**ORIGINAL PAPER**

# Interpersonal Mindfulness Questionnaire: Scale Development and Validation

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## Abstract

**Objectives** Previously developed mindfulness measures focused on its intrapersonal dimensions and did not measure the interpersonal aspects of mindfulness. Furthermore, recently developed interpersonal mindfulness measures were either specific to a certain context (e.g., parenting, conjugal, teaching) or omitted/minimized the role of the body in the interpersonal dynamic. The proposed Interpersonal Mindfulness Questionnaire (IMQ) aims to operationalize the theoretical notion of embodied and embedded mindfulness by grounding it into four dimensions, each representing a set of skills that can be cultivated through training and practice: (1) Detachment from the Mind, (2) Body-Anchored Presence, (3) Attention to and Awareness of the Other Person, and (4) Mindful Responding.

**Methods** The IMQ subscales were developed through consultations with a panel of eight graduate students and ten experts in the field. Three studies were conducted to evaluate the construct, internal consistency, reliability, convergent validity, and utility of the IMQ.

**Results** Findings from the three studies supported the proposed four subscales of IMQ and suggested that these four subscales are independent and supported by convergent evidence. In addition, results suggested that IMQ subscales' scores are sensitive to meditation experience and are associated with better intrapersonal and interpersonal outcomes.

**Conclusions** IMQ subscales are valid and are consistent with the proposed embodied and embedded conception of interpersonal mindfulness. IMQ subscales are associated with intrapersonal mindfulness, but not strongly enough to be conceived as the same phenomenon. Limitations, as well as theoretical and practical implications of IMQ subscales, are thoroughly discussed.

**Keywords** Mindfulness · Meditation · Embodiment · Scale · Interpersonal · Questionnaire

Even though conceptualizations of mindfulness according to both Eastern or Western perspectives do not refer explicitly to the interpersonal/social dimension, the underlying attention and awareness mechanisms across these definitions incorporate both internal processes (e.g., bodily sensations) and external stimuli (e.g., social/interpersonal interactions; Khoury, et al., 2017a, 2017b). Therefore, mindfulness can be equally perceived as an intrapersonal and interpersonal process. There are an increasing number of studies attending to the interpersonal/social applications of mindfulness; for example, studies have shown that trait mindfulness and training such as Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1982, 1990) are associated with interpersonal forgiveness (Karremans et al., 2020), empathy (Rimes & Wingrove, 2011), compassion towards others (Nila et al., 2016; Pommier et al., 2020), emotional competencies in interacting with others (Lamothe et al., 2016), interpersonal well-being (Cohen & Miller, 2009), active listening skills (Newsome et al., 2006), working alliance (Campbell & Christopher, 2012; Christopher et al., 2011; Schure et al., 2008), prosocial behavior (Donald et al., 2019), and growth belief and positive outcomes in social relationships (Don, 2020).

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One of the most known and researched interpersonal applications of mindfulness is mindful parenting, which refers to the ability to bring nonjudgmental, present-centered awareness to parent–child interactions and the experiences of parenting (Duncan et al., 2009). Numerous studies found that training in mindful parenting improves the quality of parenting behaviors (Gannon et al., 2017) and reduces parental stress (see Anand et al., 2021 for a review) as well as improves parent-adolescent relationship quality, social skills and quality of life of children, and decreases children psychopathology symptoms and problem behaviors including aggressive behaviors (Bögels et al., 2014; Coatsworth et al., 2015; Dehkordian et al., 2017; Meppelink et al., 2016; Singh et al., 2006, 2007, 2010; Turpyn & Chaplin, 2016). In a recent study, mindful parenting training with mothers and their babies showed positive effects on both the mothers and babies (Potharst et al., 2017; for a review/meta-analysis, see Townshend et al., 2016).

An explanation of these observed effects is the improvement of the quality of interpersonal interactions between children and their parents through the increase of emotion regulation and interpersonal attunement of the parents. In fact, the quality of interpersonal interactions depends on effective regulation of one's emotions (Gross, 2002) which further requires skillfully responding to one's own and others' emotions (Zaki & Williams, 2013). Therefore, strategies that balance attentiveness to inner and outer affective events may be especially helpful. Recent evidence suggests that mindfulness may enhance emotion regulation in socioemotional contexts by enhancing conscious attention to one's own and others' actions and emotions (Quaglia et al., 2014; Wachs & Cordova, 2007). In a dyadic study among romantic partners, trait mindfulness facilitated relationship satisfaction through a heightened perception of the partners' responsiveness (i.e., attunement to the needs of their partners; Adair et al., 2018).

## Conceptualizing and Measuring Interpersonal Mindfulness

The first attempt to conceptualize interpersonal mindfulness was led by Duncan et al. (2009), who defined it with the following four dimensions: (1) listening with full attention to others, (2) present-centered awareness of emotions experienced by the self and others during interactions, (3) openness, acceptance, and receptivity to others' thoughts and feelings, (4) self-regulation (including low reactivity and automaticity in response to other people's everyday behaviors), and (4) compassion for the self and others. Although this theoretical model could be applicable to all types of interpersonal interactions, the authors and most interpersonal research focus on parenting. In line with

that, a 31-item Interpersonal Mindfulness in Parenting (IM-P) measure that is aligned with this theoretical model was developed and validated (Duncan et al., 2009). Recently, a more methodologically robust 28-item two-dimensional measure (i.e., parent's mindful discipline and being in the moment with the child) of mindful parenting was developed and validated (Mindfulness In Parenting Questionnaire, MIPQ; McCaffrey et al., 2017). Correlations between the MIPQ and parenting style, parenting practices, practice of mindfulness, and participant demographics provided support for convergent validity. The MIPQ exhibited a positive and weak correlation with intrapersonal measures of mindfulness meditation (e.g., Mindful Attention and Awareness Scale, MAAS, Brown & Ryan, 2003) suggesting that interpersonal and intrapersonal mindfulness are related yet separate and distinct constructs. A 20-item 2-dimensional measure that assesses both intrapersonal and interpersonal mindfulness among teachers (Mindfulness in Teaching Scale, MTS; Frank et al., 2016) and a unidimensional 5-item measure of mindfulness in the context of romantic relationships (Kimmes et al., 2018) were also developed and validated.

In line with Duncan et al.'s (2009) interpersonal mindfulness' conceptualization, Pratscher et al. (2019) developed the first noncontext specific measure, Interpersonal Mindfulness Scale (IMS), that also excludes the compassion component. IMS is comprised of 27 items divided into four dimensions: (1) Presence, (2) Awareness of Self and Others, (3) Nonjudgmental Acceptance, and (4) Nonreactivity. Preliminary studies supported its validity (Chalmers et al., 2021; Medvedev et al., 2020) and potential utility (Pratscher et al., 2018). These preliminary results are very encouraging. However, the measures do not emphasize the role of the body and tend to focus on mental and metacognitive skills despite acknowledging the body as a foundation of mindfulness (Goldstein, 2016) and the role of presence in one's body and attunement to the other person's body language (including tone of voice and other body indices) during mindful interpersonal interactions (Pratscher et al., 2018). Measures that have given more importance to the body (e.g., Body Mindfulness Questionnaire or BMQ; Burg et al., 2017; State Mindfulness Scale or SMS, Tanay & Bernstein, 2013) also focus solely on body awareness and do not measure mindfulness in an interpersonal context.

## Embodied and Embedded Mindfulness

Cumulative evidence suggests that cognitions and emotions are embodied and grounded in bodily states, specifically in the sensory systems that underlie the perception of a current situation, the motor systems that underlie action, and the introspective systems that underlie conscious experiences of emotion, motivation, and cognitive

operations (see e.g., Damasio, 1994; Lakoff & Johnson, 1999; Niedenthal, 2007; Niedenthal et al., 2005; Teasdale & Barnard, 1993). The theory of embodiment implies a complex reciprocal relationship between the bodily expression of emotion and the way in which emotional information is processed in the body and encompasses a bidirectional link between cognition, emotions, behaviors, and bodily states. Embodiment is highly applicable to social interactions including social cognition (Winkielman et al., 2015) and particularly to the role of mindfulness in interpersonal relationships (Khoury, 2018; Khoury et al., 2019, 2020, 2017a, b; Siegel, 2012). Applying embodiment theory to dyadic interpersonal mindfulness grounds interpersonal mindfulness in the bodily states of each member of the dyad.

Based on the theory of embodiment, specifically on the work of Varela and colleagues (Thompson and Varela 2001; Varela et al. 1991) and Siegel (2012), the notion of *embodied and embedded mindfulness* was introduced (Khoury, 2018; Khoury et al., 2020). This new notion is grounded in interpersonal neurobiology (Siegel, 2012) and on the influence of bodily states on self and others during interpersonal interactions. According to this definition, embodied and embedded mindfulness is a skill/ ability that includes elements of emotions, cognitions, and behaviors involving the mind and body. Embodied and embedded mindfulness is comprised of the following four dimensions: (1) Detachment from the Mind, (2) Body-Anchored Presence, (3) Attention to and Awareness of the Other Person, and (4) Mindful Responding.

## Detachment from the Mind

Detachment from the Mind is based on cultivating the skill of directing the mind from its default, automatic (i.e., habitual, nondeliberate, effortless, nonconscious) mode to a more controlled (i.e., intentional, deliberate, effortful, conscious) mode of thinking that is grounded in the body in the present moment (e.g., Breslin et al., 2002; Craske & Hazlett-Stevens, 2002; Teasdale et al., 2002; Wells, 2002). This ability allows someone to "stepping out of being caught up in mental distractions, and returning back to the body" rather than being "caught up with mental chatter" (Kostanski & Hassed, 2008, p. 17). Recent evidence suggests that this ability to detach or decenter from one's mind influences interpersonal interaction by decreasing hostile attributions (van der Schans et al., 2020). Therefore, the ability to detach from one's mind by unstrapping attentional mechanisms supports flexible attention and being fully present and totally engaged with someone else during interpersonal interactions.

## Body-Anchored Presence

Unstrapping the attention from the mind and its continuous stream of thoughts as taught in the first skill can allow a better awareness of one's own body. In fact, body awareness can be defined as the dynamic and interactive process through which the body's psychological states, processes, actions, and functions are perceived, at both interoceptive and proprioceptive levels (Mehling et al., 2009). Multiple studies have shown a link between increased body awareness and improved regulation of negative affect (Füstös et al., 2012; Price & Hooven, 2018), subjective well-being (Brani et al., 2014), empathic responses (Fukushima et al., 2011; Singer et al., 2004), mindfulness (Cebolla et al., 2016), interpersonal social problem-solving performance (Henderson & Paterno, 1986), social connectedness (Arnold et al., 2019), and interpersonal emotion regulation (Özcan & Sünbül, 2020). Training in body awareness (such as body scan during mindfulness-based programs or mind–body skills) showed also positive impacts on interpersonal skills (Alexander et al., 2015) and emphatic leadership among college students (Fonow et al., 2016). As the authors of the IMS state, "Mindful listening not only involves maintaining attention to the external environment (i.e., the speaker) but also involves remaining present in one's body and nonjudgmentally and nonreactively observing one's own internal experiences." (Pratscher et al., 2019, p. 1045). In sum, Body-Anchored Presence is based on the awareness of one's internal bodily states (i.e., physical sensations, body language, body posture, tone of voice) and how it changes while interacting with someone else.

