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Validation of the English-Language Version of the Five Facet Mindfulness Questionnaire in India: a Rasch Analysis

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Abstract

Objectives Numerous studies have documented the positive effects of mindfulness practice on the alleviation of various kinds of psychological distress, but a dearth of evidence remains related to the validity of common mindfulness instruments in Indian populations. The present study aimed to explore the higher-order construct of mindfulness in India and evaluate the psychometric properties of the widely used 39-item Five Facet Mindfulness Questionnaire-English-language version (FFMQ) on a sample recruited from India.

Methods Adults ($n = 300$) between the age range of 20 and 35 years who have neither had experience nor exposure to any previous meditative technique participated in this study. Using Rasch analysis, various FFMQ models were tested. To support the findings of Rasch analysis and to provide continuity with some of the past research, confirmatory factor analysis (CFA) was also performed to validate our findings.

Results Adequate Rasch analysis fits were not achieved for the conventional five-factor model but further iterative analysis identified three misfitting items of the Describing facet (items 12, 16, and 22). Using a subtest approach, a modified five-factor solution without the three misfitting items provided an acceptable fit, which was subsequently confirmed by the CFA.

Conclusion This study confirmed the suitability of the higher-order structure of the FFMQ for use in India. The English-language version of the FFMQ has been shown to have good psychometric properties if three items from the Describing facet are removed.

Keywords Mindfulness · FFMQ · Rasch analysis · Higher-order factor · Psychometric properties · India

QueryDevelopment and understanding of the concept of mindfulness in psychology was initiated by the work of Jon Kabat-Zinn since the late 1970s. Since then, various operational definitions have been devised for the purpose of research (Krägeloh et al., 2019). Many definitions have revolved around the importance of attention in characterizing the mindfulness construct (Brown & Ryan, 2003). Mindfulness is considered to be an active state of consciousness wherein an individual pays attention to each moment's experience, which is continually refined by a persistent practice of meditation and its application in everyday life (Kabat-Zinn, 2005). Other important elements considered to be characteristic of mindfulness include non-judgmental observation (Baer, 2003) and present-moment awareness (Shapiro et al., 2008). Thus, mindfulness has been defined as "the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment" (Kabat-Zinn, 2003, p. 145).

In the understanding of mindfulness and measuring/assessing its components, various self-report measures have been developed in various contexts based on the state and trait mindfulness concept. State mindfulness in general refers to the present-moment condition, whether an individual is able to cultivate mindfulness in the present (Lau et al., 2006), whereas trait mindfulness refers to a stable characteristic of a person to be able to be mindful daily or enter those mindful states frequently (Baer et al., 2006). Recently, advancements in research suggest that mindfulness brings about both state (temporary) and trait (personality, long-term practice) changes (Medvedev et al., 2017a, b).

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Presently, there are eight trait-mindfulness scales, namely the Freiburg Mindfulness Inventory (FMI; Buchheld et al., 2001), the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003), the Cognitive and Affective Mindfulness Scale and then a revised version (CAMS-R; Feldman et al., 2004), the Southampton Mindfulness Questionnaire (SMQ; Chadwick et al., 2008), the Kentucky Inventory of Mindfulness Scale (KIMS; Baer et al., 2004), the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006), and the Philadelphia Mindfulness Scale (PHLMS; Cardaciotto et al., 2008). Two state mindfulness scales in widespread use are Toronto Mindfulness Scale (Lau et al., 2006) and State Mindfulness Scale (Tanay & Bernstein, 2013). Even though the scales are widely available and utilized, they posit several issues as discussed in a review paper by Bergomi et al. (2013) suggesting that no single questionnaire can be accountable as a true measure of mindfulness and applicable to all populations across the world.

Currently, the most widely used assessment tool is the Five-Facet Mindfulness Questionnaire (FFMQ) which has been developed through factorial analysis after pooling of items from five different scales: the Freiburg Mindfulness Inventory (Buchheld et al., 2001), the Mindful Attention Awareness Scale (Brown & Ryan, 2003), the Mindfulness Questionnaire (Chadwick et al., 2008), the Kentucky Inventory of Mindfulness Skills (Baer et al., 2004), and the Cognitive and Affective Mindfulness Scale (Feldman et al., 2004). The FFMQ has five factors named Observing, Describing, Acting with Awareness, Nonjudging, and Nonreactivity. Each factor has been assigned with eight items each except for Nonreactivity, which consists of seven items, thus altogether combining to a 39-item questionnaire.

In the original development and validation of the FFMQ in English with US samples using exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and a higher-order CFA, Baer et al. (2006) confirmed that the four of the facets (Acting with Awareness, Describing, Nonjudging, and Nonreactivity) can be described within the multifaceted mindfulness construct but results for the fifth facet (Observing) showed inconclusive results. When analyzed separately for a sample of meditators, the five-factor model showed acceptable fit, but misfit was reported for a dataset from respondents who were not regularly meditating. Later studies, however, reported that a five-factor hierarchical model worked well for both meditators and non-meditators, both when using CFA with item parcels (Baer et al., 2008) and without parcelling (Christopher et al., 2012).

Further research continued to show inconsistent factor solutions when the English-language version of the FFMQ was administered to different samples from various cultural backgrounds and geographical locations. Williams et al. (2014) engaged three different samples from the United Kingdom: adults who were recruited via the online settings from the community using a convenience sampling technique, including (group 1) adults practicing meditation recruited via online meditation sites, local centers, (group 2) the Exeter Mindfulness Network, and (group 3) adults diagnosed with recurrent depression based on the DSM-IV criteria recruited from primary care services. They found that CFA analysis with item parcelling showed a four-factor hierarchical model without the Observing factor to be tenable for the community adults and the clinical sample, whereas a five-factor model fitted to data from the meditators group well, consistent with the initial validation study by Baer et al. (2006). Siegling and Petrides (2016) reported in their study with participants from the United Kingdom that the Observing facet does not fit the factor solution using CFA (with item parcelling) and argued that the removal of this facet from the instrument could be justified. Similarly, Gu et al. (2016) recruited samples with a history of recurrent depression from the United Kingdom. They collected and analyzed data using CFA (with item parcelling) before and after a mindfulness-based cognitive therapy (MBCT; Segal et al., 2002, 2013) intervention and found that a four-factor hierarchical model (excluding the Observing facet) fits well with the sample pre-MBCT whereas a five-factor model showed acceptable fit for post-MBCT data. In other cases, in contrast, a five-factor model appeared suitable even for participants without formal mindfulness experience. In a study with a New Zealand sample, Medvedev et al., (2017a, b) used a subtest approach in their Rasch analysis. The five-factor model was found to provide adequate fit, although two items were required to be deleted.

