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The Mindful Reappraisal of Pain Scale (MRPS): Validation of a New Measure of Psychological Mechanisms of Mindfulness-Based Analgesia

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Abstract

Objectives: Mindfulness is theorized to decrease the affective amplification of chronic pain by facilitating a shift from emotionally-laden, catastrophic pain appraisals of nociceptive input to reappraising chronic pain as an innocuous sensory signal that does not signify harm. Understanding of these hypothetical psychological mechanisms of mindfulness-based analgesia has been limited by a lack of direct measures. We conducted a series of psychometric and experimental studies to develop and validate the Mindful Reappraisal of Pain Sensations Scale (MPRS).

Methods: After item generation, we conducted exploratory and confirmatory factor analyses of the MRPS in samples of opioid-treated chronic pain patients both before (n=450; n=90) and after (n=222) participating in Mindfulness-Oriented Recovery Enhancement (MORE). We then examined the convergent and divergent validity of the MRPS. Finally, in data from a randomized clinical trial (n=250), the MRPS was tested as a mediator of the effects of MORE on reducing chronic pain severity.

Results: Exploratory and confirmatory factor analyses demonstrated the single-factor structure of the MRPS. The MRPS also evidenced convergent and divergent validity. Mindfulness training through MORE significantly increased MRPS scores relative to supportive psychotherapy

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The University of Utah IRB provided approval for the study.

Informed Consent statement:
Participants provided written informed consent for this study.

($F_{4,425.03} = 16.15$, $p < .001$). Changes in MRPS scores statistically mediated the effect of MORE on reducing chronic pain severity through 9-month follow-up.

Conclusions: Taken together, these studies demonstrate that the MRPS is a psychometrically sound and valid measure of novel analgesic mechanisms of mindfulness including attentional disengagement from affective pain appraisals and interoceptive exposure to pain sensations.

Keywords

chronic pain; decentering; interoceptive exposure; pain appraisal; measurement; mindfulness

Regardless of its nociceptive generators, the experience of pain is influenced by cognitive-affective mechanisms. Catastrophic pain appraisals and consequent negative emotional reactions amplify pain perception (Wiech & Tracey, 2009). As pain becomes chronic, its association with neural systems involved in nociception weakens while pain becomes more strongly coupled with function in cognitive and affective brain circuitry (Hashmi et al., 2013; Kuner & Flor, 2017). Procedures that target nociception (e.g., nerve ablation) and common analgesic drugs (e.g., opioids) may have limited efficacy for addressing psychological mechanisms that maintain and exacerbate chronic pain (Busse et al., 2018; Leggett et al., 2014; Pushparaj et al., 2021). In contrast, mindfulness-based interventions (MBIs) have emerged as promising nonpharmacological pain treatments, with Mindfulness Based Stress Reduction (MBSR) (Cherkin DC et al., 2016; Kabat-Zinn, 1982) and Mindfulness-Oriented Recovery Enhancement (MORE) (Garland, 2013; Garland et al., 2022) among the most widely disseminated and efficacious MBIs for chronic pain. Mindfulness involves nonreactive meta-awareness and acceptance of thoughts, emotions, and sensations (Ludwig & Kabat-Zinn, 2008). Neuroimaging (Jinich-Diamant et al., 2020; Seminowicz et al., 2020; Zeidan et al., 2012) and clinical data (Garland et al., 2022; Hilton et al., 2017; McClintock et al., 2019; Smith & Langen, 2020) provide evidence of the analgesic effects of mindfulness. However, a lack of mechanistic understanding has limited general acceptance of MBIs as first-line pain therapies.