## Attention to and Awareness of the Other Person

Unstrapping the attention from the mind (as taught in the first skill) allows directing attention to and awareness of the body (as taught in the second skill) or to external stimuli, including directing attention to and awareness of other people (third skill). In fact, Attention to and Awareness of the Other Person or interpersonal attunement refers to directing attention, noticing someone else bodily states including body language, body posture, tone of voice, facial expression, physical reactions, and changes in these states while interacting with the person. Similar to the self-awareness of one's internal states (second skill), Attention to and Awareness of the Other Person's states and changes in these states is crucial to accurately understand the other person's preferences and needs and therefore to adjust one's behaviors to meet others' preferences and needs. Results from mindful parenting training, which aims at increasing the parents' attunement to the child's needs (Duncan et al., 2009), have shown improvement in the quality of parenting behaviors (Gannon et al., 2017), decrease in child psychopathology

and problem behaviors, and increase in their social skills (Bögels et al., 2014; Coatsworth et al., 2015; Dehkordian et al., 2017; Meppelink et al., 2016; Singh et al., 2006, 2007, 2010; Turpyn & Chaplin, 2016). A recent study of 2237 parents found that trait mindfulness of the parents was negatively associated with internalizing and externalizing problems in their children and that these associations were mediated by positive parenting practices (Han et al., 2019). An explanation of these findings is that higher interpersonal attunement of the parents supports intrapersonal attunement in their children such that the children are more attuned to their own needs (Siegel, 2007). The children's higher intrapersonal attunement further translated into increased self-regulation and global well-being. Similarly, a recent study suggested that mindful parenting is positively associated with a child's well-being through a more secure perception of the relationship with the parents (Medeiros et al., 2016). In addition, interpersonal attunement is central to building therapeutic alliance during counselling (Siegel, 2010) and can lead to positive results among patients independently of the therapeutic modality (Bruce et al., 2010). Recent evidence also suggests that mindfulness training of counsellors increased their attunement to their clients in comparison with controls who did not receive any training (Schomaker & Ricard, 2015). These findings are in line with interpersonal attunement and social-emotional regulation (i.e., the regulation of emotions via interpersonal interactions) as proposed in the Social Baseline Theory (SBT; Clore & Ortony, 2000; Schwarz & Clore, 1983), which suggests that the presence of other people helps individuals to conserve important and often metabolically costly somatic and neural resources through the social regulation of emotion (Beckes & Coan, 2011, 2012; Coan & Maresh, 2014). Neuroscience evidence supports this theory, showing neural areas associated with the self-regulation of emotion are less active when appropriate social support (e.g., through attunement to one's needs) is provided (Coan et al., 2006; Eisenberger et al., 2007). In sum, Attention to and Awareness of others' bodily states is central to attuning to their needs and therefore to mindful interpersonal interactions. We further hypothesize that the skill of directing and maintaining attention to and awareness of someone else bodily states build on developing this skill towards one's own body.

Unlike the IMS, our conceptualization did not combine awareness of self and others in a single dimension. Although complementary according to Buddhist scholars (Anālayo, 2020a, 2020b), they involve different locus of attention (internal versus external), may involve distinct neural networks (Vanhaudenhuyse et al., 2011), and therefore, may require different types and levels of training and experience (e.g., someone can attend to internal or self-related sensations, thoughts, emotions, but have a harder time attending to the external, like other people's feelings and mind states).

We also propose that the two skills may build sequentially on each other rather than develop simultaneously in an equal manner, especially with naïve meditators. Recent research suggests the possibility of integrating both internal and external awareness via nondual Tibetan meditation practice (Josipovic, 2014). However, our proposed measure of interpersonal mindfulness is not devised for expert meditators only (i.e., those who are able to experience nondual internal–external awareness).

## Mindful Responding

Similar to MIPQ and IMS, Mindful Responding incorporates responding to the other with nonjudgment, no-criticism, and kindness while incorporating the other person's viewpoint in the response. A difference with IMS is that the current measure integrates both nonreactivity and nonjudgment in a single dimension as both reflect the same interpersonal behavior (i.e., mindful responding). Studies have shown that nonjudgment, nonreactivity, and acting with awareness (dimensions of the FFMQ) were related to relationship satisfaction (Adair et al., 2018; Lenger et al., 2017) and nonjudgement was related to sexual satisfaction (Khaddouma et al., 2015) among romantic partners. Mindful Responding is also a central element in Mindfulness-Based Relationship Enhancement (MBRE; Carson et al., 2004). To respond mindfully, one may need to detach from their automatic thoughts (first skill), freeing the cognitive and emotional resources needed to become aware of one's own internal states (second skill) and the other person's internal states (third skill). Therefore, Mindful Responding might be the most complex and difficult skill to cultivate, as it may require the cultivation of many if not all the previous skills.

The aim of the present paper is to validate the IMQ. Study One tests an initial version of the IMQ for structure evaluation and internal consistency. Study Two examines an enhanced version of the IMQ for reliability and construct, evaluating convergent evidence. Study Three tests the final version of the IMQ for changes following a mindfulness-based intervention.

# Study One: Development, Factor Structure, and Internal Consistency of the IMQ

## Methods

### Procedures

**IMQ Design and Development** The content validation of the items and dimensions of the IMQ was conducted in four sequential steps which are more comprehensively described

by Khoury et al. (2021a). The first step involved the development of an item pool by the first author based on the four dimensions detailed in the introduction. Both positive and negative items were generated. The second phase and third phase involved vetting and enhancing the precision of the generated pool of items first by eight English-fluent graduate students (one of whom is studying interpersonal mindfulness) and then by eleven invited experts in the field. All feedback was carefully considered by the first author to add, remove, or change items. Finally, the remaining items were edited for language clarity and simplicity by the same graduate students. No items were removed at this stage, and there were 47 items in the initial version of the IMQ. Both students and experts were not monetarily compensated for their participation. Due to the nature of the items, the name of the first subscale was changed (reversed) from "Detachment from the Mind" to "Being Caught in the Mind." We will use this terminology throughout the remainder of the paper. Items were randomly ordered using the "RAND" function in Microsoft Excel before administering the questionnaire to the participants.

The instructions for participants on the top of the questionnaire and Likert scale used to rate each item of the questionnaire from 1 (*almost never*) to 5 (*almost always*) also went through the vetting process by the graduate students and the experts in the field. In the final version, the instructions were tailored to capture everyday experiences of participants during their one-on-one interactions with others (e.g., family member, a friend, or a colleague). In addition, following the feedback from experts, the instructions included asking participants to focus more on how they generally tend to interact with others in their surroundings and less on the individuals they interact with. They were also asked to accurately answer according to their lived experience rather than what they think their experience should be. The Likert scale remained unchanged. Following the development of the IMQ's items, we tested this initial version of the questionnaire to evaluate its structure and internal consistency.

This study (One) was approved by the Research Ethics Board at McGill University. Participants gave informed consent prior to completing the study. The study was conducted entirely online using LimeSurvey and included sociodemographic data with detailed information regarding meditation practice or mindfulness training/experience along with the IMQ.

## Participants

A sample of adults were recruited via paid advertising on social media (e.g., Facebook, Linkedin, Instagram). Participants were offered $50 gift certificates based on a draw with a rate of winning of 1/20. We aimed to obtain a sample of over 300 participants suggested as sufficient, being above the 5:1 item:participants ratio (MacCallum et al., 1999; Reio & Shuck, 2015). The sample was composed of 407 participants, 90.45% female, 6.53% male, and 3.02% reported another gender or preferred not to answer. The mean age was 39.82 years ± 14.73. Detailed descriptions of this sample are available in Table 1.

## Data Analyses

Given that we expected the IMQ to be used with individuals with different levels of meditation experience (i.e., not only with expert meditators), and to ensure the absence of

**Table 1** Descriptive results for the first sample used in Interpersonal Mindfulness Questionnaire (IMQ) validation

| | Mean ± SD | Min | 1st qu | Median | 3rd qu | Max |
|---|---|---|---|---|---|---|
| Age | 39.82 ± 14.73 | 15 | 26 | 39 | 50.5 | 75 |
| Years of education | 17.00 ± 3.06 | 1 | 9 | 13 | 19 | 39 |
| Total meditation practice hours | 44.31 ± 76.07 | 0 | 0 | 10 | 60 | 420 |
| Gender identity | **Woman** | **Man** | **Nonbinary** | **Trans** | **Other** | |
| | 90.45% | 6.53% | 0.75% | 0.75% | 1.25% | |
| Ethnicity | **White** | **Indigenous** | **Chinese** | **Asian (other than Chinese)** | **Latin American** | **Black** |
| | 72.36% | 6.03% | 4.02% | 4.76% | 2.51% | 1.50% |
| Employment situation | **Full-time employment** | **Part-time employment (30 h or less per week)** | **Seasonal/temporary employment** | **Did not answer** | **Other** | |
| | 36.68% | 21.85% | 1.75% | 36.43% | 3.26% | |
| Relationship status | **In a relationship** | **Married** | **Single** | **Other** | | |
| | 25.62% | 39.19% | 31.65% | 3.51% | | |

outliers (or unreliable data), we removed all participants with more than 600 h of meditation experience. The 600 h threshold constitutes 3-year meditation experience, with an average of 30 min per day (based on previous mindfulness research; e.g., Khoury et al., 2013, 2015) and one 10-day retreat per year (e.g., Khoury, et al., 2017a, 2017b). This places the participants at the high-level end of early Western practitioners and towards medium-level experience, which is the threshold according to our aims in validating IMQ among nonmeditators, novice-mediators, and early Western practitioners. This reduced the sample size from 407 to 398.

We start exploring items' behavior by obtaining internal consistencies for each subscale, identifying items potentially problematic. Then, the IMQ structure was evaluated using a mixed Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) approach. The rationale was to evaluate the theoretically proposed structure using CFA, but also checking if the same structure would emerge from EFA, allowing us therefore to increase the stability of the IMQ structure (Bandalos & Finney, 2010; Gerbing & Hamilton, 1996; Orcan, 2018; Schmitt, 2011). We started with CFA as a diagnostic of our theoretical proposal, and then continued with EFA for item pruning procedure. We terminated the procedure evaluating again using CFA. In cases where an item was dropped based on CFA, EFA and CFA were performed again until no items were dropped. For EFA, given the multidimensional nature of the IMQ, we initially performed Parallel Analysis and Optimal Coordinates methods to determine the number of factors to extract (Hayton et al., 2004; Raîche et al., 2013). Once this number was determined, we evaluated multivariate normality using the Henze-Zirklers's test. In the case where multivariate normality was not met, we proceeded using Principal Axis Factorization Extraction instead of Maximum Likelihood (Costello & Osborne, 2005; de Winter & Dodou, 2012). Finally, given the exploratory nature of this analysis and expecting at least some of the subscales will be correlated, we used an oblimin rotation. EFA was performed using 1000 bootstrap iterations, reporting the mean of the loadings and 95% confidence intervals. This procedure was iteratively implemented removing crossloaders (loading in more than one factor) and subloaders (presenting all loadings in the range of $-0.3, +0.3$). In parallel, the CFA structure was evaluated to check the weakest items by assessing residuals and local fits ($R^2$). This iterative process was also evaluated jointly taking into consideration theoretical concerns, confidence intervals of the loadings, and crossloading characteristics, exploring solutions without total removal of cross or subloaders, as well as removing some items from the analysis.

Once the IMQ structure and retained items were defined, we proceeded to evaluate internal consistency using Cronbach's Alpha (Cronbach, 1951). We also included Total Omega following the criticism of many authors about only using Cronbach's Alpha (Dunn et al., 2014; Huysamen, 2006; Peters, 2014; Sijtsma, 2009). Confidence intervals were also provided using 1000 bootstrap iterations. During internal consistency estimations, we evaluated the effects of the removal of each item on the subscale's internal consistency. Once the internal consistency analysis was completed, we conducted a final CFA, reporting global fits; Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Comparative Fit Index (CFI), and Tucker Lewis Index (TLI) as diagnostics parameters. All statistical analyses and data processing was performed with R project (R Core Team, 2021).

## Results

Initial internal consistencies were above 0.8 for Attention to and Awareness of the Other Person and Body-Anchored Presence, while above 0.75 for Being Caught in the Mind and 0.62 for Mindful Responding (for details see Supplementary Table 1). Only two items in the Mindful Responding subscale were identified as problematic and removed from the analysis. This led to a significant increase in internal consistency. We started with 45 items which were iteratively pruned according to the method described above. Once the initial solution was obtained, the analysis of each iteration, confidence intervals of item loadings, and consistency were evaluated. Using the results, each item was evaluated in terms of its potential interpretation bias. This iterative process was repeated, which led to the EFA solution presented in Table 2. The results yielded the four proposed factors. Attention to and Awareness of the Other Person presented the highest internal consistency (Cronbach's Alpha and Total Omega of 0.95) followed by Being Caught in the Mind and Body-Anchored Presence. Mindful Responding presented the lowest internal consistency with a Cronbach's Alpha of 0.65 and a Total Omega of 0.79. The lowest factor loading was 0.42 and most confidence intervals were > 0.3. Some items in Mindful Responding presented confidence intervals crossing 0.3 or close to this threshold (Table 2). Globally, the initial version of the IMQ presented a KMO of 0.94, RMSEA of 0.74, and TLI of 0.84. The same structure was submitted to CFA, yielding RMSEA of 0.074, SRMR of 0.76, CFI of 0.85, and TLI of 0.857. Overall, these results indicate a robust initial version with some caveats on Mindful Responding, related to wide confidence intervals crossing at times 0.3.