Despite the historical link to mindfulness within Indian cultures, surprisingly little research has explored the concept of mindfulness in these populations. One exception is a study by Mandal et al. (2016) who developed and validated a Hindi version of the FFMQ using a sample of 300 non-meditators recruited from Varanasi, Uttar Pradesh, India. They had established an adequate fit of a four-factor model without the Observing facet and finalized a 28 item questionnaire to utilize with the Hindi-speaking population of India. The Hindi-language version of the FFMQ showed good internal consistency for the scale and the facets, ranging from 0.61 to 0.82. While the Hindi version of the FFMQ certainly has utility in India for the assessment of mindfulness, evaluation of versions in some of the other languages spoken in the country is also necessary. This includes English, which is widely utilized in India in educational, organizational, government, and administration settings (Montaut, 2010). India is a very large country with approximately 460 different languages and English is considered to be the "subsidiary official language nationwide" (Joshi, 2020, pg.2). It is either the secondary or third language for many in the Southern and North-East regions of India. In some regions, it is not uncommon to encounter some resistance toward the use of Hindi, and in such cases, the preferred language (apart from the local language) is English. In that sense, English may

be regarded to function as a *lingua franca* in India (Kachru, 1986; Mehrotra, 2003). In our psychometric evaluation of the English-language FFMQ in India, our work is also able to provide a psychometric baseline from which to commence investigations into the extent to which the construct of mindfulness as measured by the FFMQ can be generalized to Indian populations.

In the past literature, classical test theory approaches including EFA and CFA have been predominantly applied to ascertain factor structures, with comparatively fewer studies utilizing an item-response theory (IRT) approach (Medvedev et al., 2017a, b). The present study utilized Rasch analysis due to its ability to provide detailed information about item performance. Other advantages include investigation of ordering of response thresholds, differential item functioning by demographic factors, and local dependency of items. Using a so-called subtest approach, Rasch analysis is able to differentiate between response dependency due to method effects and due to dimensionality, in a similar way to bi-factor modelling in CTT (Lundgren-Nilsson et al., 2013). Rasch analysis has been documented to be an advantageous strategy in assessing, understanding, and improving the precision of psychometrics of mindfulness instruments and other health-related outcome measures (Hobart & Cano, 2009; Medvedev et al., 2017a, b; Siegert et al., 2010). Lastly, the focus of our analyses was not necessarily on identifying the best functioning model as this may result in idiosyncratic factor solutions and thus an inflation of different scoring systems available around the world. A solution may thus be preferable if it has slightly inferior psychometric properties but nevertheless meets criteria for an adequate solution. The present exploration of the English-language FFMQ in India thus tested the conventional five-factor solution. This study thus explored the suitability of the FFMQ to assess mindfulness in India.

Method

Participants

The total sample for the present study comprised 300 participants recruited from the general population in New Delhi, India. The inclusion criteria for the sample recruitment required participants to be in the age range of 20 to 35 years. This was to ensure a homogeneous sample could be obtained in terms of sufficient proficiency in English. Exclusion criteria included presence of any significant psychiatric illness, neurological trauma or brain disease, intellectual disability, and current or past history of substance abuse. Participants were also required to be unfamiliar with the practice of meditation. This was to ensure that the sample is again homogeneous and that the scale could be evaluated for its ability to assess trait mindfulness as one would typically do in cross-sectional studies or as part of assessment prior to a mindfulness-based intervention.

Based on these criteria, the total sample constituted 163 females (54.3%) and 137 males (45.7%) with mean age of 27.14 years ($SD = 4.04$). The majority of the participants were salaried employees (62.3%) with an annual average income of at least 300,000 Rupees (41.0%).

Procedure

The participants for this cross-sectional study were initially recruited via the researchers' networks. They were briefed about the purpose of the study as well as the inclusion and exclusion criteria to assist in recruiting further participants utilizing a purposive snowball sampling technique, keeping in mind the inclusion and exclusion criteria for the purpose of the study. Each participant received a phone call from the researcher to confirm their participation in the present study, and, along with rapport building, the relevance and information pertaining to the study was explained to them. This was also outlined in an information sheet with accompanying consent form addressing India's data protection act, confidentiality, and right to discontinue participation at any given time. Finally, a suitable time was decided to meet participants individually or in a group for the purpose of completion of the questionnaire to ensure that the questionnaire was completed in full. The participants were met either at their work place or home/hostel settings. They were briefed again about the procedure outlined above, and then they were asked to complete the demographic details and were also given a general instruction sheet to begin marking the responses on the FFMQ. The total time taken to administer the test was approximately 20 minutes. No incentives were provided to the participants for their participation in this study. Upon completion, all the participants were thanked for their participations and de-briefed.

Measures

FFMQ (Baer et al., 2006) presents 39 self-report items that are rated on a five-point Likert-type scale ranging from "1 = never or very rarely true" to "5 = very often or always true." The questionnaire assesses the five facets of mindfulness. The Observing facet captures the tendency to notice or attend to internal and external experiences, such as sensations, emotions, and cognitions. Examples of items in this facet are "When I take a shower or bath, I stay alert to the sensations of water on my body" and "I notice how foods and drinks affect my thoughts, bodily sensations, and emotions." The Describing facet reflects the tendency to explain or label one's experience in words, such as "I am good at finding words to describe my feelings" and "It's hard for me to find the words to describe what I'm thinking." Acting with Awareness facet brings full awareness and undivided attention to current activity or experiences. Example statements are "When I do things, my mind wanders

off and I'm easily distracted" and "I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted." The Nonjudging facet assesses the extent to which one maintains a non-evaluative stance toward inner experiences. Examples of statements for this facet are "I criticize myself for having irrational or inappropriate emotions" and "I make judgments about whether my thoughts are good or bad." The fifth facet of this questionnaire, Nonreactivity, reflects the tendency to allow thoughts and feelings to come and go, without getting caught up in them, such as "In difficult situations, I can pause without immediately reacting" and "I watch my feelings without getting lost in them." All items of Acting with Awareness, Nonjudging, and Nonreacting and three items of Describing (total 19 items) were negatively phrased and needed to be reverse coded prior to analysis so that higher scores reflect a higher level of mindfulness. The FFMQ has been reported to have adequate reliability, convergent and discriminant validity, and incremental validity in the prediction of psychological symptoms (Baer et al., 2006). The subscales have strong internal consistency ranging from Cronbach's alpha = 0.75 to 0.92 with samples of meditators and non-meditators (Baer et al., 2008).

