demonstrated strong internal consistency reliabilities (α = .90–.95) of both the mental and physical factors as well as the total scale. They also provided evidence of construct validity through positive correlations between the SMS subscales and a state mindfulness measure (i.e., TMI; Lau et al., 2006), but not a trait mindfulness measure (Mindful Attention Awareness Scale; Brown & Ryan, 2003) and incremental sensitivity to change through demonstrated increases in SMS scores following a mindfulness meditation practice.

In addition to the original scale, new items were generated by a panel of two faculty members, four graduate students, and three undergraduate students in an attempt to better capture the relevant physical experiences that participants could be attending to. The panel was familiar with the concept of mindfulness, the field of kinesiology, and sport and exercise psychology specifically. The composition of the panel allowed for different levels of expertise and viewpoints to be reflected in the development and revision process (e.g., American Educational Research Association [AERA], American Psychological Association [APA], & National Council on Measurement in Education [NCME], 2014). This process, detailed below, was used to provide evidence of content validity.

In phase one, the panel was instructed to generate items using the following definition of mindfulness as a guiding framework: open, receptive attention and awareness to the present moment (Brown & Ryan, 2003; Brown et al., 2007). Consistent with Tanay and Bernstein's (2013) conceptualization of mindfulness, the panel was instructed to generate new items that included both the object (i.e., physical experience) and qualities (e.g., openness, acceptance, nonjudgment) of mindfulness. Specifically, items were generated that were consistent with the definition of physical activity ("any bodily movement produced by skeletal muscles that results in energy expenditure," Caspersen et al., 1985, p. 126; e.g., "I was in tune with how hard my muscles were working") as well as items that tapped into the experience of physical activity (e.g., "I was aware of how my body felt"). Item generation was also guided by the intentional inclusion of elements of openness and acceptance in each item by using terms from the original SMS items (e.g., "noticed," "aware," "felt") as well as some new, similar words (e.g., "in tune," "listened to").

In phase two, each item was reviewed both for its relevance to the experience of physical activity and its inherent degree of openness to or acceptance of the experience. Each item was discussed until group consensus was reached and the item was either retained or eliminated. This process resulted in adding eight new items related to mindfulness of one's physical experience to the SMS item pool (see Table 1). Participants responded to these items on a scale from 0 (*not at all*) to 4 (*very much*). These anchors were modified to be consistent with the TMI (see below).

TMI (Sample 1)

The TMI (Lau et al., 2006) includes 13 items reflecting two dimensions of state mindfulness: decentering (i.e., separating oneself from one's thoughts and feelings) and curiosity (i.e., an active interest in one's experiences). While this measure does not include items pertaining specifically to the self-regulation of attention on current experience, the authors argue that this aspect of mindfulness is an inherent aspect of both curiosity and decentering. Thus, this measure provided them with additional aspects of mindfulness that would be expected to correlate positively with the subscales of the modified SMS. Participants respond to each item on a scale from 0 (*not at all*) to 4 (*very much*) and items within each dimension were averaged to calculate two scores representing decentering and curiosity. Lau et al. (2006) provided evidence supporting a two-factor structure, internal consistency reliability (composite reliability index = .93 and .91) and construct validity through expected correlations with theoretically relevant constructs.

State body surveillance (Samples 1 and 2)

Seven items from the body surveillance subscale of the Objectified Body Consciousness Scale (McKinley & Hyde, 1996) were modified to measure the degree to which participants were concerned with how they looked during the physical activity they had just completed (e.g., "I rarely thought about how I looked"). One item was not used because it was not relevant to state body surveillance ("I think it is more important that my clothes are comfortable than whether they look good on me"). Participants responded to each item on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*) and items were averaged to calculate a state body surveillance score. Similar versions of this instrument, which were modified to refer to state rather than trait body surveillance have demonstrated construct validity and high internal consistency (e.g., O'Hara, Cox, & Amorose, 2014).