## Discussion

The objectives of the current study were to develop the initial four-dimensional structure using the 47-item version of the IMQ and test each dimension's internal consistency. Initial internal consistency results (Cronbach's Alpha and

**Table 2** Original IMQ version exploratory factor analysis results post-item pruning. Loadings and internal consistencies were estimated using one thousand bootstrap iterations, reporting mean (95% C.I.). Loading with values < 0.3 was not reported in this table

| Items | Attention to and Awareness of the Oher Person | Being Caught in the Mind | Body-Anchored Presence | Mindful Responding |
|---|---|---|---|---|
| 20. I am aware of the eye contact of the other person | 0.55 (0.37, 0.73) | | | |
| 15. I am aware of the feelings of the other person | 0.60 (0.47, 0.72) | | | |
| 9. I notice the mood of the other person | 0.65 (0.52, 0.77) | | | |
| 39. I notice changes in the eye contact of the other person | 0.68 (0.51, 0.85) | | | |
| 27. I notice the tone of voice of the other person | 0.72 (0.57, 0.87) | | | |
| 12. I notice the reactions of the other person | 0.77 (0.65, 0.88) | | | |
| 33. I notice changes in the body posture of the other person | 0.77 (0.64, 0.90) | | | |
| 25. I pay attention to the other person's facial expression | 0.77 (0.66, 0.89) | | | |
| 1. I notice changes in the tone of voice of the other person | 0.77 (0.65, 0.90) | | | |
| 5. I notice changes in the facial expression of the other person | 0.81 (0.72, 0.90) | | | |
| 16. I notice changes in body language of the other person | 0.82 (0.73, 0.91) | | | |
| 40. I notice the body posture of the other person | 0.82 (0.71, 0.93) | | | |
| 36. I am aware of the body language of the other person | 0.85 (0.78, 0.93) | | | |
| 37. I am able to detach from my internal thoughts during my interactions with the other person | | −0.60 (−0.69, −0.50) | | |
| 31. I am able to distance myself from my internal dialogue when talking with the other person | | −0.57 (−0.66, −0.49) | | |
| 7. I get easily distracted while talking to the other person | | 0.50 (0.40, 0.60) | | |
| 24. I am in my head during my interactions with the other person | | 0.65 (0.56, 0.74) | | |
| 13. I overthink during my interactions with the other person | | 0.66 (0.59, 0.73) | | |
| 19. My mind wonders a lot while speaking with the other person | | 0.73 (0.66, 0.80) | | |
| 14. I get entangled in my thoughts while interacting with the other person | | 0.83 (0.78, 0.88) | | |
| 35. I get stuck in my thoughts when chatting with the other person | | 0.86 (0.81, 0.91) | | |
| 34. I get caught up in my mind while talking to the other person | | 0.90 (0.86, 0.94) | | |
| 4. I am aware of my mood when interacting with the other person | | | 0.48 (0.32, 0.64) | |
| 10. I notice my physical sensations when interacting with the other person | | | 0.52 (0.37, 0.66) | |
| 38. I am aware how I am feeling during my interactions with the other person | | | 0.56 (0.43, 0.69) | |
| 21. I am aware of my facial expression when interacting with the other person | | | 0.62 (0.52, 0.72) | |

**Table 2** (continued)

| Items | Attention to and Awareness of the Oher Person | Being Caught in the Mind | Body-Anchored Presence | Mindful Responding |
|---|---|---|---|---|
| 28. I notice my tone of voice when interacting with the other person | | | 0.64 (0.51, 0.77) | |
| 11. I am aware of my body language when interacting with the other person | | | 0.72 (0.62, 0.83) | |
| 26. I notice changes in me during my interactions with the other person | | | 0.77 (0.68, 0.86) | |
| 17. I am aware of my body posture while interacting with the other person | | | 0.81 (0.73, 0.89) | |
| 6. I criticize the other person when I disagree with them | | | | −0.58 (0.02, −0.45) |
| 18. I am critical towards the other person's thoughts or behaviors | | | | −0.56 (0.19, −0.43) |
| 30. I fully listen to what the other person means before responding to them | | | | 0.42 (0.22, 0.58) |
| 22. I take in consideration the impact of my words on others when responding to them | | | | 0.42 (0.31, 0.54) |
| 8. I respond warmly to the other person | | | | 0.44 (0.40, 0.57) |
| 29. I take the other person's opinion in consideration when responding to them | | | | 0.52 (0.26, 0.68) |
| 23. I respond to the other person without judging what they are saying | | | | 0.56 (0.07, 0.69) |
| 41. I respond with kindness to the other person | | | | 0.69 (0.24, 0.82) |
| **Internal consistencies** | | | | |
| Cronbach's Alpha (95CI) | 0.95 (0.94, 0.96) | 0.90 (0.88, 0.91) | 0.65 (0.60, 0.69) | 0.90 (0.88, 0.92) |
| Total Omega (95CI) | 0.95 (0.94, 0.96) | 0.90 (0.88, 0.92) | 0.79 (0.75, 0.82) | 0.90 (0.88, 0.91) |

Total Omega) supported the four suggested dimensions, with some weakness in Mindful Responding. Results from EFA and CFA confirmed the four proposed dimensions of the IMQ, with almost no differences in global fit for EFA compared with CFA. In EFA, factor loading confidence intervals did cross the 0.3 threshold for some items, presenting some caveats on Mindful Responding. For both EFA and CFA, RMSEA were higher than 0.05, and TLI were lower than 0.9, suggesting the need for reevaluating and improving some of the items that composed the IMQ's four dimensions.

Based on these obtained results, we improved the instrument by ameliorating the item loadings and increasing the internal consistency of the weaker subscales (especially the fourth, Mindful Responding). To do so, we inspected items one by one, evaluating the performance of their scores on CFA and EFA and their impact on internal consistency, as well as potential interpretation problems, such as wording ambiguity. This procedure led to the modification of some items and the inclusion of new items, yielding to the second version of the IMQ with 23 items. The new version

underwent the same evaluation, and items were randomly ordered, but we also included other instruments to evaluate convergent evidence (Study Two).

## Study Two: IMQ's Second Version Structure, Internal Consistency, and Convergent Evidence

### Methods

#### Participants

With the aim of increasing external validity for the current study and to achieve the most conservative sample size, we aimed for a sample size of > 1000 (MacCallum et al., 1999). It is fairly accepted that there are no good recommendations for sample size when conducting factor analysis; however, it is accepted that ranges above 500–1000 using item observation ratios above 1:5 are a conservative and safe approach

(Costello & Osborne, 2005; MacCallum et al., 1999; Reio & Shuck, 2015). Using the same means as in Study One (i.e., paid ads on social media), 1191 adult participants were recruited, among them 87.64% were female, 9.07% male, and 3.29% reported another gender or preferred not to answer. The mean age was 34.05 years ± 13.31. Participants were offered $100 gift certificates based on a draw with a rate of winning of 1/16. Detailed descriptions of the sample are available in Table 3.

## Procedures

Similar to the previous study, Study Two was conducted online using LimeSurvey and included sociodemographic data with detailed information regarding meditation practice or mindfulness training/experience along with the new measure under validation (i.e., IMQ), and a list of other measures for external validation.

## Measures

Three groups of measures were used for convergent purposes. The first group included the only existing interpersonal mindfulness measure for general use, i.e., the Interpersonal Mindfulness Scale (IMS, 27 items; Pratscher et al., 2018). The second group included five measures of mindfulness and related concepts such as acceptance and cognitive defusion, namely the Five Facet Mindfulness Questionnaire (FFMQ, 39 items; Baer et al., 2006), Mindfulness Attention and Awareness Scale (MAAS, 15 items; Brown & Ryan, 2003), Body Mindfulness Questionnaire (BMQ, 14 items; Burg et al., 2017), Acceptance and Action Questionnaire-II (AAQ2, 7 items; Bond et al., 2011), and Cognitive Fusion Questionnaire (CFQ,

7 items; Gillanders et al., 2014). The third group included seven social and interpersonal-related instruments, namely the Social Connectedness Scale-Revised (SCoS-R, 20 items; Lee & Robbins, 1995), Social Safeness and Pleasure Scale (SSS, 11 items; Gilbert et al., 2009), Active-Empathic Listening Scale (AELS, 11 items; Bodie, 2011), Toronto Empathy Questionnaire (TEQ, 16 items; Spreng et al., 2009), Sussex-Oxford Compassion for Others Scale (SOCS-O, 20 items; Gu et al., 2020), Sussex-Oxford Compassion for the Self Scale (SOCS-S, 20 items; Gu et al., 2020), and Neff's Self-Compassion Scale (SCS, 26 items; Neff, 2003). Two self-compassion measures were included in this group as their conceptualizations include the role of connection to others. An additional two instruments (for a total of 15) were used for exploratory purposes, specifically the Satisfaction With Life Scale (SWLS, 5 items; Diener et al., 1985), and Oxford Happiness Questionnaire (OHQ, 29 items; Hills & Argyle, 2002). Internal consistencies were calculated using Cronbach's alpha and were found to be acceptable overall (see Table 4).

In addition, we measured the amount of meditation practice. This amount was computed using four questions: (1) the average number of minutes participants practiced meditation per week (0 if they do not practice meditation), (2) the number of months since participants started practicing meditation (0 for no practice and for less than one month of practice; in the case of the latter, participants were also asked to enter a number between 0 and 0.99 that reflects the percentage of days they practiced during the month), (3) the number of meditation retreats they attended (0 if they did not attend any retreat), and (4) the number of hours participants practiced meditation during the retreats they attended (0, if they did not attend any retreat).

**Table 3** Descriptive results for the second sample used in Interpersonal Mindfulness Questionnaire (IMQ) validation

| | Mean ± SD | Min | 1st qu | Median | 3rd qu | Max |
|---|---|---|---|---|---|---|
| Age | 34.05 ± 13.31 | 17 | 23 | 30 | 43 | 81 |
| Years of education | 17.75 ± 3.13 | 0 | 16 | 18 | 20 | 31 |
| Total meditation practice hours | 51.52 ± 102.03 | 0 | 0 | 2.17 | 45.7 | 565 |
| Gender identity | **Woman** | **Man** | **Nonbinary** | **Trans** | **Other** | |
| | 87.64% | 9.07% | 2.01% | 0.84% | 0.42% | |
| Ethnicity | **White** | **Chinese** | **Mixed** | **South Asian** | **Latin American** | **Arab** |
| | 63.39% | 8.39% | 8.06% | 6.96% | 2.43% | 1.59% |
| Employment situation | **Full-time employment** | **Part-time employment (30 h or less per week)** | **Seasonal/temporary employment** | **Did not answer** | **Other** | |
| | 55.48% | 32.76% | 5.94% | 0.00% | 5.94% | |
| Relationship status | **In a relationship** | **Married** | **Single** | **Other** | | |
| | 33.30% | 23.60% | 41.06% | 2.02% | | |