Data Analysis

All descriptive statistical analyses were performed using SPSS Version 25.0., and RUMM2030 (Andrich et al., 2009) was used for Rasch analysis (Fig. 1, overview of the analysis strategy). A likelihood-ratio test ascertained the suitability of the unrestricted Partial Credit model for our dataset with all 39 FFMQ items. Individual item analysis was conducted initially as a baseline model, followed by investigation of the higher-order structure of the FFMQ using a subtest analysis (Lundgren-Nilsson et al., 2013). This approach has been found to be an effective strategy in a previous evaluation of the FFMQ using Rasch analysis (Medvedev et al., 2017a, b). Combining facet items into subtests can address local dependency that arises between items due to their shared item content. This approach involves creating summary scores of locally dependent items and testing a further iteration of the model (Lundgren-Nilsson et al., 2013). If this subtest solution provides a satisfactory unidimensional fit to the Rasch model, it can be concluded that the subtests constitute elements within a higher-order structure of mindfulness. Careful consideration at each step of the iterative analysis followed the guidelines comprehensively outlined by Siegert et al. (2010) and Balalla et al. (2019). The present study examined goodness of fit for each model on the basis of the following criteria: item-trait interaction examined by chi square value was not significant, item thresholds were not disordered, individual item fit residuals were between the acceptable range of −2.50 and +2.50, item location mean approximated 0.00, and person and item fit residuals approached 0.00 with $SD = 1.00$. Differential item functioning (DIF) was also examined for the four socio-demographic categories available for the dataset (age, gender, occupation, and annual income). This investigated to what extent items contribute to the latent trait (in this case

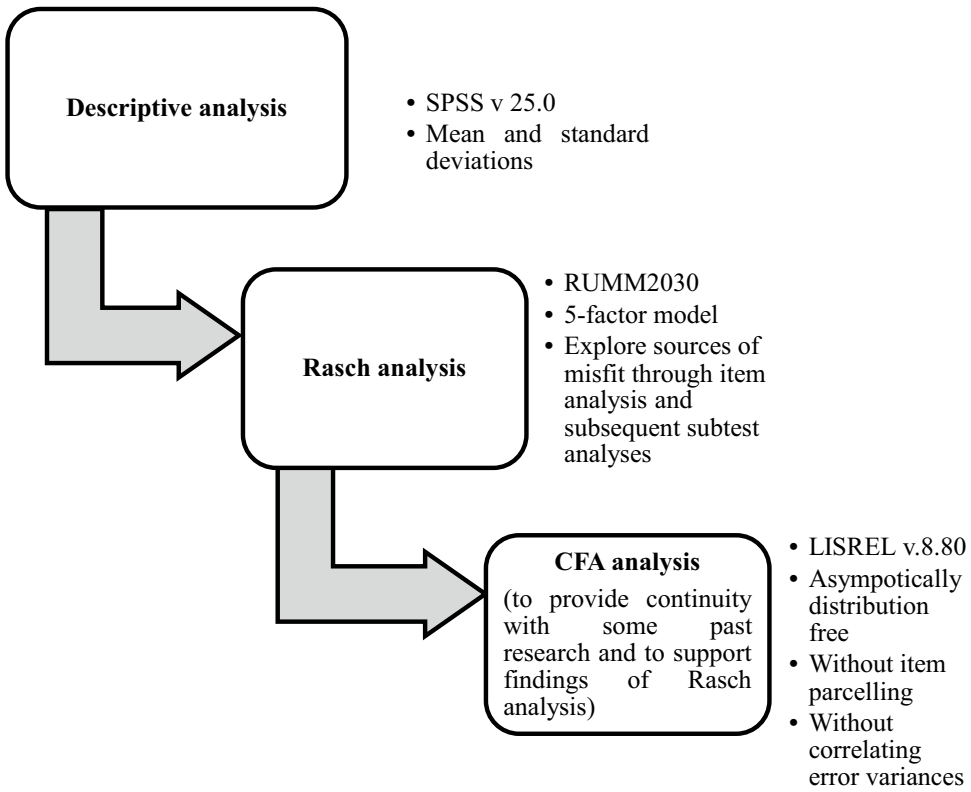


Fig. 1 Overview of the analysis strategy employed in the present study

mindfulness) in the same way for different demographic groups. Unidimensionality was investigated using Smith's (2000) test. When applied to individual subscales, we thus tested to what extent subscales present one single construct. When applied to subtests of item clusters by subscale, a unidimensional solution would indicate that a single higher-order factor of mindfulness can be postulated. Lastly, within Rasch analysis, reliability is expressed as person separation index (PSI), which is interpreted in the same way as Cronbach's alpha (Tennant & Conaghan, 2007).

To further corroborate our findings, we investigated the factor structure yielded from the Rasch analysis using CFA with the software package LISREL Version 8.80 (Jöreskog & Sörbom, 1993). Even though items exhibited acceptable skewness and kurtosis, CFA was performed using the asymptotically distribution free method of diagonally weighted least squares, which is the most appropriate for ordinal-level data (Flora & Curran, 2004). We did not use item parcelling and employed a conservative approach of not correlating the error co-variances of items. The following fit-index cut-off values were considered to evaluate model fit: root mean square error of approximation (RMSEA) < 0.06, comparative fit index (CFI) > 0.95, and standardized root mean square residual (SRMR) < 0.08 (Marsh et al., 1988; McDonald & Ho, 2002). CFA was performed to provide continuity with other past research such as the Hindi version (Mandal et al., 2016), Dutch version (Bruin et al., 2012), Italian version (Giovannini et al., 2014), and the English-language version (Aguado et al. 2015; Gu et al., 2016; Gordon, 2018). Another reason for performing CFA was to lend support to the findings yielded from Rasch analysis to investigate the higher-order structure using another analytic approach.

Results

Baseline Model Fit

The baseline analysis included all 39 items without any higher-order factor structure suggested by any subtests (Table 1, 5F), which did not show an acceptable fit (χ^2 (195) = 479.50, $p < 0.01$). Three items of the Describing facet showed elevated significant (Bonferroni adjusted) fit residuals (Table 2): item 12 (7.40), item 16 (6.14), and item 22 (7.14). Smith's (2002) test indicated evidence for multidimensionality. No DIF was found for any socio-demographic (person) factors. Due to their high degree of misfit, these three items of the Describing facet required deletion prior to continuing further investigation of the higher-order factor structure. Thus, in the subsequent analysis of the five-factor model, items 12, 16, and 22 were not included (Table 1, 5F1). This model showed an acceptable fit (χ^2 (180) = 184.45, $p > 0.05$) but failed the test of unidimensionality (Table 1).

Five-Factor Model Fit

Using the subtest analysis approach as outlined by Medvedev et al., (2017a, b), five subtests were created named Observing, Acting with Awareness, Nonjudging, Describing, and Nonreactivity. Each subtest had 8 items each as categorized in the original instrument but guided by our first analysis, the three misfit items were not included in the Describing subtest. No significant DIF was found for any person factors (Fig. 2, person-item distribution plot). The analysis showed an acceptable fit (χ^2 (25) = 28.49, $p = 0.28$). For this five-factor higher-order structure, unidimensionality was confirmed (Table 1, 5F2). Although, compared to models 5F and 5F1, PSI dropped when using subtests in model 5F2, the value still indicated good reliability. However, with $PSI = 0.81$, the value was slightly below the 0.85 criterion used to indicate the scale is suitable for assessment of within-participant changes, and instead may preferably be used for between-group comparisons (Tennant & Conaghan, 2007).