State intrinsic motivation (Sample 2)

The degree to which participants endorsed internal reasons for participating in their yoga class that day such as fun, interest, and feeling good was assessed with the intrinsic motivation subscale from the Situational Motivation Scale (Guay, Vallerand, & Blanchard, 2000). The anchors on this scale were modified slightly to be consistent with other measures on the same survey. Response options ranged from 1 (*strongly disagree*) to 7 (*strongly agree*). Participants responded to four items (e.g., "Because I think that this activity is interesting") that followed the stem, "Why are you currently engaged in this activity?" The items were averaged to calculate a state intrinsic motivation score. There is construct validity and internal consistency reliability evidence for scale items in an exercise context (Lavigne et al., 2009).

Reasons for exercise (Sample 2)

The Reasons for Exercise Inventory (Silberstein, Striegel-Moore, Timko, & Rodin, 1988) was used to measure the different internal and external reasons why participants are physically active in general. One item, "to be attractive to members of the opposite sex" was modified to "to be attractive to other individuals" in order to apply more broadly. Participants respond to 24 items on a scale from 1 (*not at all important*) to 7 (*extremely important*). Consistent with past research (Strelan, Mehaffey, & Tiggemann, 2003), items were grouped by subscale and averaged to represent appearance, health/fitness, and mood/enjoyment reasons for exercise. Data support the internal consistency reliability and construct validity of the items on these three subscales (Strelan et al., 2003).

Data analysis

We gathered validity evidence in several ways to inform a validity argument for the inferences and uses of scores resulting from the measure (e.g., AERA et al., 2014). Under the validation argument framework (see Kane, 2013), there are several components of evidence that can be used to support validity. We used the two independent samples to examine score validity following standard practice (e.g., AERA et al., 2014). First, we examined the internal structure of the measure via exploratory and confirmatory factor analysis (CFA). Then, we examined validity evidence through associations with other variables via correlations and examining expected group mean differences. This allowed us to address multiple forms of validity evidence to support score inferences.

An unrotated principal axis exploratory factor analysis (EFA) was conducted to determine the appropriate number of factors to retain (Nunnally & Bernstein, 1994). Next, a principal axis EFA with promax (oblique) rotation was conducted with the 29 items from the modified SMS using data from Sample 1. An oblique rotation was selected as it was assumed factors would be correlated. The use of an EFA at this stage was appropriate given the new items and a lack of certainty of how the new items would load on the intended factor (e.g., Fabrigar & Wegner, 2012). Several criteria, as recommended (Fabrigar & Wegner), were used collectively to determine the number of factors to retain, including (a) the Cattell scree plot, (b) percent of variance accounted for by each factor (> 10%), (c) parallel analysis (Horn, 1965), (d) pattern coefficients greater than .30 (accounting for > 10% of the variance) on a given factor, and (e) interpretability. Please see Fabrigar & Wegner for a review of these criteria. Generally, it has been recommended that pattern coefficients be above .30 or .40 (e.g., Comrey & Lee, 1992; Pett, Lackey, & Sullivan, 2003). See Comrey and Lee (1992) for definitions of fair to excellent loading criteria. The value of .30 has been suggested as a lower bound due to representing only 9% of shared variance with the factor. Item loadings along with conceptual consistency and item redundancy were inspected to identify a parsimonious set of items that best represented state mindfulness of physical and mental events. We employed both statistical criteria and theory during this process to follow cautions issued about relying only on statistical criteria for determining final item sets in scale construction (e.g., Gorsuch, 1983).