**Table 4** Internal consistencies, calculated via Cronbach's Alpha, of total and subscale scores of instruments used for convergent, discriminant, and exploratory evidence

| Instrument | Total Scale Reliability | Subscale Reliability | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| IMS | 0.94 | Nonreactivity | Nonjudgmental Acceptance | Awareness | Presence | | | | |
| | | 0.85 | 0.80 | 0.89 | 0.91 | | | | |
| FFMQ | 0.94 | Observe | Describe | Act with Awareness | Nonjudging | Nonreactivity | | | |
| | | 0.82 | 0.93 | 0.91 | 0.94 | 0.88 | | | |
| MAAS | 0.91 | | | | | | | | |
| BMQ | 0.92 | | | | | | | | |
| AAQ2 | 0.93 | | | | | | | | |
| CFQ | 0.95 | | | | | | | | |
| SCoS-R | 0.94 | | | | | | | | |
| SSS | 0.96 | | | | | | | | |
| AELS | 0.91 | Sensing | Processing | Responding | | | | | |
| | | 0.89 | 0.71 | 0.83 | | | | | |
| TEQ | 0.89 | | | | | | | | |
| SOCS-O | 0.94 | Recognizing Suffering | Understanding Suffering | Feeling Suffering | Tolerating Feelings | Acting to Alleviate | | | |
| | | 0.91 | 0.87 | 0.82 | 0.80 | 0.90 | | | |
| SOCS-S | 0.95 | Recognizing Suffering | Understanding Suffering | Feeling Suffering | Tolerating Feelings | Acting to Alleviate | | | |
| | | 0.88 | 0.93 | 0.90 | 0.88 | 0.92 | | | |
| SCS | 0.96 | Self-Kindness | Self-Judgment | Common Humanity | Isolation | Mindfulness | Overidentified | Self-Warmth | Self-Coldness |
| | | 0.90 | 0.91 | 0.86 | 0.88 | 0.83 | 0.83 | 0.94 | 0.95 |
| SWLS | 0.91 | | | | | | | | |
| OHQ | 0.95 | | | | | | | | |

*AAQ2* Acceptance and Action Questionnaire-II; *AELS* Active-Empathic Listening Scale; *BMQ* Body Mindfulness Questionnaire; *CFQ* Cognitive Fusion Questionnaire; *FFMQ* Five Factor Mindfulness Questionnaire; *IMS* Interpersonal Mindfulness Scale; *MAAS* Mindfulness Attention and Awareness Scale; *SCoS-R* Social Connectedness Scale-Revised; *SCS* Self-Compassion Scale; *SOCS-O* Sussex-Oxford Compassion for Others Scale; *SOCS-S* Sussex-Oxford Compassion for the Self Scale; *SSS* Social Safeness and Pleasure Scale; *SWLS* Satisfaction With Life Scale; *TEQ* Toronto Empathy Questionnaire; *OHQ* Oxford Happiness Questionnaire

## Data Analyses

Similar to the first study and for the same reasons, we removed all participants with more than 600 h of meditation experience. This procedure reduced the sample size from 1191 to 1077 participants.

We used the same analytical strategies as Study One. However, we also included Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) as diagnostics parameters. The Bayesian diagnostics allowed us to contrast an oblique CFA solution against a hierarchic structure denoting the existence of one global IMQ variable. Additionally, to evaluate if the second version of the IMQ outperformed the first (presented in Study One), we compared the CFA solutions for the first and second versions. Moreover, given that the sample size of study two was large enough, to perform Split-half Cross-validation, we conducted cross-validation.

Convergent evidence was assessed using Pearson's correlations of the IMQ subscales with the instruments mentioned above, splitting the correlation results into three main aims: (1) IMQ subscale association with IMS subscales, (2) IMQ subscale association with mindfulness instruments, and (3) IMQ subscale associations with interpersonal-/social-related instruments. For comparison purposes, we also report IMS associations. To explore convergent validity in more detail, we included clusters to contrasts groups (i.e., profiles) derived from meditation experience and IMQ. We aimed to evaluate first how meditation experience relates to both the IMS and IMQ

subscales and then to evaluate the relationship between IMQ and IMS profiles.

For meditative experience, we performed a hierarchical clustering analysis using Euclidean distance, dividing the sample according to the total number of meditation hours and the number of breaths during meditation until participants lose their focus and have to redirect attention back on the breath. Given that both variables (i.e., meditation hours and number of breaths) are expected to present highly skewed distributions, we used the bestNormalize R library to explore variable normalizations (Peterson & Cavanaugh, 2020). To select the number of clusters, we used 30 different indices indicating the likely number of clusters in the sample (Charrad et al., 2014). Each method suggestion was considered as a vote. The number of clusters presenting the highest number of votes was considered as the most likely solution. Clusters were then characterized by means of the IMQ and IMS. The same procedure, but without the normalization performed with the bestNormalize library, was performed using the IMQ scores for clusters obtention. Obtained clusters were characterized by means of the IMQ (used to produce the clusters), IMS, SCoS-R, SSS, SWLS, and OHQ. All contrast results derived from cluster analysis were performed using the Mann–Whitney test with Bonferroni corrections.

## Results

### Construct and Reliability Evaluation

The second version of the IMQ started with 23 items, with the aim to improve the EFA and internal consistency results. A priori internal consistency analysis found all subscales, but Mindful Responding presented internal consistencies $\geq 0.8$ (for details see Supplementary Table 2). Mindful Responding had a Cronbach's Alpha of 0.68 and a Total Omega of 0.68. Removal of items did not significantly change internal consistency. Then this version was tested and submitted to the same pruning procedure, leading to a final version of 19 items (Table 5). In this second version, all items presented loadings and confidence intervals > 0.3.

Nonetheless, internal consistency (Cronbach's Alpha and Total Omega) dropped compared to the initial version, with values ranging from 0.68 to 0.92. The drop was only relevant for Body-Anchored Presence and Mindful Responding. In the case of Body-Anchored Presence, we were able to retain only three items for the subscale. Globally, this second version presented a KMO of 0.88, RMSEA of 0.08, and a TLI of 0.89. KMO did drop compared to the first version, but RMSEA was similar and TLI was better (Table 6).

We then explored the structure of the second version submitting it to a confirmatory factor analysis. We used a hierarchical and an oblique solution. Since we proposed IMQ subscales are specific behavior targeting skills, we would expect them to be fairly independent and to not obtain a global score. As such, a hierarchical solution would be the alternative hypothesis, suggesting that all IMQ subscales are correlated enough to estimate a global IMQ latent variable. As shown in Table 7, an oblique solution is significantly better than the hierarchical, supporting our initial proposal that IMQ subscales represent skills which can be independently or sequentially trained. Figure 1 displays both models graphically and presents how Attention to and Awareness of the Other Person and Body-Anchored Presence load together into a global latent variable. However, Mindful Responding and Being Caught in the Mind present low loadings values, which contributes to the difference already found. This final oblique solution presented a CFI of 0.90, TLI of 0.88, RMSEA of 0.08, and SRMR of 0.06.

When replicating the procedure using split-half cross-validation, the same items were dropped during EFA pruning yielding a solution with a KMO of 0.86, RMSEA of 0.08, and a TLI of 0.89. The EFA results did not present any qualitative differences (for details see Supplementary Table 3). When evaluating the structure in the second half using CFA, the results supported the same structure with a CFI of 0.90, TLI of 0.88, RMSEA of 0.08, and SRMR of 0.06. Overall, results were highly consistent and support an adequate construct validity.

### IMQ Convergent Evidence

To explore convergent evidence, we first estimated IMQ subscale scores as the average of each item. Convergent evidence was conducted in three consecutive steps. The first step was to evaluate IMQ subscale associations with other instruments, the second was to evaluate the impact of meditative experience on IMQ subscales, and the third was to explore profiles obtained from IMQ subscale scores. For the first one, we started evaluating the associations between IMQ subscales and IMS (Fig. 2a). IMS total score presented significant correlations with all IMQ subscale scores with absolute Pearson's $r \geq 0.48$. Attention to and Awareness of the Other Person and Body-Anchored Presence scores presented both very high correlation with IMS Awareness scores ($r = 0.66$ and $0.59$), Being Caught in the Mind subscale scores with IMS Presence ($r = -0.77$) scores, and Mindful Responding scores with both IMS Nonreactivity ($r = 0.53$) and IMS Nonjudgment ($r = 0.64$) scores. These results suggest strong and multidimensional associations between IMQ and IMS subscales.

We then proceeded to evaluate associations of the IMQ and IMS subscales with intrapersonal mindfulness instruments. Overall, the IMS scores presented higher absolute Pearson's $r$ coefficients than the IMQ subscale scores. IMQ

**Table 5** Second IMQ version exploratory factor analysis results post-item pruning. Loadings and internal consistencies were estimated using one thousand bootstrap iterations, reporting mean (95% C.I.) Loading with values < 0.3 was not reported in this table

| Items | Attention to and Awareness of the Other Person | Being Caught in the Mind | Body-Anchored Presence | Mindful Responding |
|---|---|---|---|---|
| 12. I notice changes in the facial expression of the other person | 0.90 (0.86, 0.94) | | | |
| 21. I pay attention to the other person's facial expression | 0.86 (0.82, 0.90) | | | |
| 13. I notice changes in the tone of voice of the other person | 0.84 (0.79, 0.88) | | | |
| 23. I notice the reactions of the other person | 0.77 (0.72, 0.83) | | | |
| 11. I notice changes in body language of the other person | 0.66 (0.59, 0.74) | | | |
| 22. I am aware of the body language of the other person | 0.64 (0.56, 0.72) | | | |
| 20. I get caught up in my mind while talking to the other person | | 0.93 (0.91, 0.95) | | |
| 19. I get entangled in my thoughts while interacting with the other person | | 0.90 (0.87, 0.93) | | |
| 8. I get stuck in my thoughts when chatting with the other person | | 0.79 (0.76, 0.83) | | |
| 17. I am in my head during my interactions with the other person | | 0.76 (0.71, 0.81) | | |
| 6. My mind wonders a lot while speaking with the other person | | 0.75 (0.71, 0.79) | | |
| 14. I am aware of my body posture while interacting with the other person | | | 0.92 (0.87, 0.96) | |
| 15. I am aware of my body language when interacting with the other person | | | 0.85 (0.79, 0.90) | |
| 5. I notice my physical sensations when interacting with the other person | | | 0.39 (0.30, 0.49) | |
| 9. I am critical towards the other person's thoughts or behaviors | | | | − 0.62 (− 0.71, − 0.53) |
| 7. I criticize the other person when I disagree with them | | | | − 0.61 (− 0.70, − 0.53) |
| 3. I respond with kindness to the other person | | | | 0.58 (0.49, 0.66) |
| 10. I respond to the other person without judging what they are saying | | | | 0.44 (0.35, 0.53) |
| 1. I take the other person's opinion in consideration when responding to them | | | | 0.43 (0.33, 0.53) |
| **Internal Consistency** | | | | |
| Cronbach's Alpha (95CI) | 0.92 (0.91 − 0.93) | 0.91 (0.90, 0.92) | 0.79 (0.86 − 0.82) | 0.68 (0.63, 0.71) |
| Total Omega (95CI) | 0.92 (0.91 − 0.93) | 0.91 (0.90, 0.93) | 0.82 (0.80, 0.84) | 0.68 (0.64, 0.72) |

subscale scores did present significant correlations with FFMQ, MAAS, BMQ, AAQ2, and CFQ scores. Most of them were medium to low (< 0.4) except for Body-Anchored Presence and FFMQ observe ($r = 0.51$) and Being Caught in the Mind scores (Fig. 2b). This subscale presented the highest correlation with those instruments with absolute Pearson's $r$ ranging from 0.53 to 0.31 for global scores. Overall,

these results support that the IMQ is related, but different, from intrapersonal mindfulness. Such differences were more accentuated for the IMQ compared with IMS.

When exploring social-related variables, IMQ subscale scores and IMS scores presented significant correlations (Fig. 2c). IMS scores presented higher correlations, while IMQ subscale scores presented more specific correlation

**Table 6** Exploratory factor analysis diagnostics comparison between the original and second IMQ versions. PA stands for Parallel Analysis, OC for Optimal Coordinates; multivariate normality was assessed using the Henze-Zirkler test. Results reported here correspond to the last iteration

| Criteria | | Original version | Second version |
|---|---|---|---|
| Pre-extraction | Sample size | 398 | 916 |
| | PA | 4 | 4 |
| | OC | 4 | 4 |
| | Number of extracted factors | 4 | 4 |
| | Multivariate normality | Rejected | Rejected |
| | Number of items | 38 | 19 |
| Post-extraction | KMO | 0.94 | 0.88 |
| | RMSEA | 0.074 | 0.08 |
| | TLI | 0.84 | 0.897 |

*PA* Parallel Analysis; *OC* Optimal Coordinates; *KMO* Kaiser–Meyer–Olkin; *RMSEA* Root Mean Square Error of Approximation; *TLI* Tucker Lewis Index

**Table 7** Confirmatory factor analysis diagnostics using hierarchical or oblique Interpersonal Mindfulness Questionnaire (IMQ) subscales

| | Hierarchical structure | Oblique subscales |
|---|---|---|
| RMSEA | 0.082 | 0.079 |
| TLI | 0.901 | 0.908 |
| AIC | 36,093 | 36,023 |
| BIC | 36,295 | 36,235 |
| Significantly different? | $x^2$ diff $= 74.15$; df $= 2$; $p < 0.01$ | |

*RMSEA* Root Mean Square Error of Approximation; *TLI* Tucker Lewis Index; *AIC* Akaike Information Criteria; *BIC* Bayesian Information Criteria

patterns. While IMS subscale scores were associated with all instruments and their subscales, IMQ subscale scores presented many nonsignificant correlations and had more specific associations. For instance, Attention to and Awareness

of the Other Person subscale scores presented multiple non-significant correlations with SSS scores, and those reaching significance were very low. Nonetheless, they presented consistently significant correlations with SCoS-R and its sub-scale scores. Body-Anchored Presence subscale scores were only associated with some of SSS subscale scores, while Being Caught in the Mind subscale scores were mostly associated with SSS scores.