Confirmatory Factor Analysis: Five-Factor Model Fit

Keeping in view the aim of the present study to investigate the higher-order model of mindfulness for its suitability in India, to further support our findings derived from the Rasch analysis and to provide continuity with past research utilizing classical test theory approaches, CFA was performed.

Table 1 Summary of fit statistics for the baseline and the final Rasch analyses of the FFMQ-item fit residual (value and standard deviation), person fit residual (value and standard deviation), item-trait interaction, goodness of fit (χ^2 and p value), person separation index (PSI), and results from Smith's (2000) test of unidimensionality. The three models were baseline model; baseline (5F1) after deleting three misfitting items from the Describing facet (items 12, 16, and 22), and the final five-factor final model using subtest analysis approach (5F2)

	Item fit residual		Person fit residual		Item-trait interaction		PSI	Significant *t*-tests (Smith's test for unidimensionality)		
Analyses	Value / SD		Value / SD		χ^2 (df)	p		%	Lower bound	Unidimensional
5F	0.47	1.99	−0.54	2.60	479.70 (195)	< .01	0.86	26.33	23.87	NO
5F1	0.41	**0.83**	−0.51	2.44	184.45(180)	0.39	0.90	26.00	23.53	NO
5F2	0.34	1.50	−0.40	1.20	28.49 (25)	0.28	0.81	6.67	4.20	YES

Table 2 Item number, wording of the items, item location, standard error (SE), item fit residual, and chi square for the FFMQ 39-item baseline model (5F)

FFMQ item number	Item wording	Item location	SE	Item fit residual	Chi square[a]
1	When I am walking, I deliberately notice the sensations of my body moving	0.55	0.06	0.86	6.59
2	I'm good at finding words to describe my feelings	−0.27	0.06	−0.02	2.48
3	I criticize myself for having irrational or inappropriate emotions. [R]	0.05	0.05	0.81	3.13
4	I perceive my feelings and emotions without having to react to them	0.09	0.06	1.06	5.13
5	When I do things, my mind wanders off and I'm easily distracted. [R]	−0.15	0.05	0.83	4.89
6	When I take a shower or bath, I stay alert to the sensations of water on my body	0.11	0.05	0.23	1.60
7	I can easily put my beliefs, opinions, and expectations into words	−0.37	0.06	−0.37	5.39
8	I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted. [R]	0.45	0.05	−0.02	1.62
9	I watch my feelings without getting lost in them	0.11	0.06	0.76	3.13
10	I tell myself I shouldn't be feeling the way I'm feeling. [R]	−0.15	0.06	0.29	0.62
11	I notice how foods and drinks affect my thoughts, bodily sensations, and emotions	0.18	0.05	0.84	4.94
12	It's hard for me to find the words to describe what I'm thinking. [R]	−0.12	0.05	7.41	92.31*
13	I am easily distracted. [R]	0.05	0.05	0.61	1.69
14	I believe some of my thoughts are abnormal or bad and I shouldn't think that way. [R]	0.16	0.05	0.22	2.02
15	I pay attention to sensations, such as the wind in my hair or sun on my face	−0.30	0.05	−0.82	11.81
16	I have trouble thinking of the right words to express how I feel about things. [R]	−0.24	0.06	6.14	78.99*
17	I make judgments about whether my thoughts are good or bad. [R]	−0.13	0.06	−0.76	7.35
18	I find it difficult to stay focused on what's happening in the present. [R]	0.34	0.06	−0.44	1.91
19	When I have distressing thoughts or images, I "step back" and am aware of the thought or image without getting taken over by it	−0.07	0.06	−0.18	6.07
20	I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing	−0.23	0.05	−1.03	12.68
21	In difficult situations, I can pause without immediately reacting	−0.07	0.06	0.60	4.63
22	When I have a sensation in my body, it's difficult for me to describe it because I can't find the right words. [R]	−0.22	0.06	7.14	83.86*
23	It seems I am "running on automatic" without much awareness of what I'm doing. [R]	0.43	0.06	0.13	5.17
24	When I have distressing thoughts or images, I feel calm soon after	0.22	0.06	0.97	7.41
25	I tell myself that I shouldn't be thinking the way I'm thinking. [R]	−0.05	0.06	−0.99	12.27
26	I notice the smells and aromas of things	−0.43	0.05	−1.01	7.93
27	Even when I'm feeling terribly upset, I can find a way to put it into words	0.00	0.06	−0.14	8.44
28	I rush through activities without being really attentive to them. [R]	0.27	0.06	−0.54	1.77
29	When I have distressing thoughts or images I am able just to notice them without reacting	−0.02	0.07	−0.26	8.26
30	I think some of my emotions are bad or inappropriate and I shouldn't feel them. [R]	0.03	0.06	−0.75	10.48
31	I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow	−0.21	0.05	−1.10	12.22
32	My natural tendency is to put my experiences into words	−0.29	0.06	−0.39	4.41
33	When I have distressing thoughts or images, I just notice them and let them go	0.03	0.06	1.10	8.56
34	I do jobs or tasks automatically without being aware of what I'm doing. [R]	0.54	0.06	−0.29	6.26
35	When I have distressing thoughts or images, I judge myself as good or bad, depending what the thought/image is about. [R]	−0.06	0.06	−0.75	3.24
36	I pay attention to how my emotions affect my thoughts and behavior	−0.40	0.06	−0.84	16.99
37	I can usually describe how I feel at the moment in considerable detail	−0.17	0.06	−0.12	9.75
38	I find myself doing things without paying attention. [R]	0.34	0.06	−0.66	3.19
39	I disapprove of myself when I have irrational ideas. [R]	0.00	0.06	−0.15	10.49

[a]Degrees of freedom overall was 5

[R]Reverse coded items

*$p < .01$, Bonferroni adjusted

The CFA model corroborated our findings for the higher-order five-factor model without the three misfitting items of the Describing facet. RMSEA (0.05), CFI (0.96), and SRMR (0.09) values confirmed the acceptable five-factor model fit as evidenced through Rasch analysis. Considering that we did not correlate any item error variances, the fact