From an experimental medicine perspective, valid measurement of processes mediating treatment-related change is essential to understanding mechanisms of behavioral interventions like mindfulness (Nielsen et al., 2018). Extant psychometric tools do not necessarily capture the contemporary understanding of mechanisms by which mindfulness facilitates pain reduction. For instance, existing measures often center on the degree to which mindfulness helps individuals *accept* their pain (Vowles et al., 2008). Though acceptance is an important process in improving pain-related functional impairment, meta-analyses have shown that acceptance-based interventions may not reduce chronic pain severity (de C Williams et al., 2020) – suggesting that mechanisms other than acceptance account for the analgesic effects of mindfulness. In contrast, mechanistic research shows that cognitive-affective factors may contribute to mindfulness-based pain attenuation (Zeidan & Vago, 2016). A scale addressing the novel pain relieving mechanisms facilitated by MBIs is needed.

Going beyond acceptance, mindfulness has been proposed to decrease negative affective amplification of pain by facilitating a shift from emotionally-laden, catastrophic pain appraisals to reappraising pain as a relatively innocuous sensory signal that does not signify harm (Garland, 2020). Mindfully reappraising pain as pure sensation is consistent with the Buddhist *Abidharma* tradition, which encourages fine-grained, mindful introspection of phenomenological experience to decompose phenomenal gestalts into an impermanent and interdependent flux of cognitive, affective, and sensorial qualia (Nyanaponika, 1998). This shift, which involves reinterpretation the meaning of pain, is thought to be subserved by a range of cognitive processes. First, mindfulness may facilitate attentional disengagement and psychological distancing from pain. Meditation practices that involve disengaging attention from pain and reorienting attention towards the breath (e.g., mindful breathing) or nonpainful body parts (e.g., body scan) may facilitate decentering from catastrophic pain appraisals. Mindfulness meditation attenuates self-referential processes. Recent findings indicate that mindfulness-based analgesia may result from a nociceptive self-referential filtering mechanism, decoupling pain from one's identity and allowing pain to be viewed as a transitory perception within a broader field of meta-awareness (Riegner et al., 2022). In addition, mindfulness may foster interoceptive awareness and exposure to chronic pain sensations (Craske et al., 2011; Flink et al., 2009) by directing patients to focus mindful awareness on the sensations themselves, thereby demonstrating that pain is endurable and not injurious. This approach includes meditation techniques (e.g., mindfulness of pain) involving deconstruction of pain experience into its subcomponent sensations, such as prickling, heat, or numbness, while attending to the borders, permeability, and fluctuation of those sensations (Cayoun et al., 2020; Garland, 2013). Although mindfulness' effects on facilitating a shift from affective to sensory processing of pain sensations has been supported by indirect evidence from self-reports (Garland et al., 2012, 2014) and neuroimaging data (Zeidan et al., 2011), psychometric instruments are not currently available to directly test these mechanistic hypotheses.

To inform future research on mindfulness-based analgesia, here we describe the Mindful Reappraisal of Pain Scale (MRPS). We propose the MRPS as a tool for MBI researchers to measure mechanisms underpinning the effect of mindfulness on pain. The aims of this study were to provide psychometric analysis of the MRPS, ascertain its construct validity, and examine the MRPS as a mediator of the pain relieving effects of mindfulness. We hypothesized that the MRPS would be positively associated with measures of dispositional mindfulness, interoceptive awareness, and adaptive cognitive coping, and would show no association with maladaptive cognitive coping. In addition, we hypothesized that MRPS scores would be sensitive to change following MBI, and that changes in MRPS scores would mediate the effect of MBI on reductions in chronic pain severity.

METHODS

Participants

We first examined the psychometric properties of the MRPS in two distinct samples of individuals with chronic pain who had not been exposed to MBIs. Demographic and clinical characteristics for each baseline sample are reported in Table 1. The first sample (n=450) consisted of baseline data from opioid-treated chronic pain patients enrolled in a randomized clinical trial (RCT) at a university in the Mountain West. Given the size of this sample, it was randomly split into two sub-samples. The first sub-sample was used for the initial exploratory factor analysis of the MRPS, and the second sub-sample was used for confirmatory factor analysis. Finally, data from all participants in the first sample was used to examine bivariate relationships between the MRPS and theoretically aligned constructs of interest. The second sample (n=90) was comprised of opioid treated chronic pain patients that participated in another RCT at a university in the Mountain West.