Next, a series of CFAs were conducted with Sample 2, an independent sample, with the identified items from the EFA. Robust weighted least squares (i.e., Weighted Least Squares Mean and Variance adjusted) estimation in M*plus* was used to account for the ordinal data (Finney & DiStefano, 2013). WLSMV does result in greater stability of estimates with smaller samples under a variety of conditions compared to standard weighted least squares (WLS) estimation used with ordinal data (e.g., Beauducel & Herzberg, 2006; Flora & Curran, 2004). Note that the degrees of freedom for the chi-square test with WLSMV estimation is estimated and not computed in standard fashion (see M*plus* user's guide). Since testing multiple models provides stronger validity evidence (Thompson & Daniel, 1996), three models were tested: a one-factor model or a unidimensional model, a two-factor model with items loading only on the respective physical or mental factor implied by the EFA, and a bi-factor model with all items loading on one global factor as well as their respective physical or mental factor, which is consistent with the conceptual definition of mindfulness, as discussed above. We note that they did not examine a second-order model with two first-order factors. This model is a more complex model due to accounting for a single model parameter (one inter-factor correlation) with two model parameters (two second-order loadings). Thus, additional model constraints are required for identification making it statistically identical to the two-factor model with identical fit.

Model fit was evaluated by multiple fit indices (Hu & Bentler, 1999) including the chi-square significance test, comparative fit index (CFI), Tucker–Lewis fit index (TLI), weighted root mean square residual (WRMR), and the standardized root mean square residual (SRMR). WRMR values less than 1.0 indicate good fit (Yu & Muthén, 2002) and is the appropriate index with WLSMV. In model comparison, the lower values indicate better fit. CFI and TLI values above .90 and SRMR values below .08 may be an indication of adequate fit. We selected these criteria values versus more stringent values (e.g., CFI > .95; SRMR < .05) because it is unclear how these indices perform with the robust estimation procedures (Finney & DiStefano, 2013).

The next set of analyses used calculated construct scores. Therefore, data from both samples were screened for patterns of missing data, normality of calculated variable score distributions, outliers, and internal consistencies of subscales. To test validity evidence with theoretically relevant constructs, correlations were calculated using the emergent state mindfulness factors. In Sample 1, correlations were calculated between the new state mindfulness subscale scores and the TMI and state body surveillance. In Sample 2, the new state mindfulness subscale scores were correlated with state body surveillance, state intrinsic motivation, and reasons for exercise. To test for differences based on known or conceptually different groups, analyses of variance (ANOVAs) were conducted to examine whether there were differences in state mindfulness scores for those who participated in mindful-based physical activity (i.e., yoga) compared to other physical activities (Sample 1) and for those who reported greater proficiency in mindful-based physical activity (Sample 2).

Results

Internal structure validity evidence

EFA with Sample 1

Since the EFA's were conducted at the item level with a correlation matrix, participants in Sample 1 with missing data on the modified SMS were excluded (n = 15). The unrotated EFA extraction with the Sample 1 data suggested a two-factor solution given above stated criteria for determining the number of factors. Therefore a rotated EFA was conducted specifying a two-factor solution. Table 1 contains pattern coefficients. In this solution, one factor included items reflecting mindfulness of physical or body-related events and the other factor included items relating to mindfulness of mental events (r = .58).

Based on the item loadings, we then eliminated six items that had moderate loadings on both factors or a higher loading on the opposite factor indicating item ambiguity (M8, M11, M12, B3, B4, B6). These items did not support simple factor structure and the remaining items maintained content representation. All remaining items loaded adequately on their respective factor (i.e., loadings .45 and higher). Next, we identified the items that best captured the meaning of these two factors while attempting to arrive at a relatively concise number of items per factor. Achieving this balance was a goal in order to have an assessment that would result in accurate content representation, have accurate and stable scores (i.e., psychometrically sound), yet require short administration time. This was important as the intended use of this scale is to assess persons immediately following a physical activity experience. Scale development typically involves arriving at a smaller subset of items that achieve this balance from a larger item pool (e.g., two–four times the number of final items; Devillis, 2012). Therefore, we examined the items with the highest loadings only on one factor to determine how many items were needed to capture the breadth of content on each of the two domain specific factors. On the factor related to mindfulness of mental events, we found that the items with the six highest loadings appeared to capture the breadth of both mental objects of mindfulness (i.e., "thoughts," "emotions") and the qualities of openness and acceptance (i.e., "interesting," "noticed," and "aware"). On the factor related to mindfulness of physical events, we found that the items with the seven highest loadings captured the breadth of one's physical experience (i.e., "movement," "felt," "sensations," "muscles") as well as diversity in the words used to capture the open quality of mindfulness (i.e., "noticed," "aware," "listened to," and "in tune"). Additionally, as a set of items these represented a general mindful factor.