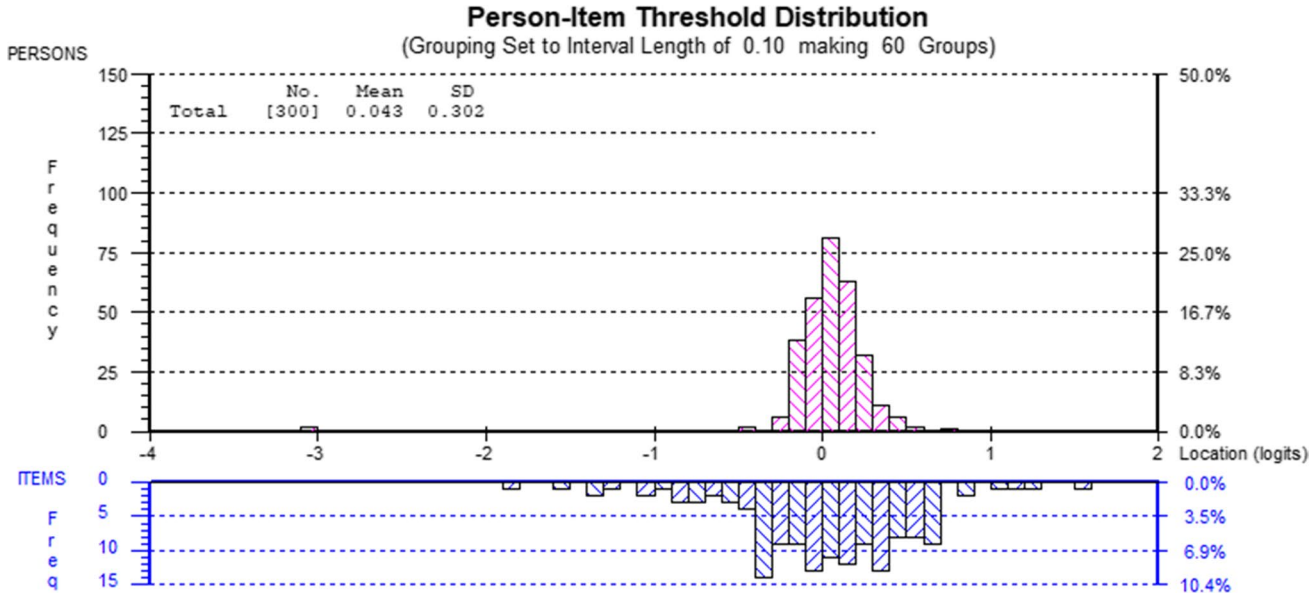


Fig. 2 Person-item thresholds distributions for the FFMQ with three items discarded and facet subtests

that SRMR was found to be marginally above the cut-off levels can be deemed as acceptable (Hermida, 2015). Some of the item factor loadings of the items were found to be at the lower end of the ideal range (between 0.40 and 0.50): items 1 and 11 of the Observing facet, item 3 of the Nonjudging facet, and items 4 and 33 of the Nonreactivity facet (Fig. 3, factor loadings).

Discussion

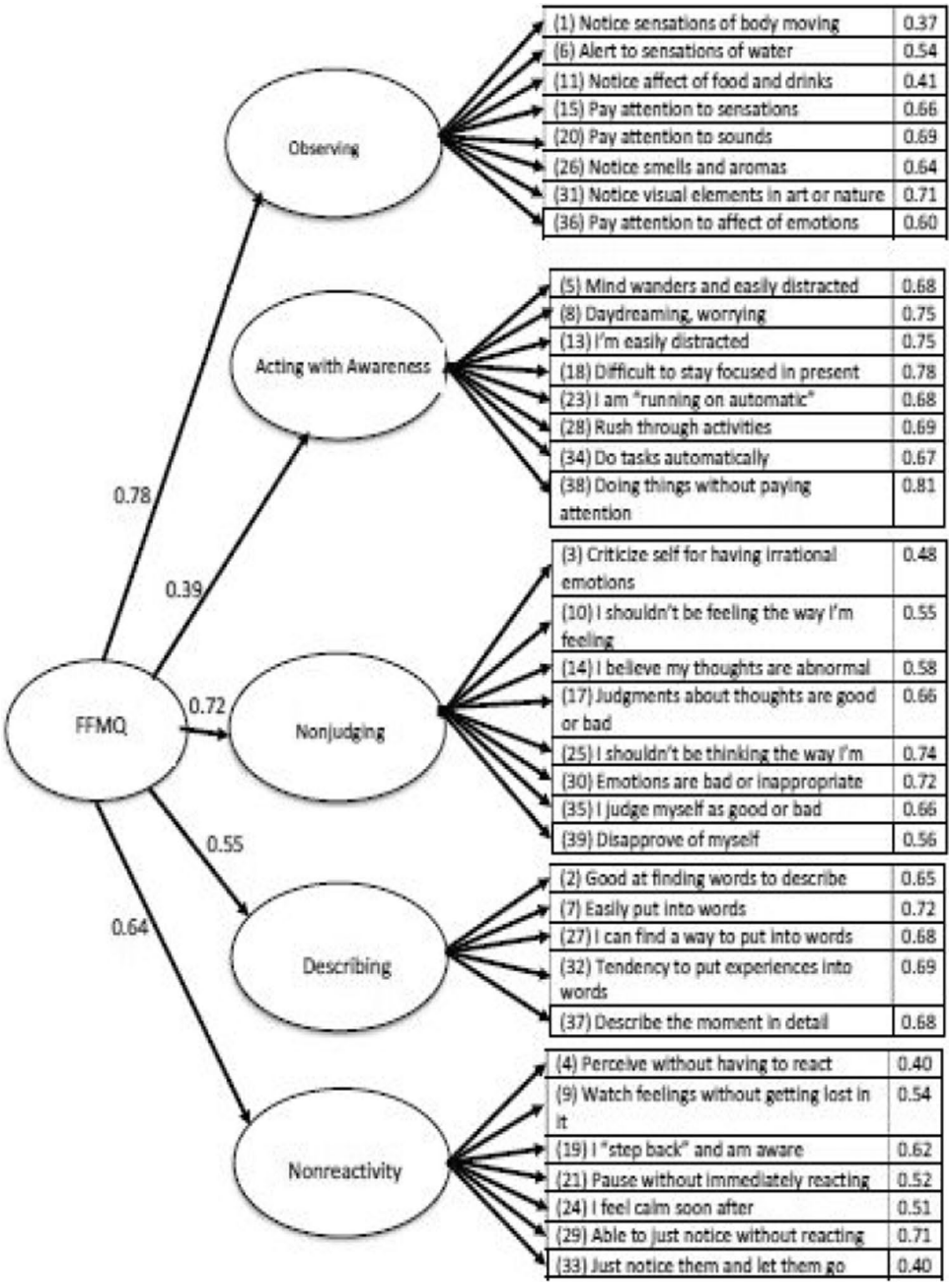
The aim of the present study was to investigate the higher-order structure of mindfulness using the FFMQ-English-language version in a sample recruited from India. It also aimed to provide an acceptable model fit for the recruited sample which would open the pathway for future research to ascertain the cross-cultural generalizability and validity of the mindfulness instrument. Overall, a five-factor solution without three misfitting items of the Describing facet totalling to 36 items was found to provide an acceptable fit for use with the present sample from India. This finding from Rasch analysis was subsequently confirmed with CFA.