We then tested the replicability of the MRPS psychometric properties among participants with chronic pain being treated with long-term opioid therapy (n=222) who had been randomized to and completed mindfulness training during RCTs of MORE. Primary trial outcomes have been published elsewhere (Garland et al., 2019, 2022).

Procedures

In two prior RCTs, increases in scores on the Reinterpreting Pain Sensations subscale of the Coping Strategies Questionnaire (CSQ) (Rosenstiel & Keefe, 1983) were found to statistically mediate the effect of MBSR (Garland et al., 2012) and MORE (Garland et al., 2014) on chronic pain severity. Though this scale produced replicable findings indicative of the proposed analgesic mechanisms of mindfulness, the CSQ was not designed to match language used in MBIs. Use of language with which mindfulness practitioners would be familiar is vital to understanding the process by which change occurs. Therefore, we adapted the Reinterpreting Pain Sensations subscale of the CSQ to create the Mindful Reappraisal of Pain Sensations Scale (MRPS), providing a measure directly relevant to mindfulness research. Three coauthors, who were experienced mindfulness practitioners, teachers, and researchers with a combined 40 years of expertise in the mindfulness field adapted and reviewed the items. The items were then re-reviewed by one of the developers of the original CSQ. We performed the adaptation by adjusting language on the CSQ to be congruent with concepts introduced in MBIs. For instance, the CSQ item “I just think of it as some other sensation, such as numbness” implies coping with pain by thinking about pain differently, but mindfulness does not involve generating thoughts. Similarly, the CSQ item “I imagine that the pain is outside my body” implies the use of imagination as a pain coping technique, but mindfulness does not rely on generating images to reduce pain. As such, the language of the CSQ was adjusted to be more meaningful to MBI practitioners. In addition, we generated several other items not found in the original CSQ to provide comprehensive measurement of the aforementioned mechanisms of mindfulness. A comparison of the original CSQ items, and the new MRPS items is shown in Table 2.

Following the development of the MRPS items, we first examined the psychometric properties of the MRPS in two samples of individuals with chronic pain who had not been exposed to MBIs.

The first sample (n=450) consisted of baseline data from opioid-treated chronic pain patients enrolled in a randomized clinical trial at a university in the Mountain West. Given the size of this sample, it was randomly split into two sub-samples. The first sub-sample was used for the initial exploratory factor analysis of the MRPS, and the second sub-sample was used for confirmatory factor analysis. Finally, data from all participants in the first sample was used to examine bivariate relationships between the MRPS and theoretically aligned constructs of interest. The second sample (n=95) was comprised of opioid treated chronic pain patients that participated in another RCT at a university in the Mountain West.

For the aforementioned study samples, the University of Utah Institutional Review Board approved the study procedures and informed consent was obtained from each participant.

Measures

Mindful reappraisal of pain.—The MRPS (α = .84, Ω = .84) is a 9-item questionnaire measured on a likert-type scale (0=never do that, 6=always do that) assessing the frequency of various forms of mindful reinterpretation of pain.

Reinterpretation of pain.—Adapting cognitive coping with pain by reinterpreting painful sensations as sensory experiences was assessed with the 6-item reinterpreting pain sensations (α = .82, Ω = .82) subscale of the CSQ (Rosenstiel & Keefe, 1983) rated on a likert-type scale (0=never do that, 6=always do that).

Cognitive reappraisal.—Adaptive cognitive coping was also measured with the Emotion Regulation Questionnaire's (ERQ; α = .91, Ω = .91) cognitive reappraisal subscale (Gross & John, 2003), a 6-item measure scored on a 7-point Likert scale (1="strongly disagree" to 7="strongly agree") that assesses one's self-reported ability to regulate emotion by reconstruing the meaning of adverse situations (e.g., "When I really want to, I am very capable of changing the way I'm thinking about a situation when I want to feel less negative emotion").