In order to evaluate the impact of experience over IMQ subscales, we performed a cluster analysis using meditation hours and amount of meditative practice. According to this procedure, we divided the sample into two groups, which we named Low and High meditative experience. The Low meditative group consisted of participants with almost no meditative experience, while the High meditative group included participants ranging from a few hours up to 600 h of meditation experience. This latter group presents in a general higher number of breaths without losing their focus on their
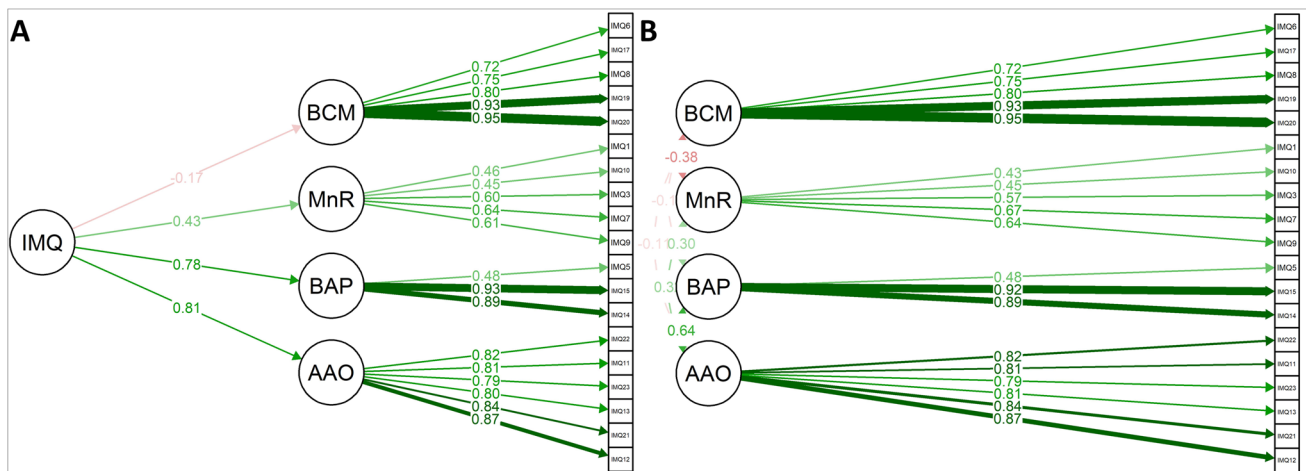


**Fig. 1** Confirmatory factor analysis results for the a hierarchical and b oblique subscales solutions. Note. Thickness and darkness of arrows depict the value of standardized to all coefficients. Green depicts pos-itive values, while red depicts negative values. BCM: Being Caught in the Mind; MnF: Mindful Responding; BAP: Body-Anchored Pres-ence; AAO: Attention to and Awareness of the Other Person
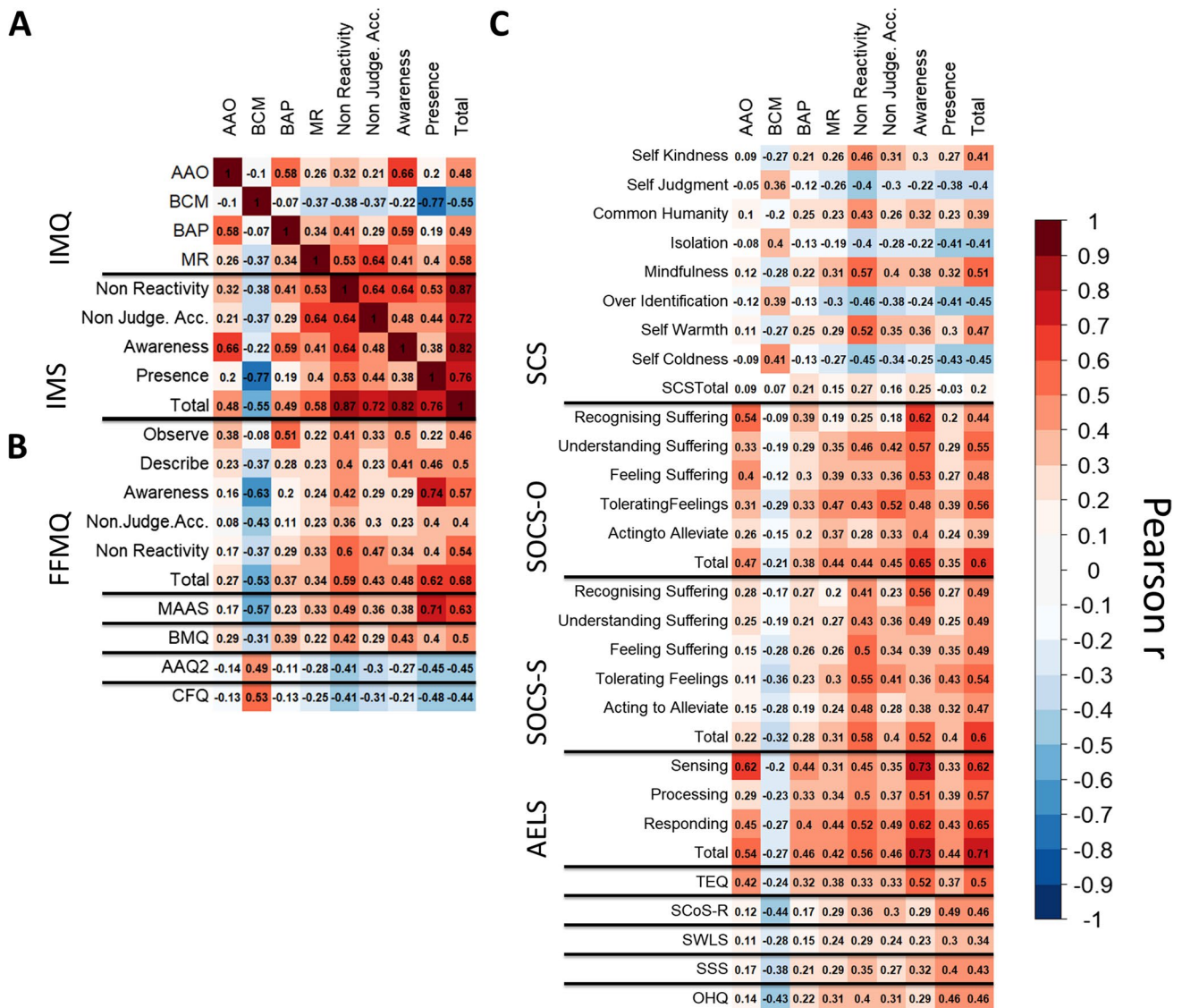
**A / B**

| | AAO | BCM | BAP | MR | Non Reactivity | Non Judge. Acc. | Awareness | Presence | Total |
|---|---|---|---|---|---|---|---|---|---|
| **IMQ** AAO | 1 | -0.1 | 0.58 | 0.26 | 0.32 | 0.21 | 0.66 | 0.2 | 0.48 |
| BCM | -0.1 | 1 | -0.07 | -0.37 | -0.38 | -0.37 | -0.22 | -0.77 | -0.55 |
| BAP | 0.58 | -0.07 | 1 | 0.34 | 0.41 | 0.29 | 0.59 | 0.19 | 0.49 |
| MR | 0.26 | -0.37 | 0.34 | 1 | 0.53 | 0.64 | 0.41 | 0.4 | 0.58 |
| **IMS** Non Reactivity | 0.32 | -0.38 | 0.41 | 0.53 | 1 | 0.64 | 0.64 | 0.53 | 0.87 |
| Non Judge. Acc. | 0.21 | -0.37 | 0.29 | 0.64 | 0.64 | 1 | 0.48 | 0.44 | 0.72 |
| Awareness | 0.66 | -0.22 | 0.59 | 0.41 | 0.64 | 0.48 | 1 | 0.38 | 0.82 |
| Presence | 0.2 | -0.77 | 0.19 | 0.4 | 0.53 | 0.44 | 0.38 | 1 | 0.76 |
| Total | 0.48 | -0.55 | 0.49 | 0.58 | 0.87 | 0.72 | 0.82 | 0.76 | 1 |
| **FFMQ** Observe | 0.38 | -0.08 | 0.51 | 0.22 | 0.41 | 0.33 | 0.5 | 0.22 | 0.46 |
| Describe | 0.23 | -0.37 | 0.28 | 0.23 | 0.4 | 0.23 | 0.41 | 0.46 | 0.5 |
| Awareness | 0.16 | -0.63 | 0.2 | 0.24 | 0.42 | 0.29 | 0.29 | 0.74 | 0.57 |
| Non.Judge.Acc. | 0.08 | -0.43 | 0.11 | 0.23 | 0.36 | 0.3 | 0.23 | 0.4 | 0.4 |
| Non Reactivity | 0.17 | -0.37 | 0.24 | 0.33 | 0.6 | 0.47 | 0.34 | 0.4 | 0.54 |
| Total | 0.27 | -0.53 | 0.37 | 0.34 | 0.59 | 0.43 | 0.48 | 0.62 | 0.68 |
| MAAS | 0.17 | -0.57 | 0.23 | 0.33 | 0.49 | 0.36 | 0.38 | 0.71 | 0.63 |
| BMQ | 0.29 | -0.31 | 0.39 | 0.22 | 0.42 | 0.29 | 0.43 | 0.4 | 0.5 |
| AAQ2 | -0.14 | 0.49 | -0.11 | -0.28 | -0.41 | -0.3 | -0.27 | -0.45 | -0.45 |
| CFQ | -0.13 | 0.53 | -0.13 | -0.25 | -0.41 | -0.31 | -0.21 | -0.48 | -0.44 |