When testing a baseline model, three items from the Describing facet were found to be misfitting, which was followed up by a subtest analysis (Medvedev et al., 2017a, b) to investigate a higher-order factor structure. Medvedev et al., (2017a, b) found acceptable fit of five factors but two misfitting items (items 24 and 32) were removed from the original questionnaire, whereas in the present analysis, three items (items 12, 16, and 22) from the Describing facet were removed due to elevated fit residuals. The final five-factor model using the subtest analysis approach met the criteria of unidimensionality based on Smith's (2002) test confirming that these five factors without the three misfitting items adequately assess the higher-order construct of mindfulness in a sample of non-meditators from India.

In the previous literature, issues related to the FFMQ factor structure have often been reported about the Observing facet for the English-language version (Aguado et al. 2015; Gu et al., 2016; Gordon, 2018). Inconsistent factor structures such as reported for the English-language version of the FFMQ were also noted for translations into various different languages. While CFAs of the Dutch (Bruin et al., 2012), Chinese (Deng et al., 2011), Japanese (Sugiura et al., 2012), and Italian versions (Giovannini et al., 2014) pointed toward a five-factor solution, a four-factor model appeared more suitable in other cases. For Portuguese (Ramos et al., 2018) and German versions (Tran et al., 2013), the Nonreactivity facet was discarded resulting in a 26-item Portuguese version of the FFMQ and a 20-item German version of the FFMQ questionnaire. For the Polish (Radon 2014), Hindi (Mandal et al., 2016), and French versions (Heeren et al., 2011), the Observing facet was discarded yielding a four-factor solution. When utilizing the Dutch version of the FFMQ in a sample of pregnant women, Truijens et al. (2016) concluded that a three-factor solution without Observing and Describing and reducing the number of items to 12 was required.

The present study using the English-language version of the FFMQ in Delhi did not confirm the issues reported when the Hindi version was validated in another part of India (Varanasi). Mandal et al. (2016) reported that the Observing

Fig. 3 Factor loadings



facet did not fit well within the overall factor structure of the FFMQ-Hindi, but in the present study, the five-factor model was adequate as long as three misfitting items of the Describing facet had been discarded. These three items may reflect specific features of mindfulness as expressed by the KIMS (Baer et al., 2004) items that were included in the FFMQ during its development. The KIMS was specifically designed to assess certain skills which are cultivated with the practice of mindfulness-based interventions such as dialectical-behavioral therapy (DBT; Hayes et al., 2004) involving Observing, Describing, and Nonjudging aspects of the approach. As the participants in the present study were not directly exposed to mindfulness-based interventions and practice, there could be possible variability in the comprehension and understanding of the item statements. Additionally, as argued by Rudkin et al. (2018), FFMQ Observing facet does not sufficiently address aspects of emotional awareness. The misfit for the three Describing items could also potentially be accounted for by differences in the style of communication adopted by the Indian communities and personality traits that are considered to be socially desirable. The Indian community has been categorized as generally adopting a high-context communication style (non-verbal, introvert, silent, and not believing in long talks) as described

by Hall (1976) in his initial understanding of the communication style which was further reiterated by Lewis (2005). This reflects their response toward describing their feelings and emotions to others as assessed by the describe facet of FFMQ by the statements such as "I can easily put my beliefs, opinions and expectations into words," "Even when I'm feeling terribly upset, I can find a way to put it into words," and "My natural tendency is to put my experiences into words." Nishimura et al. (2008) explained that the major drive to describe and communicate for the Indian communities is to preserve harmony and unity in relationships rather than prioritizing conveyance of accurate information. Medvedev et al. (2016) also argued that the statements of the Describing facet are ambiguous in the sense that they insufficiently differentiate between tendency and ability.

Haas and Akamatsu (2019) concluded that cultural differences are relevant in explaining the difference in the conceptual understanding of mindfulness in the East and the West. They also suggested that further studies should attempt to utilize and investigate the efficacy of Rasch analysis in the investigation of cross-cultural differences and generalizability. The present study provided some further steps toward this goal by utilizing Rasch analysis to demonstrate the suitability of the higher-order factor of mindfulness in India. The steady increase and popularity in utilizing the Rasch model has been illustrated in a systematic review (Leung et al., 2014) but only recently, the thoroughness in reporting the outcomes of Rasch studies has improved. Leung et al. (2014) suggested that the recommended way of reporting the Rasch results is to be able to present tables that permit conversion of ordinal-level data to interval-level scores, which will thus assist in increasing the precision of measurement scales. This recommendation has now recently been implemented in mindfulness research, such as for the KIMS (Medvedev et al., 2016), FFMQ (Medvedev et al., 2017a, 2017b), the Comprehensive Inventory of Mindfulness Experience (CHIME; Medvedev et al., 2019), and the Interpersonal Mindfulness in Parenting-Korean version (IM-P-K; Kim et al., 2019). In the present study, our primary rationale was to start an investigation of the generalizability of the higher-order construct of mindfulness in India. Given the diversity and size of the country, a more diverse sample from various parts of the country will need to be obtained before suitable conversion tables can be developed. The present study has demonstrated that the five-factor structure of the FFMQ appears tenable in an Indian sample, giving confidence that further studies in India will be able to confirm that. The advantage of the English-language version is that it may be applicable in a wide range of regions where, apart from local languages, English may occasionally be preferred over Hindi when completing questionnaires. However, more work will also need to be conducted to translate the FFMQ into other languages of India and to explore to what extent the five-factor structure can be replicated there.

Limitations

The following limitations need to be acknowledged: The study recruited a homogeneous sample within a limited age range, with no prior exposure and experience with meditation, and from a localized region of North India. Past literature showed the variability of model fit to be related to prior experience in meditation. Thus, further research should aim to recruit a more heterogeneous sample with a wider age range as India is a diverse country with varied cultural and geographical locations. India provides an interesting context for mindfulness, not only due to its historical links to mindfulness but also due to its cultural diversity. Using the English-language version of the FFMQ permits investigation of cross-cultural generalizability, but additional translations are necessary to explore the effect of linguistic variation.

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Author Contribution KR designed the study, collected the data, conceived the appropriate statistical approach, performed the analysis, composed, and edited the manuscript. RJS contributed to statistical analysis and writing of the manuscript. PKS collaborated with designing the study, and participated in statistical analysis and writing of the manuscript; CUK contributed to conceiving and conducting the statistical analysis, writing, and editing of the manuscript.