Finally, we examined these items for any redundancy across items and concluded that B8 and B14 captured similar aspects of the physical experience. We observed that the wording in B8 implies paying attention to certain parts of the body over others, which may contradict the "open" quality of mindfulness. Thus, it was eliminated in favor of keeping B14. This process led to a concise, yet content-balanced, set of six items on each factor that would be convenient to administer immediately following a physical activity experience. The items on the final two subscales reflect clear and distinct aspects of mindfulness of mental (i.e., thoughts, emotions) and physical or body-related events, respectively. All items appear in Table 1 with the final items appearing in bold.

CFA with Sample 2

Using the 12 items identified in the EFA with Sample 1, an item level CFA was conducted utilizing the covariance matrix from Sample 2. There were no missing data on the items used in the CFA. CFA results supported conceptualizing the scale in terms of the hypothesized bi-factor model ($\chi^2(42) = 185.35$, $p < .05$, SRMR = .05, CFI = .96, TLI = .94, WRMR = 1.15), with moderate to high item loadings (.44–.85) on the global factor and on their respective factor (.29–.71). A two-factor model did meet fit criteria ($\chi^2(53) = 176.22$, $p < .01$, SRMR = .06, CFI = .96, TLI = .95, WRMR = 1.42), with high item loadings (> .65) on their respective factor and factors moderately correlated (.59) representing distinct yet related factors. However, the WRMR was higher with this model compared to the bi-factor model. The bi-factor model had the WRMR value closest to 1.0. The unidimensional model did not meet fit criteria data ($\chi^2(54) = 502.68$, $p < .01$, SRMR = .15, CFI = .87, TLI = .84, WRMR = 2.85).

Table 2. Confirmatory bi-factor analysis results with Sample 2 (N = 185).

	Item	General factor loadings	Standard error	Specific factor loadings	Standard error	R^2
	State mind factor					
M1	I was aware of different emotions that arose in me.	.60*	.07	.44*	.08	.55
M6	I noticed pleasant and unpleasant emotions.	.60*	.07	.56*	.07	.68
M9	I noticed pleasant and unpleasant thoughts.	.62*	.07	.67*	.07	.83
M10	I noticed emotions come and go.	.56*	.07	.67*	.06	.76
M13	I noticed thoughts come and go.	.44*	.07	.49*	.07	.43
M15	It was interesting to see the patterns of my thinking.	.54*	.07	.46*	.08	.50
	State body factor					
B7	I focused on the movement of my body.	.54*	.08	.45*	.10	.50
B9	I felt present in my body.	.75*	.06	.32*	.11	.70
B10	I listened to what my body was telling me.	.57*	.09	.71*	.09	.84
B12	I was aware of how my body felt.	.64*	.07	.51*	.09	.67
B13	I noticed the sensations in my body.	.85*	.06	.28*	.14	.80
B14	I was in tune with how hard my muscles were working.	.51*	.10	.61*	.10	.63

Note. *$p < .01$.

Table 2 contains pattern coefficients for the bi-factor model. This model is supported by the CFA and consistent with how the measure was originally conceptualized as both a general factor and two specific factors. In addition, we relied on the WRMR to compare models as the literature indicates that it is not clear how standard guidelines function for CFI and SRMR with WLSMV (Beauducel & Herzberg, 2006). No other modifications or models were empirically indicated or theoretically justified and no areas of localized strain in the residuals could be identified (Brown, 2015).

Data screening for calculated construct score level analyses

In Sample 1 (N = 199), 3.95% of calculated scores used in the main analyses were missing values and a missing

Table 3. Descriptive statistics and correlations for Sample 1 (N = 199) and Sample 2 (N = 185).