Pain catastrophizing.—As a form of maladaptive cognitive coping, catastrophizing was assessed with the six-item pain catastrophizing subscale of the CSQ (α = .88, Ω = .88). Items on this scale assess the frequency (0=never do that, 6=always do that) with which individuals engage in various dimensions of pain castrophizing like, "I feel I can't stand it anymore," and "It's terrible and I feel it's never going to get any better."

Suppression.—Maladaptive cognitive coping was also measured with the expressive suppression subscale of the ERQ (α = .74, Ω = .76), which assesses suppression of unwanted emotions and experiences.

Interoceptive awareness.—The Multidimensional Assessment of Interoceptive Awareness (MAIA)(Mehling et al., 2012) is a self-report measure with response options ranging on a 6-point Likert scale (0 = Never to 5 = Always). Data from the current sample indicated acceptable internal consistency (average coefficient for the 8 scales: (α = .85, Ω = .84). The MAIA is composed of eight individual scales, specifically *Noticing* (awareness of uncomfortable, comfortable, or neutral body sensations); *Not-Distracting* (tendency to not ignore or distract oneself from pain or discomfort); *Not-Worrying* (tendency to not experience emotional distress with pain or discomfort); *Attention Regulation* (ability to sustain and control attention to body sensations); *Emotional Awareness* (awareness of the connection between body sensations and emotion); *Body Listening* (active listening to the body for insight); *Trusting* (experience of one's body as safe and trustworthy); and *Self-Regulation* (ability to regulate distress by attention to body sensations).

Dispositional mindfulness.—Facets of dispositional mindfulness were measured with the Five Facet Mindfulness Questionnaire (FFMQ; α = .92, Ω = .90) (Baer et al., 2006), a 39-item scale comprising five domains: observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience. Participants rated items on a five-point Likert-type scale (1=*never or very rarely true*, 5=*very often or always true*), from which a total dispositional mindfulness score can be computed.

Data Analyses

First, we employed exploratory factor analysis to determine the factor structure of the MRPS items. Next, we performed confirmatory factor analyses (CFA) of the single-factor model revealed by EFA on data from two new samples of chronic pain patients. Then, we conducted a CFA on participants who had been randomized to and attended MORE group sessions. Three fit indices were used to assess the model according to widely accepted cut-offs as reviewed in Kline (Kline, 2005): (a) the Comparative Fit Index (CFI) – values greater than .90 were considered a good fit; (b) Tucker Lewis-Index (TLI) relative fit index) – values greater than .90 were considered a good fit; and (c) The Root Mean Square Error of Approximation (RMSEA) – values lower than .08. Pearson correlations examined the concurrent and divergent validity of the MPRS with constructs theoretically associated with mindful reappraisal of pain. Next, using data from a RCT, we employed linear mixed modeling with maximum likelihood estimation to examine the MRPS' sensitivity to change following mindfulness training (i.e., via MORE) through a 9-month follow-up. Finally, we used path analysis with boostrapped confidence intervals to test the MRPS as a mediator of the effects of a mindfulness-based intervention (MORE) on chronic pain severity through a 9-month follow-up, after adjusting for baseline levels of chronic pain severity.

RESULTS

Exploratory Factor Analysis with Baseline Samples

See Table 3 for MRPS item descriptive statistics in the baseline samples. To explore the scale's factor structure, we used the maximum likelihood method of parameter estimation followed by oblique rotation (Direct Oblimin) to allow the factors to correlate. The Kaiser-Meyer-Olkin test of sampling adequacy value (.79) and a highly significant Bartlett's test of sphericity (718.80, $p<.001$) indicated that the data were suitable for factor analysis. Results from the initial exploratory factor analysis (EFA), yielded two factors with eigenvalues above 1. Inspection of the eigenvalues and scree plot (Factor 1 eigenvalue = 3.80; Factor 2 eigenvalue = 1.15), suggested that a single factor solution may be most appropriate for these data. Parallel analysis also suggested a single factor solution as only the first eigenvalue was greater than the random data eigenvalues (Factor 1 eigenvalue = 3.80, random data eigenvalue = 1.38; Factor 2 eigenvalue = 1.15, random data eigenvalue = 1.25; etc.). Therefore, a second EFA was performed using the same extraction and rotation methods after constraining the solution to one factor. Table 3 presents the 9-item Mindful Reinterpretation of Pain Scale (MRPS) for a baseline sample. Inspection of the item-level statistics indicate all items loaded above .40 on the single factor. The average factor loading was .59.