Declarations

Conflict of Interest The authors declare no competing interests.

References

Aguadon, J., Luciano, J. V., Cebolla, A., Serrano-Blanco, A., Soler, J., & García-Campayo, J. (2015). Bifactor analysis and construct validity of the Five Facet Mindfulness Questionnaire (FFMQ) in non-clinical Spanish samples. *Frontiers in Psychology, 6*, 1–14.

Andrich, D., Sheridan, B., & Luo, G. (2009). *RUMM 2030*. Perth: RUMM Laboratory.

Baer, R. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Clinical Psychology: Science and Practice, 10*(2), 125–142.

Baer, R. A., Smith, G. T., & Allen, K. B. (2004). Assessment of mindfulness by self-report: The Kentucky inventory of mindfulness skills. *Assessment, 11*(3), 191–206.

Baer, R., Smith, G., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*(1), 27–45.

Baer, R., Smith, G., Lykins, E. L. B., Button, D., Krietemeyer, J., Sauer, S., Walsh, E., Duggan, D., & Williams, J. M. G. (2008). Construct

validity of the Five Facet Mindfulness Questionnaire in meditating and non-meditating samples. *Assessment, 15*(3), 329–342.

Balalla, S. K., Medvedev, O. N., Siegert, R. J., & Krägeloh, C. U. (2019). Validation of the WHOQoL-BREF and shorter versions using Rasch analysis in traumatic brain injury and orthopaedic populations. *Archives of Physical Medicine and Rehabilitation, 100*(10), 1853–1862.

Bergomi, C., Tschacher, W., & Kupper, Z. (2013). The assessment of mindfulness with self-report measures: Existing scales and open issues. *Mindfulness, 4*(3), 191–202.

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*(4), 822–848.

Buchheld, N., Grossman, P., & Walach, H. (2001). Measuring mindfulness in insight meditation (vipassana) and meditation-based psychotherapy: The development of the Freiburg Mindfulness Inventory (FMI). *Journal for Meditation and Meditation Research, 1*, 11–34.

Cardaciotto, L. A., Herbert, J. D., Forman, E. M., Moitra, E., & Farrow, V. (2008). The assessment of present-moment awareness and acceptance: The Philadelphia Mindfulness Scale. *Assessment, 15*(2), 204–223.

Chadwick, P., Hember, M., Symes, J., Peters, E., Kuipers, E., & Dagnan, D. (2008). Responding mindfully to unpleasant thoughts and images: Reliability and validity of the Southampton Mindfulness Questionnaire (SMQ). *The British Journal of Clinical Psychology, 47*(4), 451–455.

Christopher, M. S., Neuser, N. J., Michael, P. G., & Baitmangalkar, A. (2012). Exploring the psychometric properties of the Five Facet Mindfulness Questionnaire. *Mindfulness, 3*(2), 124–131.

De Bruin, E. I., Topper, M., Muskens, J. G. A. M., Bögels, S. M., & Kamphuis, J. H. (2012). Psychometric properties of the Five Facets Mindfulness Questionnaire (FFMQ) in a meditating and a non-meditating sample. *Assessment, 19*(2), 187–197.

Deng, Y. Q., Liu, X. H., Rodriguez, M. A., & Xia, C. Y. (2011). The Five Facet Mindfulness Questionnaire: Psychometric properties of the Chinese version. *Mindfulness, 2*(2), 123–128.

Feldman, G. C., Hayes, A. M., Kumar, S. M., & Greeson, J. M. (2004). Development, factor structure, and initial validation of the Cognitive and Affective Mindfulness Scale. Unpublished manuscript.

Flora, D. B., & Curran, P. J. (2004). An empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. *Psychological Methods, 9*(4), 466–491.

Giovannini, C., Giromini, L., Bonalume, L., Tagini, A., Lang, M., & Amadei, G. (2014). The Italian Five Facet Mindfulness Questionnaire: A contribution to its validity and reliability. *Journal of Psychopathology and Behavioral Assessment, 36*, 415–423.

Gordon, I. K. (2018). Factor structure and external validity of the Five-Facet Mindfulness Questionnaire in pregnancy. *Mindfulness, 9*(1), 243–257.

Gu, J., Strauss, C., Crane, C., Barnhofer, T., Karl, A., Cavanagh, K., & Kuyken, W. (2016). Examining the factor structure of the 39-item and 15-item versions of the Five Facet Mindfulness Questionnaire before and after mindfulness-based cognitive therapy for people with recurrent depression. *Psychological Assessment, 28*(7), 791–802.

Haas, B. W., & Akamatsu, Y. (2019). Psychometric investigation of the five facets of mindfulness and well-being measures in the Kingdom of Bhutan and the USA. *Mindfulness, 10*(7), 1339–1351.

Hall, E. T. (1976). *Beyond culture*. Doubleday.

Hayes, S. C., Follette, V. M., & Linehan, M. M. (Eds.). (2004). *Mindfulness and acceptance: Expanding cognitive behavioral tradition*. The Guilford Press.

Heeren, A., Douilliez, C., Peschard, V., Debrauwere, L., & Philippot, P. (2011). Cross cultural validity of the Five Facets Mindfulness Questionnaire: Adaptation and validation in a French-speaking sample. *European Review of Applied Psychology, 61*(3), 147–151.

Hermida, R. (2015). The problem of allowing correlated errors in structural equation modeling: Concerns and considerations. *Computational Methods in Social Sciences, 3*(1), 5–17.

Hobart, J., & Cano, S. (2009). Improving the evaluation of therapeutic interventions in multiple sclerosis: The role of new psychometric methods. *Health Technology Assessment, 13*(12), 1–200.

Jöreskog, K. G., & Sörbom, D. (1993). LISREL 8: *Structural equation modelling with the SIMPLIS command language*. Hillsdale: Erlbaum Associates.

Joshi, S. K. (2020). *The linguistic landscape of India.* Heritage: India Perspectives, Issue 4.

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice, 10*(2), 144–156.

Kabat-Zinn, J. (2005). Bringing mindfulness to medicine: An interview with Jon Kabat-Zinn, PhD Interview by Karolyn Gazella. *Advances in Mind Body Medicine, 21*(2), 22–27.

Kachru, B. B. (1986). The Indianization of English. *English Today, 2*(2), 31–33.

Kim, E., Krägeloh, C. U., Medvedev, O. N., Duncan, L. G., & Singh, N. N. (2019). Interpersonal mindfulness in parenting scale: Testing the psychometric properties of a Korean version. *Mindfulness, 10*(3), 516–528.