	Mindfulness	Mind	Body	α	Range	Mean	*SD*
Sample 1							
Mindfulness				.90	0–4	2.59	.77
Mindfulness (mind)	.87**			.90	0–4	2.06	.99
Mindfulness (body)	.81**	.40**		.93	0–4	3.13	.84
TMI—Decentering	.57**	.51**	.44**	.80	0–4	2.10	.78
TMI—Curiosity	.65**	.75**	.30**	.88	0–4	1.70	.96
State body surveillance	−.16*	−.05	−.24**	.85	1–7	2.84	1.14
Sample 2							
Mindfulness				.89	0–4	2.66	.67
Mindfulness (mind)	.91**			.87	0–4	2.23	.89
Mindfulness (body)	.82**	.50**		.87	0–4	3.09	.66
State body surveillance	−.22*	−.10	−.31**	.85	1–7	3.21	1.21
State intrinsic motivation	.40**	.32**	.40**	.94	1–7	6.10	1.05
Appearance reasons	.11	.10	.10	.87	1–7	4.22	1.26
Health reasons	.33**	.24**	.34**	.86	1–7	5.52	.95
Mood reasons	.31**	.30**	.24**	.78	1–7	4.35	1.08

Notes. Mindfulness = average of all 12 state mindfulness items; Mindfulness (mind) = state mindfulness of mental events; Mindfulness (body) = state mindfulness of physical events.
*p < .05; **p < .01.

data analysis showed these scores to be missing completely at random (MCAR; Little's MCAR χ^2 = 23.58, df = 38, p = .97). Of the participants in Sample 2 (N = 185), .48% of calculated scores were missing at random (Little's MCAR χ^2 = 27.98, df = 32, p = .67). Since data were MCAR for both samples and only a small percentage was missing (i.e., less than 5%) expectation-maximization (EM) was used to handle missing data at the calculated score level for subsequent analyses (i.e., correlations and ANOVAs). This approach provides unbiased parameter estimates and improves statistical power under these conditions (Enders, 2001; Scheffer, 2002).

Internal consistency reliability estimates for all study variable scores including the new state mindfulness variables met the suggested criterion for the purpose of the scores' use (i.e., α > .80; Nunnally & Bernstein, 1994; see Table 3). Skewness (range = −1.30–.52) and kurtosis values (range = −.69–1.66) fell within acceptable ranges (≤ ± 2) with the exception of intrinsic motivation in Sample 2, which had a skewness value of −2.40 and kurtosis value of 8.63. An exponential transformation to this variable prior to calculating correlations resolved the issue (i.e., skewness = .16, kurtosis = −1.51) and allowed for correlation estimates that were not constrained by the negative kurtosis.

Validity evidence via associations with other variables

Bivariate correlations showed that the calculated average scores for general mindfulness and both mindfulness of the mind and of the body related positively to both subscales of the TMI, state intrinsic motivation, health/fitness reasons, and mood/enjoyment reasons for exercise (see Table 3). General mindfulness and the body factor related negatively to state body surveillance. These correlations all support hypothesized relationships, with the exception of the lack of correlation between the mindfulness of the mind factor and body surveillance, and appearance reasons for exercise and any of the mindfulness variables. In addition, the two state mindfulness factors were moderately correlated with each other and strongly correlated with the general factor.

Validity evidence via expected mean differences

To provide additional validity evidence, we tested for expected mean differences in the calculated average scores for mindfulness of the mind, body, and general mindfulness between those who participated in yoga (n = 67) compared to those who participated in other forms of physical activity, such as sport, aerobic activities, and strength training (n = 132) in Sample 1. We used a Bonferroni adjusted alpha criterion for conducting three analyses (α = .017). ANOVA results were significant for mindfulness of the mind (F(1, 197) = 9.14, p < .01, η_p^2 = .04), mindfulness of the body (F(1, 197) = 23.86, p < .01, η_p^2 = .11), and the general mindfulness factor (F(1, 197) = 21.84, p < .01, η_p^2 = .10). Yoga participants had higher means on all three scores compared to those who participated in another form of physical activity (see Table 4).