**C**

| | AAO | BCM | BAP | MR | Non Reactivity | Non Judge. Acc. | Awareness | Presence | Total |
|---|---|---|---|---|---|---|---|---|---|
| **SCS** Self Kindness | 0.09 | -0.27 | 0.21 | 0.26 | 0.46 | 0.31 | 0.3 | 0.27 | 0.41 |
| Self Judgment | -0.05 | 0.36 | -0.12 | -0.26 | -0.4 | -0.3 | -0.22 | -0.38 | -0.4 |
| Common Humanity | 0.1 | -0.2 | 0.25 | 0.23 | 0.43 | 0.26 | 0.32 | 0.23 | 0.39 |
| Isolation | -0.08 | 0.4 | -0.13 | -0.19 | -0.4 | -0.28 | -0.22 | -0.41 | -0.41 |
| Mindfulness | 0.12 | -0.28 | 0.22 | 0.31 | 0.57 | 0.4 | 0.38 | 0.32 | 0.51 |
| Over Identification | -0.12 | 0.39 | -0.13 | -0.3 | -0.46 | -0.38 | -0.24 | -0.41 | -0.45 |
| Self Warmth | 0.11 | -0.27 | 0.25 | 0.29 | 0.52 | 0.35 | 0.36 | 0.3 | 0.47 |
| Self Coldness | -0.09 | 0.41 | -0.13 | -0.27 | -0.45 | -0.34 | -0.25 | -0.43 | -0.45 |
| SCSTotal | 0.09 | 0.07 | 0.21 | 0.15 | 0.27 | 0.16 | 0.25 | -0.03 | 0.2 |
| **SOCS-O** Recognising Suffering | 0.54 | -0.09 | 0.39 | 0.19 | 0.25 | 0.18 | 0.62 | 0.2 | 0.44 |
| Understanding Suffering | 0.33 | -0.19 | 0.29 | 0.35 | 0.46 | 0.42 | 0.57 | 0.29 | 0.55 |
| Feeling Suffering | 0.4 | -0.12 | 0.3 | 0.39 | 0.33 | 0.36 | 0.53 | 0.27 | 0.48 |
| Tolerating Feelings | 0.31 | -0.29 | 0.33 | 0.47 | 0.43 | 0.52 | 0.48 | 0.39 | 0.56 |
| Acting to Alleviate | 0.26 | -0.15 | 0.2 | 0.37 | 0.28 | 0.33 | 0.4 | 0.24 | 0.39 |
| Total | 0.47 | -0.21 | 0.38 | 0.44 | 0.44 | 0.45 | 0.65 | 0.35 | 0.6 |
| **SOCS-S** Recognising Suffering | 0.28 | -0.17 | 0.27 | 0.2 | 0.41 | 0.23 | 0.56 | 0.27 | 0.49 |
| Understanding Suffering | 0.25 | -0.19 | 0.21 | 0.27 | 0.43 | 0.36 | 0.49 | 0.25 | 0.49 |
| Feeling Suffering | 0.15 | -0.28 | 0.26 | 0.26 | 0.5 | 0.34 | 0.39 | 0.35 | 0.49 |
| Tolerating Feelings | 0.11 | -0.36 | 0.23 | 0.3 | 0.55 | 0.41 | 0.36 | 0.43 | 0.54 |
| Acting to Alleviate | 0.15 | -0.28 | 0.19 | 0.24 | 0.48 | 0.28 | 0.38 | 0.32 | 0.47 |
| Total | 0.22 | -0.32 | 0.28 | 0.31 | 0.58 | 0.4 | 0.52 | 0.4 | 0.6 |
| **AELS** Sensing | 0.62 | -0.2 | 0.44 | 0.31 | 0.45 | 0.35 | 0.73 | 0.33 | 0.62 |
| Processing | 0.29 | -0.23 | 0.33 | 0.34 | 0.5 | 0.37 | 0.51 | 0.39 | 0.57 |
| Responding | 0.45 | -0.27 | 0.4 | 0.44 | 0.52 | 0.49 | 0.62 | 0.43 | 0.65 |
| Total | 0.54 | -0.27 | 0.46 | 0.42 | 0.56 | 0.46 | 0.73 | 0.44 | 0.71 |
| TEQ | 0.42 | -0.24 | 0.32 | 0.38 | 0.33 | 0.33 | 0.52 | 0.37 | 0.5 |
| SCoS-R | 0.12 | -0.44 | 0.17 | 0.29 | 0.36 | 0.3 | 0.29 | 0.49 | 0.46 |
| SWLS | 0.11 | -0.28 | 0.15 | 0.24 | 0.29 | 0.24 | 0.23 | 0.3 | 0.34 |
| SSS | 0.17 | -0.38 | 0.21 | 0.29 | 0.35 | 0.27 | 0.32 | 0.4 | 0.43 |
| OHQ | 0.14 | -0.43 | 0.22 | 0.31 | 0.4 | 0.31 | 0.29 | 0.46 | 0.46 |

Pearson r (scale: 1 to -1)

**Fig. 2** Pearson correlation matrices of **a** IMQ and IMS, **b** IMQ and IMS association with intrapersonal mindfulness questionnaires (FFMQ, MAAS, BMQ, AAQ2, and CFQ), and **c** IMQ and IMS associations with instruments related with social interactions and compassion (SCS, SOCS-S, SOCS-O, AELS, TEQ, SCoS-R, SSS) and global well-being (SWLS and OHQ)

breath in comparison with the low meditative group (Fig. 3). As such, the high experience group should be interpreted as participants who are likely to have some experience in meditation (and not as expert meditators), while participants in the Low group have practically no meditation experience. We contrasted both groups using IMQ and IMS. For both, IMS and IMQ, this difference in experience produced significant differences in score. For IMQ Mindful Responding subscale scores presented significant results, while IMS Nonjudgmental acceptance scores presented nonsignificant results (Fig. 3b–c).

Finally, we wanted to detect potential behavioral profiles based on IMQ subscale scores, meaning different profiles of interpersonal mindfulness skills. In doing so, we conducted another cluster analysis using only IMQ subscale scores. This analysis led us to select three groups. Based on their IMQ subscale scores (Fig. 4a), we named the group "Self-centered," "Inattentive," and "Mindful." Self-centered group presented in general medium IMQ scores, being particularly high in Being Caught in the Mind subscale score. Our interpretation is that this group is likely to be able to listen with attention to other people, to be aware of their internal states, and to notice properly what is happening with people around them, but they are highly centered on themselves, hence, Self-centered. The Inattentive group is not caught in their mind; however, they present the lowest scores on
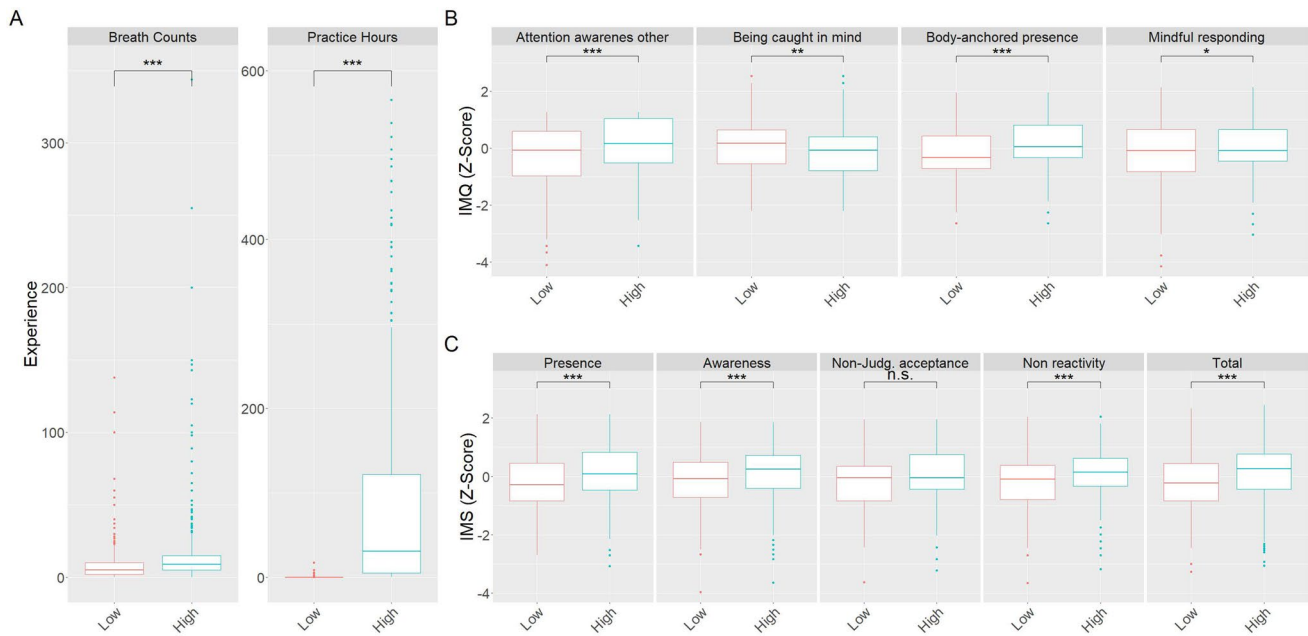
**Fig. 3** Evaluation of the impact of experience over IMS and IMQ. a Differences between Breath Counts and Practice hours (both variables were used to perform the cluster analysis) between the two groups. Differences between Low and High experience groups for

IMQ (**b**) and IMS (**c**) are presented. Contrasts were made using the Mann–Whitney test corrected with Bonferroni's method. \*\*\*$p < 0.001$; \*\*$p < 0.01$; \*$p < 0.05$; ns $p \geq 0.05$

attending to self and others; hence, they show difficulties in directing/maintaining their attention. Finally, the Mindful group presents high scores in all IMQ subscales; therefore, we expect them to have a high interpersonal mindfulness. As we expected, the Self-centered group also presented lower scores on IMS Nonjudgmental acceptance, supporting that this group is likely to be highly judgmental towards others during social interactions. The Inattentive group did not differentiate strongly from the Self-centered group when observing IMS scores as both showed low scores on all IMS subscales. However, the Inattentive profile presented the lowest scores in all subscales but IMS Presence. Conversely, the Mindful group presented the highest scores in all IMS subscales. When evaluating social-related variables and satisfaction with life, we observed that only the Mindful group is significantly different from the other two groups and presented better scores.

## Discussion

The aims of the current study were to evaluate the structure and the reliability of the modified 23-item version of the IMQ, while also evaluating convergent evidence. EFA-CFA results support a robust structure and adequate to good internal consistencies within the four subscales' scores. Results obtained using split-half cross-validation were virtually the same as those obtained using our CFA-EFA-CFA iterative

procedure with bootstrap. In practical terms, split-half cross-validation was one of the first subsampling approaches along with the "leave one out method" of a more global family called k-folds (Scheinost et al., 2019), with the first two approaches being less reliable. In fact, some analytical pipelines which uses dimensional assessments (such as factor analysis) are introducing novel techniques given the low reliability of split-half cross-validation (Artoni et al., 2014). To deal with the lack of reliability, k-folds methods have increased the amount of subsampling (reducing statistical power and estimation reliability) and/or including resampling iterative methods (Jung, 2018). Nonetheless, this highly sophisticated method produces results that are as reliable as those using Bootstrap (Ljumović & Klar, 2015; Xu & Goodacre, 2018). In sum, our results support that validating IMQ's structure based on confident intervals of loadings and reassessing results through EFA and CFA produced reliable results, as previously suggested by multiple authors (e.g., Gerbing & Hamilton, 1996; Orcan, 2018; Schmitt, 2011).