Krägeloh, C. U., Henning, M. A., Medvedev, O. N., Feng, X. J., Moir, F., Billington, R., & Siegert, R. J. (2019). *Mindfulness-based intervention research: Characteristics, approaches, and developments*. Routledge.

Lau, M. A., Bishop, S. R., Segal, Z. V., Buis, T., Anderson, N. D., Carlson, L., Shapiro, S., Carmody, J., Abbey, S., & Devins, G. (2006). The Toronto Mindfulness Scale: Development and validation. *Journal of Clinical Psychology, 62*(12), 1445–1467.

Leung, Y. Y., Png, M. E., Conaghan, P., & Tennant, A. (2014). A systematic literature review on the application of Rasch analysis in musculoskeletal disease—A special interest group report of OMERACT 11. *Journal of Rheumatology, 41*(1), 159–164.

Lewis, R. D. (2005). *Finland, cultural lone wolf*. Intercultural Press.

Lundgren-Nilsson, Å., Jonsdottir, I. H., Ahlborg, G., & Tennant, A. (2013). Construct validity of the psychological general well-being index (PGWBI) in a sample of patients undergoing treatment for stress-related exhaustion: A Rasch analysis. *Health and Quality of Life Outcomes, 11*(2), 1–9.

Mandal, S. P., Arya, Y. K., & Pandey, R. (2016). Validation of the factor structure of the Five Facet Mindfulness Questionnaire. *Indian Journal of Health and Wellbeing, 7*(1), 61–66.

Marsh, H. W., Balla, J. R., & McDonald, R. P. (1988). Goodness-of-fit indexes in confirmatory factor analysis: The effect of sample size. *Psychological Bulletin, 103*(3), 391–410.

McDonald, R. P., & Ho, M.-H.R. (2002). Principles and practice in reporting structural equation analyses. *Psychological Methods, 7*(1), 64–82.

Medvedev, O. N., Siegert, R. J., Kersten, P., & Krägeloh, C. U. (2016). Rasch analysis of the Kentucky Inventory of Mindfulness Skills. *Mindfulness, 7*(2), 466–478.

Medvedev, O. N., Krägeloh, C. U., Narayanan, A., & Siegert, R. J. (2017a). Measuring mindfulness: Applying generalizability theory to distinguish between state and trait. *Mindfulness, 8*(4), 1036–1046.

Medvedev, O. N., Siegert, R. J., Kersten, P., & Krägeloh, C. U. (2017b). Improving the precision of the Five Facet Mindfulness Questionnaire using a Rasch approach. *Mindfulness, 8*(4), 995–1008.

Medvedev, O. N., Bergomi, C., Röthlin, P., & Krägeloh, C. U. (2019). Assessing the psychometric properties of the Comprehensive Inventory of Mindfulness Experiences (CHIME) using Rasch analysis. *European Journal of Psychological Assessment, 35*(5), 650–657.

Mehrotra, R. (2003). A British response to some English uses. *English Today, 19*(3), 19–25.

Montaut, A. & Inalco. (2010). English in India and the role of the elite in the national project. In S. I. Hasnain & S. Chaudhary (Eds.), *Problematizing language studies, cultural, theoretical and applied perspectives: Essays in honor of Rama Kant Agnihotri* (pp. 83-116). Delhi: Akbar Books.

Nishimura, S., Nevgi, A., & Tella, S. (2008). Communication style and cultural features in high/low context communication cultures: A case study of Finland, Japan and India. In A. Kallioniemi (Ed.), Renovating and developing subject didactics. *Proceedings of a subject-didactic symposium in Helsinki, University of Helsinki, Department of Applied Sciences of Education, 2*, 783–796.

Radon, S. (2014). Validation of the Polish adaptation of the Five Facet Mindfulness Questionnaire. *Annals of Psychology, 17*(4), 737–760.

Ramos, A., Rosado, A., Serpa, S., Cangas, A., Gallego, J., & Ramos, L. (2018). Validity evidence of the Portuguese version of the Five Facet Mindfulness Questionnaire. *Journal of Sport Psychology, 27*(2), 87–98.

Rudkin, E., Medvedev, O. N., & Siegert, R. J. (2018). The Five-Facet Mindfulness Questionnaire: Why the observing subscale does not predict psychological symptoms. *Mindfulness, 9*(1), 230–242.

Segal, Z. V., Williams, J. M., & Teasdale, J. (2002). *Mindfulness-based cognitive therapy for depression: A new approach to preventing relapse*. Guilford Press.

Segal, Z. V., Williams, J. M., & Teasdale, J. (2013). *Mindfulness-based cognitive therapy for depression* (2nd ed.). Guilford Press.

Shapiro, S. L., Oman, D., Thoresen, C. E., Plante, T. G., & Flinders, T. (2008). Cultivating mindfulness: Effects on well-being. *Journal of Clinical Psychology, 64*(7), 840–862.

Siegert, R. J., Tennant, A., & Turner-Stokes, L. (2010). Rasch analysis of the Beck depression inventory-II in a neurological rehabilitation sample. *Disability and Rehabilitation, 32*(1), 8–17.

Siegling, A. B., & Petrides, K. V. (2016). Zeroing in on mindfulness facets: Similarities, validity, and dimensionality across three independent measures. *PLoS ONE, 11*(4), 1–17.

Smith, E. V. (2002). Detecting and evaluation the impact of multidimensionality using item fit statistics and principal component analysis of residuals. *Journal of Applied Measurement, 3*(2), 205–231.

Sugiura, Y., Sato, A., Ito, Y., & Murakami, H. (2012). Development and validation of the Japanese version of the five facet mindfulness questionnaire. *Mindfulness, 3*(2), 85–94.

Tanay, G., & Bernstein, A. (2013). State Mindfulness Scale (SMS): Development and initial validation. *Psychological Assessment, 25*(4), 1286–1299.

Tennant, A., & Conaghan, P. G. (2007). The Rasch measurement model in rheumatology: What is it and why use it? When should it be applied, and what should one look for in a Rasch paper? *Arthritis & Rheumatism, 57*(8), 1358–1362.

Tran, U. S., Glück, T. M., & Nader, I. W. (2013). Investigating the Five Facet Mindfulness Questionnaire (FFMQ): Construction of a short form and evidence of a two-factor higher order structure of mindfulness. *Journal of Clinical Psychology, 69*(9), 951–965.

Truijens, S. E. M., Nyklíček, I., Son, J. V., & Pop, V. J. M. (2016). Validation of a short form Three facet Mindfulness Questionnaire (TFMQ-SF) in pregnant women. *Personality and Individual Differences, 93*, 118–124.

Williams, M. J., Dalgleish, T., Karl, A., & Kuyken, W. (2014). Examining the factor structures of the Five Facet Mindfulness Questionnaire and the Self-Compassion Scale. *Psychological Assessment, 26*(2), 407–418.