Next, we tested for differences in the calculated average scores for mindfulness of the mind, the body, and general mindfulness by level of yoga proficiency in Sample 2. The three groups compared were *beginners* (n = 101), *beginner–intermediates* (n = 50), and *intermediate/intermediate–advanced* (n = 34). We used a Bonferroni adjusted alpha criterion for conducting

Table 4. Means and standard deviations for subgroups of Samples 1 and 2.

	Mindfulness of mind, *M/SD*	Mindfulness of body, *M/SD*	General mindfulness, *M/SD*
Sample 1 (N = 199)			
Yoga participants (n = 67)	^{a}2.35/.95	^{a}3.51/.57	^{a}2.93/.62
Other (e.g., sport, aerobic, strength training; n = 132)	^{b}1.91/.99	^{b}2.93/.89	^{b}2.42/.78
Sample 2 (N = 185)			
Beginner (n = 101)	^{a}2.01/.87	^{a}2.92/.62	^{a}2.46/.63
Beginner–intermediate (n = 50)	^{b}2.53/.87	^{b}3.25/.63	^{b}2.89/.64
Intermediate/intermediate–advanced (n = 34)	^{b}2.45/.83	^{b}3.37/.68	^{b}2.91/.67

Note. Different superscripts indicate significant group differences (p < .01).

three analyses (α = .017). The first ANOVA testing mindfulness of the mind was significant ($F(2, 182) = 7.42$, $p < .01$, $\eta_p^2 = .08$). Tukey post hoc tests indicated that those who classified themselves as a beginner reported lower mindfulness of the mind compared to both beginner–intermediates and intermediate/intermediate–advanced. The second ANOVA testing mindfulness of the body was significant ($F(2, 182) = 8.82$, $p < .001$, $\eta_p^2 = .09$). Tukey post hoc tests indicated that those who classified themselves as a beginner reported lower mindfulness of the body compared to both beginner–intermediates and intermediate/intermediate–advanced. The third ANOVA, with Tukey post hoc tests, supported the same group differences on the general mindfulness factor ($F(2, 182) = 10.56$, $p < .01$, $\eta_p^2 = .10$). All subgroup means and standard deviations are in Table 4.

Discussion

Through the use of multiple samples, and both exploratory and confirmatory analyses, we identified a measure of state mindfulness during physical activity that minimizes the time needed to complete the items and provided evidence to support inferences and actions to be drawn from the scale's scores. The final measure includes two factors reflecting mindfulness of mind and body, consistent with Tanay and Bernstein (2013), though the final items differ. We refer to the final measure as the SMS for Physical Activity (SMS-PA). The items on the SMS-PA appear consistent with the conceptual underpinnings of mindfulness (Bishop et al., 2004; Brown & Ryan, 2003; Brown et al., 2007) and appropriate for use in physical activity settings. Significant correlations with relevant contextual constructs and significant group differences by activity mode and skill level in mindful-based physical activity provided evidence of construct validity. The resulting measure shows promise for use in future studies investigating the meaning and significance of this mental state during physical activity.

Tanay and Bernstein's (2013) intent behind the development of their state mindfulness items was to capture two key aspects of mindfulness: awareness of and attention to one's present experience as well as characteristics of openness and acceptance. Both of these inherent qualities of mindfulness appear to be captured in the mind and body items of the SMS-PA. Specifically, the mental items refer both to an awareness of thoughts and emotions but also to a curiosity of one's experience. Similarly, the body items represent being present in one's physical experience, an awareness of what the body feels like and openness to that experience.