The current version of the IMQ does present some caveats. The Body-Anchored Presence subscale has a small number of items (i.e., three items), and the Mindful Responding subscale has lower than expected internal consistency. Some of these limitations are derived from the item reduction performed from Study One to Study Two. Naturally, reducing the number of items can negatively impact the instrument diagnostics. Nonetheless, the current version has strong evidence in favor of its current form.
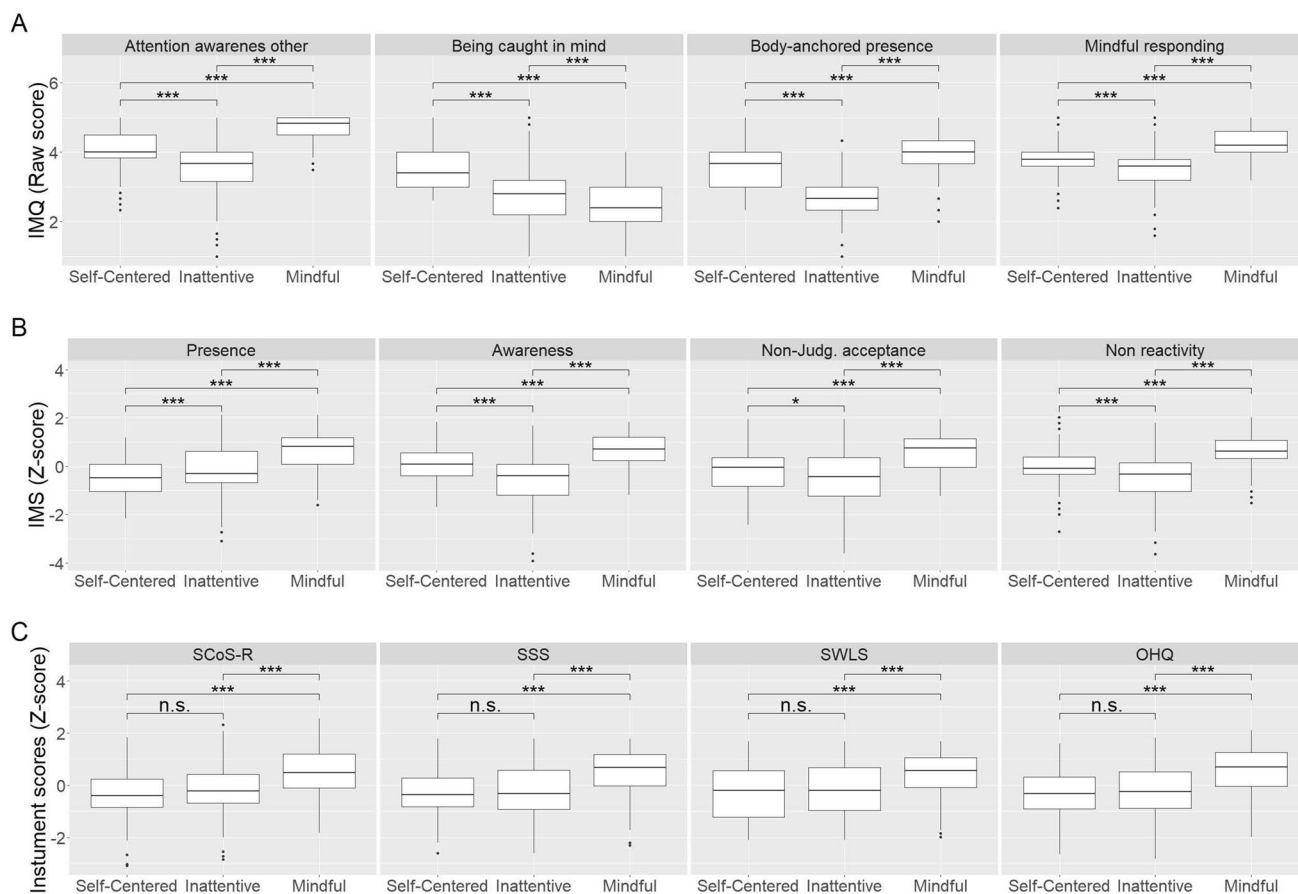
**Fig. 4** Exploration of the IMQ profiles. In **a**, the differences between the three groups were found when clustering using IMQ subscales. In **b**, we present the differences in IMS between the IMQ profiles. In **c**, we present differences derived from IMQ profiles in SCoS R, SSS, SWLS, and OHQ. Contrasts were made using the Mann–Whitney test corrected with Bonferroni's method. ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; ns $p \geq 0.05$

Analyses support the absence of a single latent variable of the IMQ (i.e., a global score should not be computed) which is aligned with our theoretical expectation that embodied and embedded mindfulness is trained through the four noted skills. In line with that, the four subscales are weakly associated and can be considered independent, suggesting they represent abilities that can be trained either independently or perhaps in a sequential way (i.e., building on each other). This means that a certain level of some of these abilities may be required to train others, but that having one does not per se produce the other. Being high on all IMQ subscales has important implications. Participants in that category also displayed higher social connectedness, social safeness, satisfaction with life, and happiness in comparison with those who were low on one or more of the IMQ subscales. These results strongly suggest the role and importance of the IMQ subscales in predicting both intrapersonal (life satisfaction and happiness) and interpersonal (social connectedness and social safeness) outcomes.

In addition, the IMQ subscales are related to the IMS subscale and global scores. This association suggests that both instruments were able to articulate mostly a common essence of the concept of interpersonal mindfulness, and their associations with other mindfulness measures highlight how they have successfully differentiated interpersonal from intrapersonal mindfulness. Furthermore, this association suggests the IMQ behaves as expected despite the reduction in diagnostic values from Study One to Study Two. They also showed similar sensitivity to meditation experience where meditation is associated with better outcomes. Only the Mindful Responding subscale falls slightly short of statistical significance. However, this is not surprising given participants had limited meditation experience and our hypothesis that Mindful Responding being the most advanced and complex skill to cultivate.

However, there are some important differences to consider between the instruments. The conceptualization of the IMS was largely based on previous intrapersonal mindfulness instruments (namely the FFMQ), while the IMQ

subscales had a distinct conceptualization that is rooted in the theory of embodiment. Like the FFMQ, the IMS aims to measure a personality trait or disposition and tackles the consequences of having interpersonal mindfulness. On the other hand, the IMQ subscales focus on the skills required to produce interpersonal mindfulness and attend to the mechanisms for cultivating them. The IMQ profile results support this idea as it is only when all four subscales are sufficiently high that the IMS scores also reflect their highest values. As such, both instruments are complementary, and their usage will depend on the specific goals of the research. IMQ is particularly useful in the context of mindfulness programs, in order to direct efforts in developing the skills/abilities that can be prerequisites for interpersonal mindfulness. The IMS would be useful in evaluating whether cultivating those skills will ultimately affect interpersonal mindfulness. In general, we consider that using both measures will collectively provide more comprehensive information when evaluating and interpreting results related to interpersonal mindfulness.

Another salient difference is that while both the IMQ and IMS presented associations with social/interpersonal measures, the IMS presented higher and wider associations with all used measures and most of their subscales, whereas the IMQ showed stricter and more specific associations. For example, the Attention and Awareness of the Other Person subscale was highly associated with empathy, recognizing suffering in others, sensing others' feelings and state of mind, and responding to them; the Being Caught in the Mind subscale was highly associated with self-judgment and self-coldness and inversely associated with social connectedness, social safeness, and happiness; the Mindful Responding subscale showed high association with tolerating negative feelings in others, understanding their suffering, and empathic responding to them. The Body-Anchored Presence subscale had the lowest associations with social/interpersonal measures, showing contributions to recognizing suffering in others, sensing others' feelings and state of mind, and responding emphatically to them. This discriminating difference can be due to at least two main reasons; either we have missed a relevant skill that would be related to the other intrapersonal mindfulness measures that the IMS is highly related to, or the factors measured by IMS include other phenomena beyond interpersonal mindfulness. Either way, the results generally suggest that the IMQ subscales are better at discriminating between intrapersonal mindfulness and other social/interpersonal constructs compared to the IMS subscale and global score. Based on our conceptualization of embodied and embedded mindfulness, we are inclined to conclude that we did not miss any relevant skill. Nonetheless, more research is required to elucidate this difference. Given that we expected that IMQ subscales would be helpful in assessing mindfulness/meditation interventions, we

conducted a brief 6-week mindfulness-based intervention (Study Three) to evaluate how IMQ subscales change following the intervention.

## Study Three: Following an Online Mindfulness and Compassion Training Program

### Methods

#### Participants

Twenty-seven graduate students training to be counsellors/therapists were recruited from Canadian universities. They were offered pro-rated monetary compensation (up to $100) for their participation. Twenty-three participants (female = 22, $M_{age}$ = 29.04, $SD_{age}$ = 6.46) completed the full study (four withdrew prior to completing the program). At baseline, about half of the participants shared how mindfulness had little to no role or importance in their daily life. Most had prior experience practicing mindfulness ($n$ = 19) and some formal training ($n$ = 14).

#### Procedures

The study was approved by the Research Ethics Board at McGill University. Participants gave informed consent and completed several measures including a sociodemographic questionnaire, the measure under validation (i.e., IMQ), the FFMQ, and the DASS-21. The FFMQ is included here to compare the intrapersonal and interpersonal effects of the training, and the DASS is included to highlight the intervention's impact on mental health. Measures were completed online through LimeSurvey at baseline, post-intervention, and 3-month follow-up.

#### Mindfulness and Compassion Training Program

The program was designed for novice therapists and aimed to increase their tolerance for ambiguity through mindfulness and compassion training. There were six weekly online sessions (90-min duration) that involved teaching, discussion, and meditative practice (all facilitated by the third author). The program was partially based on the embodied and embedded mindfulness and compassion framework (EEMCF; Khoury, 2018, 2019; Khoury & Dionne, 2020; Khoury et al., 2019, 2020, 2021b, 2017a, b). The program was developed with the expectation that participants would be novice meditators. As such, the program took more time to discuss and practice embodied mindfulness and compassion (one session for each concept) as compared to interpersonal mindfulness and compassion (one session covering

both concepts). Participants meditated approximately 15 to 25 min per session and were exposed to at least two different meditation practices. They were further encouraged (but were not required) to practice mindfulness formally and informally between sessions. A complete description of the program is available in the work of Spinelli et al. (2021).

### Data Analyses

When calculating subscale and total scores, participants had to have completed all items within each measure to be included, and listwise deletion was used to omit any missing data. No univariate outliers ($\pm 3.5$ SD) were found. The outcomes are trainable skills or distress measures which can produce skewed distributions. As outcomes did not consistently conform to the normality assumption, we elected to use a nonparametric approach and compared post-training and follow-up to baseline using Wilcoxon's signed-rank tests. A Bonferroni correction was applied for the two comparisons such that alpha was set at 0.025. Nonparametric effect sizes were calculated using rank-biserial correlation ($r$). A small effect size is 0.1, medium is 0.3, and large is 0.5. All analyses were conducted using IBM SPSS (Version 27).

## Results

At baseline, about half of the participants ($n = 12$) practiced mindfulness less than once per week. While completing the program, participants reported an average of 9.85 min/day

(SD $= 10.93$, range $= 2.22$ to 48.89) of mindfulness activity. Changes between baseline to post-training and follow-up for the FFMQ, DASS-21, and IMQ can be found in Table 8. For the DASS-21, a decreasing trend was found for stress at post-training ($p = 0.02$) and a significant decrease was noted at follow-up ($p = 0.01$). Significant increases were also found on the Observing ($p = 0.004$) and Acting with awareness ($p = 0.02$) facets of the FFMQ as well as total FFMQ ($p = 0.0008$) at post-training. These findings persisted into follow-up with significant increases also noted for the Nonjudging ($p = 0.008$) and Nonreactivity ($p = 0.004$) facets. Total FFMQ had the largest effect size at both time points ($r = 0.49$ and $0.56$ respectively) followed by the Observing facet ($r = 0.42$ and $0.46$ respectively). For the IMQ, a benefit-consistent trend was found for the Mindful Responding subscale ($p = 0.03$; $r = 0.32$) at post-training and for the Being Caught in the Mind subscale at follow-up ($p = 0.08$; $r = 0.26$). The other subscales did not show significant or trending changes following mindfulness training.

## Discussion

The aim of the current study was mainly to assess the effects of a 6-week mindfulness-based intervention on counsellors-in-training. An additional aim was to assess whether IMQ subscales will change following the intervention. Therefore, the intervention was not specifically designed to validate IMQ. Overall, none of the subscales showed significant changes at post-intervention or follow-up, but there were some