A key difference between the original SMS (Tanay & Bernstein, 2013) and the SMS-PA are the items that were retained on the mindfulness of body factor. The final six body-related items did not include any of the body items from the original SMS. Comparing the original body items to the body items on the SMS-PA reveals some key differences. The original body items appear more general such as being in contact with one's body and even include physical sensations caused by one's environment. One item, "I noticed physical sensations come and go" does not seem to fit as well in a physical activity setting due to the constant physical feedback one receives during exercise. The new items, on the other hand, tap into being present in one's body, attending to the way the body feels and include awareness of the movement of the body. This latter focus was intentionally included as we developed the new items in order to relate more closely to the experience of physical activity (Caspersen et al., 1985). Whereas the original SMS body items could be answered whether one had been sitting quietly, walking, or vigorously exercising, we argue that the specific focus on movement and the way the body feels in the new items are more relevant to mindfulness of the body during physical activity.

Based on a reviewer's suggestion, we conducted a set of post-hoc analyses using the items of the original SMS and the revised SMS-PA. Overall, they found that the magnitude and direction of correlations of the two SMS scales and criterion variables were similar and lead to the same conclusions. In addition, the scale/subscale reliabilities were comparable and slightly higher for the SMS-PA body-related subscale. This indicates that the SMS-PA operates similarly to the original SMS, but provides a shorter measure that may be administered quickly to capture state mindfulness in a physical activity context. Since the body subscale was a focus of this revised measure for use in a physical activity context, we also conducted partial correlations between the SMS-PA body subscale and criterion variables, controlling for the original SMS body subscale. There were statistically significant correlations between the new SMS-PA body subscale, over and above the original SMS body subscale, and the more conceptually relevant criterion variables of body surveillance and state intrinsic motivation for physical activity. These findings support incremental validity of the new SMS-PA body subscale.[1]

The CFA results support a bi-factor model suggesting a general mindfulness factor that accounts for much of the covariance among variables. Yet, the mind factor and the body factor are domain specific factors that account for unique variance in the indicators of their respective domains beyond the general mindfulness factor. This is evident in the parameter estimates where there are high loadings on the general factor while each domain-specific factor also has acceptable loadings (See Table 2). This indicates that after controlling for the general factor, there remains variance to be explained by the smaller, domain specific factors. If the bi-factor model did not work (e.g., fit the data), these domain-specific loadings would be zero or near zero. Furthermore, this model allows for the examination of how the domain-specific factors relate to external variables while holding the general factor constant. That is, a person's response to a given item on the scale depends on their ability or trait level of the single mindfulness factor as well as the domain specific factor. This allows for exploration of how these domain factors differ among groups or offer predictive value while accounting for general mindfulness. Such advantages of the bi-factor model over other models (e.g., second-order) are documented, including with quality of life assessments (e.g., Chen, West, & Sousa, 2006). Thus, for empirical, theoretical, and practical use reasons, the bi-factor model appears most appropriate for the data at hand. Consistent with Tanay and Bernstein (2013) recommendations, these results suggest that it is appropriate to use an overall state mindfulness score or separate scores representing each object of mindfulness separately.

The application of bi-factor analysis is relatively new in the physical domain, but shows promise as a way to test scales that may be used to measure either a general construct, or one with multiple sub-scales (Myers, Martin, Ntoumanis, Celimli, & Bartholomew, 2014). It may be especially important to test for a bi-factor structure early in scale development to allow future applications of the scale to consider whether items load directly onto a general factor (if theoretically relevant). This type of factor structure is not typically considered when conducting more traditional higher-order CFA, which limits the understanding of factor structure (Myers et al., 2014). We argue that, in fact, the bi-factor model should be investigated more often, when theoretically defensible, as it serves as a baseline model to higher-order models (Brown, 2015).