**Table 8** Results of the pilot study evaluating the change in Interpersonal Mindfulness Questionnaire (IMQ) after a mindfulness intervention and 3 months later. We included the Five Facet Mindfulness Questionnaire (FFMQ) and Depression Anxiety Stress Scales (DASS) change as reference for comparison

| Measure | Scale | Baseline | | Post-training | | Follow-up | | Baseline-post-training | | | Baseline-follow-up | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $n$ | M ($\pm$SD) | $n$ | M ($\pm$SD) | $n$ | M ($\pm$SD) | Z | $p$ value | ES ($r$) | Z | $p$ value | ES ($r$) |
| FFMQ | Observing | 23 | 9.30 (1.99) | 23 | 10.43 (2.06) | 23 | 10.57 (1.78) | $-2.83$ | 0.004* | 0.42 | $-3.14$ | 0.001* | 0.46 |
| | Describing | 23 | 10.61 (2.43) | 23 | 11.17 (1.99) | 23 | 11.22 (2.47) | $-1.21$ | 0.22 | 0.18 | $-1.06$ | 0.28 | 0.16 |
| | Acting with Awareness | 23 | 8.17 (2.17) | 23 | 9.13 (1.74) | 23 | 9.17 (1.90) | $-2.28$ | 0.02* | 0.34 | $-2.25$ | 0.02* | 0.33 |
| | Nonjudging | 23 | 11.35 (1.75) | 23 | 12.09 (1.88) | 23 | 12.61 (1.90) | $-2.00$ | 0.04 | 0.29 | $-2.65$ | 0.008* | 0.39 |
| | Nonreactivity | 23 | 8.57 (1.97) | 23 | 9.48 (1.50) | 23 | 10.00 (1.65) | $-1.99$ | 0.04 | 0.29 | $-2.87$ | 0.004* | 0.42 |
| | Total | 23 | 48.00 (5.74) | 23 | 52.30 (4.93) | 23 | 53.57 (5.38) | $-3.35$ | 0.0008* | 0.49 | $-3.81$ | 0.0001* | 0.56 |
| IMQ | Attention to and awareness of the other person | 23 | 4.17 (0.58) | 22 | 4.35 (0.60) | 23 | 4.05 (0.54) | $-1.51$ | 0.13 | 0.23 | $-0.99$ | 0.32 | 0.15 |
| | Body-Anchored Presence | 23 | 3.38 (0.77) | 22 | 3.55 (0.92) | 23 | 3.45 (0.81) | $-1.21$ | 0.22 | 0.18 | $-0.86$ | 0.38 | 0.13 |
| | Mindful Responding | 23 | 3.92 (0.49) | 22 | 4.14 (0.49) | 23 | 3.99 (0.40) | $-2.12$ | 0.03 | 0.32 | $-0.79$ | 0.42 | 0.12 |
| | Being caught in the mind | 23 | 2.77 (0.69) | 22 | 2.70 (0.61) | 23 | 2.55 (0.56) | $-0.19$ | 0.84 | 0.03 | $-1.73$ | 0.08 | 0.26 |
| DASS | Anxiety | 23 | 7.13 (5.62) | 23 | 6.00 (4.59) | 23 | 6.17 (4.71) | $-1.08$ | 0.28 | 0.16 | $-0.94$ | 0.34 | 0.14 |
| | Depression | 23 | 9.22 (8.31) | 22 | 6.27 (5.25) | 21 | 6.76 (4.54) | $-1.31$ | 0.19 | 0.20 | $-1.31$ | 0.19 | 0.20 |
| | Stress | 23 | 13.57 (8.35) | 23 | 9.74 (6.25) | 23 | 10.17 (5.39) | $-2.22$ | 0.02 | 0.33 | $-2.50$ | 0.01* | 0.37 |

*$p < .025$

benefit-consistent changes for two of the IMQ subscale scores (i.e., Being Caught in the Mind and Mindful Responding).

The obtained results were not surprising. First, participants in the study do not represent the general population. As counsellors-in-training, they would likely be attentive, empathic, and sensitive to others. They already presented at baseline a very high level of Attention to and Awareness of the Other Person ($M = 4.17$, $SD = 0.58$) and Mindful Responding ($M = 3.92$, $SD = 0.49$); both were close to the maximum (i.e., 5). Second, IMQ subscales were designed as a set of independent skills, rather than a personality disposition or trait. Therefore, the dimensions are not necessarily equally cultivated at a time point, such that a participant can score high on the two subscales while scoring low on the remaining two subscales, depending upon their level of mindfulness training or involvement in interpersonal-related work.

Therefore, when examining the two subscales that showed very high values at baseline, they were directly related to counselling skills (i.e., Attention to and Awareness of the Other Person and Mindful Responding). Although they increased following the intervention, these subscales did not reach statistical significance (trend was found for Mindful Responding) perhaps due to a ceiling effect produced by prior training of the participants in the measured skills. For the other two subscales (i.e., Being Caught in the Mind and Body-Anchored Presence), participants also showed ameliorations following the intervention and at follow-up without reaching statistical significance (trend for Being Caught in the Mind at 3-month follow-up) because of the limited training time. In fact, the training included a total of nine hours during the six online sessions, with an average of 20-min meditation per session and 10 min daily home practice (culminating to around 8 h of meditation during the 6 weeks including the in-session meditation). This amount of training/practice constitutes a very loose dose of mindfulness training, especially when compared to other standard mindfulness-based programs like MBSR (Kabat-Zinn, 1982, 1990) or MBCT (Segal et al., 2013). In addition, the program was offered online (due to the COVID-19 pandemic), which might have limited the training of the embodied and interpersonal components due to the physical distance and absence of a direct contact with the facilitator and other participants. Moreover, the training program included other objectives besides mindfulness training (e.g., cultivating ambiguity tolerance). As such, it is difficult to reach definite conclusions based on the current training program and specificity of the targeted population.

## General Discussion

Results from Studies One and Two support the four dimensions of the IMQ, while suggesting the absence of a single latent variable (i.e., all items did not load on a single variable) that represents the concept of embodied and embedded mindfulness. This finding is not surprising as the IMQ subscales were developed as a set of skills/abilities that can be cultivated independently and sequentially through mindfulness/meditation and other cognitive-behavior training and practice. In line with that, the results suggested differences among the subscales of the IMQ in terms of necessary training to show significant differences and degree of sensitivity to meditation practice.

In addition, previous mindfulness measures that included awareness and acceptance did not find strong correlations between these two factors among naïve meditators and, therefore, did not yield to a singular global latent variable (e.g., Philadelphia Mindfulness Scale, PHMS, Cardaciotto et al., 2008). Moreover, other measures that measured interoceptive body awareness did not yield a single latent variable when tested with naïve community samples (e.g., Body Mindfulness Questionnaire, Burg et al., 2017; Multidimensional Assessment of Interoceptive Awareness, Mehling et al., 2012). Potential explanations of such phenomenon can be the lack of body-based training among naïve participants and cultural factors. Awareness of the body has been consistently minimized and disregarded in the West while adopting a cartesian dualistic philosophy and a disembodied style of life (Lakoff & Johnson, 1999; Leder, 1990; Mehling et al., 2009). This is also true in the context of scientific research including in measuring mindfulness (see e.g., Khoury et al., 2019, 2017a, b). Therefore, it is not surprising that concepts/practices that are fully anchored in the body can be challenging and difficult to cultivate in a naïve western population.

Results from the pilot study suggested that training on mindfulness may impact interpersonal mindfulness, as trends for both IMQ's Being Caught in the Mind and Mindful Responding subscales were observed. A combination of the pilot study being underpowered, limited in its coverage of interpersonal mindfulness during the training (around half on a single session) and in the amount of mindfulness training/practice, as well as the background of the participants (i.e., counsellors-in-training) may explain the absence of significant results. As mentioned, it is also expected that some skills of interpersonal mindfulness (e.g., Being Caught in the Mind) will develop before others and this process may differ for each population. For example, counsellors in training may be expected to have a higher level of Mindful Responding at baseline and to develop such skill more easily and quickly than the general population due to the nature of their training and clinical work.

Overall, results support that IMQ subscales are valid and are consistent with the proposed embodied and embedded conception of interpersonal mindfulness. IMQ subscales are associated with intrapersonal mindfulness, but not strongly enough to be conceived as the same phenomenon. As expected, meditation experience and mindfulness training

positively affect IMQ subscale scores. Finally, high scores in all IMQ subscales are associated with better outcomes, highlighting important implications for both research and clinical practice.

A central question remains regarding the utility of the IMQ subscales taking in consideration that the IMS was already developed and validated. This is even more relevant as two measures included common components such as attention and awareness to oneself and others and both excluded compassion from their conceptualizations. In addition, the IMS has a global score that captures the concept of interpersonal mindfulness, while IMQ does not present one global latent score. Despite that, the IMQ subscales contribute to the measurement on interpersonal mindfulness in many significant ways.

First, the IMQ subscales conceptualized interpersonal mindfulness as a set of embedded skills/abilities that can be trained independently or sequentially and where the body is central. In line with that, 12 items referred directly to the body among a total of 23 items (i.e., 52%). In addition, five among these 12 items referred to a distinct attention and awareness of dynamic changes in the bodily states of the individual (e.g., item 4, "I notice changes in me during my interactions with the other person") and the other person interacting with them (e.g., item 11, "I notice changes in body language of the other person"). The IMQ only has three items referring directly to the body (specifically, items 15, 16, and 18) and only two (items 15 and 16) specifically use the word *body*.

Second, in line with the conceptualization of the IMQ subscales as a set of skills/abilities, the IMQ subscales items focused solely on very specific, simple, unidimensional, and easily measurable behaviors (e.g., item 3, "I respond with kindness to the other person") and did not include metacognitive abilities, as is the case for the IMS. This led to short and simple items in terms of length/complexity (mean/median item length was 11 words, range: 8–13 words, SD = 1.5). The simplicity and specificity of the IMQ subscales items led to a reading level of 8.5 compared to 9.7 for the IMS items, which has direct implications on the education level and metacognitive abilities of the populations to whom the measure can be administered.

Third, in line with the proposed conceptualization, the IMQ subscales provided very detailed instructions for participants, asked them explicitly to direct their attention towards their internal states and behaviors during the interactions independently of the individual they are interacting with, and the instructions focused on dyadic interactions while providing potential examples of these interactions (e.g., family, friend, colleague). In addition, the IMQ subscales included a reminder that all items apply only during interpersonal interactions. In comparison, the IMS instructions were brief and included all types of interactions (i.e., dyadic or in groups).

In summary, despite the absence of a single latent variable presenting the underlying concept of embodied and embodied mindfulness, the IMQ subscales are useful in operationalizing simple skills/abilities and specific behavioral abilities that can be trained independently or sequentially. Furthermore, they constitute the basis (or ingredients) in developing more complex multidimensional socio-cognitive and metacognitive abilities that can be measured using other interpersonal mindfulness measures like the IMS. Therefore, the IMQ and IMS can be considered complementary and equally beneficial for researchers.

## Limitations and Future Directions

The presented studies have many limitations. First, the participants in the three studies were overwhelmingly female. Although this bias is common in mindfulness research, especially when recruitment takes place mainly using social media (such as Facebook), the lack of male participants might limit the use of the IMQ subscales for males. In addition, even though the samples included participants with different ethnicities and orientations, the majority (over than 60%) of participants were White English-speaking Canadians (as the study was conducted in Canada), which might not fully generalize the IMQ to a non-White/Canadian (or North American) sample. Moreover, most participants had limited meditation experience, which might have limited our results as IMQ subscales may require different levels of mindfulness training and experience. Therefore, participants with higher meditation experience might score high on all the subscales, which may have substantially increased the correlations among the four subscales. As a result, there may be convergence of the subscales into a single global latent variable among highly experienced meditators. In other words, embodied and embedded mindfulness may emerge as a singular concept once skills are trained enough to establish such trait or disposition. We excluded participants with over 600 h of meditation to address reliability-related concerns and to fit our current aims in validating the IMQ among non-highly experienced meditators. This decision limited our ability to test this hypothesis; therefore, it is highly warranted to test this hypothesis in future studies. Second, in three of the four subscales (i.e., Being Caught in the Mind, Body-Anchored Presence, and Attention to and Awareness of the Other Person), items that were part of the final version were worded in a similar direction (i.e., either positive or negative) for each subscale, which might have limited the full potential of the subscales. Third, rest-retest reliability across time was not evaluated in the current studies. Finally, Study Three was a pilot intervention that did not include the IMS, limiting further comparison between the IMS and IMQ. Robust RCTs with a longer and sustained mindfulness training and home practice (such as MBSR or MBCT)

and with a larger number of community-based participants are highly warranted to establish the use and limitations of the IMQ subscales when measuring changes following a mindfulness-based intervention.

The IMQ subscales are the first operationalization of embodiment within interpersonal mindfulness, with important theoretical and practical implications. On a theoretical level, it integrates the complex theory of embodiment when measuring interpersonal mindfulness, making the body central in the definition and measurement of interpersonal mindfulness. On the practical level, by measuring interpersonal mindfulness as a skill/ability based on practice, the IMQ subscales facilitate the integration of embodiment and interpersonal mindfulness in mindfulness-based programs. In addition, the sensitivity of the IMQ subscales to the meditative experience of participants can be very useful in studying the influence of meditation experience on the processes involved in interpersonal mindfulness, as well as on intrapersonal and interpersonal measures. Moreover, the associations between high IMQ subscales and both intrapersonal and interpersonal outcomes are very revealing and warrant conducting more research on the impact of training on interpersonal mindfulness. Finally, while the current paper provides an initial validation of the IMQ subscales and their potential theoretical and practical use, more research is highly warranted to further establish the validity of the IMQ subscales and their usefulness in the emerging field of interpersonal mindfulness.

## Declarations

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