The pattern of correlations between the mindfulness of mind and body subscales and a variety of relevant constructs support the validity of scale scores and the use of this scale in physical activity settings. First, we found positive correlations between the mind and body subscales of the SMS-PA and both subscales of the TMI, offering evidence of construct validity. Not surprisingly, the mind factor correlated more strongly with both subscales of the TMI, neither of which refers specifically to one's physical experience. Next, the body factor, but not the mind factor, had a negative association with state body surveillance in both samples. Therefore, when individuals were more mindful of their physical experience, they spent less time thinking about what their body looked like from an observer perspective. However, being present with one's thoughts and emotions was unrelated to body surveillance. Presumably, the content of one's thoughts could be related to how the body may appear to others thus making these two constructs at least partially compatible. These relationships suggest that being mindful of the way the body feels and moves may be an effective strategy for reducing body surveillance, which associates with a variety of negative experiences (e.g., Fredrickson & Roberts, 1997).

The results regarding correlations with different reasons for exercise were somewhat mixed. In support of hypotheses, both mind and body mindfulness subscales positively associated with mood/enjoyment and health/fitness reasons for exercise. This was anticipated since these reasons for exercise are internal to the experience of physical activity itself and are aligned with the definition of intrinsic goals (Vansteenkiste, Soenens, & Lens, 2007). However, neither factor related to appearance-related reasons for exercise. This null relationship may be due to not taking into account the combination of reasons that individuals have for exercising. Evidence shows that more external reasons for exercise such as appearance relate differently to relevant outcomes when combined with internal reasons (Ullrich-French & Cox, 2009). Internal reasons for exercise, such as enjoyment, tend to be the strongest predictors of psychosocial variables associated with physical activity (Ryan & Deci, 2007; Teixeira et al., 2012), and may override the external reasons when both are present. In future research, it may be fruitful to examine how state mindfulness during physical activity relates to different combinations of reasons for exercise.

We also replicated the positive relationship between state mindfulness and state autonomous motivation (i.e., intrinsic motivation) reported by Brown and Ryan (2003) and extended this finding to the physical activity context. This new evidence supports the important role of awareness and attention to one's experience during physical activity as a potential way to enhance physical activity motivation. This is important new evidence given the focus that is often placed on external factors (i.e., music, television, concern with appearance/weight) as means to promote physical activity. This trend coupled with the fact that many individuals do not find physical activity inherently interesting (Ryan, Williams, Patrick, & Deci, 2009) suggests that a change in the way that physical activity is experienced could be an important step in mitigating low levels of adherence to physical activity in the population. Future research should explore the connections of mindfulness to both motivation and long-term physical activity behavior. Certainly, examination of broader samples with varying degrees of physical activity experience, types of activities, and age groups will be necessary to support these initial findings and provide additional validity evidence for the SMS-PA.

Further validity evidence supporting study hypotheses were the differences in state mindfulness between subgroups. In Sample 1, those who had just participated in yoga reported greater state mindfulness compared to those who participated in other activities (e.g., strength training, aerobic exercise). In Sample 2, yoga class participants who identified themselves as beginners, experienced lower levels of state mindfulness compared to more advanced participants. Thus, as expected, forms of physical activity that are mindfully based, such as yoga, associate with greater state mindfulness. However, due to the cross-sectional nature of the data, it is unclear if practicing yoga led to greater mindfulness or if individuals who are more mindful in general are drawn to this practice. Longitudinal research is needed to test the direction of this relationship. In addition, experimental study designs would help further test the validity of the SMS-PA through intentional manipulation of state mindfulness through mindful physical activities like yoga or tai chi.

Overall, results support the use of this new SMS-PA to be used as an overall assessment of state mindfulness or as specific assessments of mindfulness of mind and body. The factor analyses, pattern of correlations, and group mean differences provide score validity evidence supporting inferences to be drawn from the use of this measure. In addition to the development of this new instrument, results supported the positive role of state mindfulness in physical activity motivation as well as potential for state mindfulness to be cultivated through more intentional emphasis on being mindful during physical activity. Despite the need for further testing and examination, both the measure and the construct of state mindfulness show promise for elucidating new information about adaptive physical activity experiences.

Note

1 Please contact the first author for complete results using the original SMS measure.

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