Confirmatory Factor Analysis with Baseline Data Samples

We performed two confirmatory factor analyses (CFA) of the single-factor model revealed by EFA on data from two new samples of chronic pain patients (n=205; n=95) using AMOS 26 (IBM SPSS). Five fit indices were used to evaluate model fit: the chi-square value (χ^2), the comparative fit index (CFI) (Bentler, 1990), the Tucker–Lewis Index (TLI) (Tucker & Lewis, 1973), the root mean square error of approximation (RMSEA) (Browne & Cudeck, 1993; Steiger, 1990), and the standardized root mean squared residual (SRMR) (L.-T. Hu & Bentler, 1995). A non-significant χ^2 value, CFI and TLI values above .95, RMSEA values below .06, and SRMR values below .08 indicate the model fits the data well (Brown, 2015; L. Hu & Bentler, 1999).

All models fit the data well, allowing for errors to co-vary (See Table 4). In each sample, all 9 MRPS items were significantly related to the latent factor (Sample 1: all *p*s < .001; Sample 2: all *p*s < .004). Figure 1 illustrates the loadings for each of the MRPS items in the baseline samples.

Confirmatory Factor Analysis with Post-Treatment Data

Participants in the post-intervention sample who had been randomized to and attended MORE group sessions were included in a CFA to test the single factor structure of the MRPS with participants who had mindfulness experience. Table 5 presents the 9-item Mindful Reinterpretation of Pain Scale (MRPS) for the post sample. All items loaded above .64 on the single factor, and the average standardized factor loading was .71. Allowing for errors to co-vary, the model fit the data well (See Table 6 for fit indices). Further, in the post-treatment sample, the 9 MRPS items were significantly related to the latent factor (all *p*s < .001). Figure 2 illustrates the loadings for each of the MRPS items in the post samples.

Convergent and Discriminant Validity

To explore the MRPS' convergent and discriminant validity, we computed Pearson correlation coefficients (Table 7) to examine relationships between the MRPS and multidimensional measures of adaptive cognitive coping, maladaptive cognitive coping, interoceptive awareness, and dispositional mindfulness. The MRPS was found to be positively associated with CSQ reinterpretation of pain sensations and ERQ cognitive reappraisal. In contrast, the MRPS was not associated with maladaptive cognitive coping via suppression or pain catastrophizing. The MRPS also correlated with a number of facets of interoceptive awareness as measured by the MAIA, with the strongest associations found with the MAIA self-regulation and body listening subscales. Finally, the MRPS was most strongly associated with the observing facet of the FFMQ, but was only weakly associated with the other FFMQ subscales, indicating that the MRPS measures a construct distinct from dispositional mindfulness.

Sensitivity of the MRPS to Mindfulness Training

In an intention-to-treat analysis of data (n=250) from the mindfulness training sample 1 (NCT02602535), linear mixed modeling with maximum likelihood estimation revealed a significant treatment (MORE vs. supportive therapy) by time (baseline, post-treatment, 3-, 6-, and 9-month follow-up) interaction for MRPS scores ($F_{4,425.03} = 16.15$, $p < .001$, Cohen's D Δ from baseline to 9-month = 1.51). Participants allocated to MORE evidenced significantly greater increases in MRPS scores (pre-treatment $\bar{x} = 13.24$, $S.E.$ = .94; post-treatment $\bar{x} = 26.75$, $S.E.$ = 1.03; 9-month follow-up $\bar{x} = 24.11$, $S.E.$ = 1.19) in comparison with SG participants (pre-treatment $\bar{x} = 11.77$, $S.E.$ = .98; post-treatment $\bar{x} = 15.37$, $S.E.$ = 1.06; 9-month follow-up $\bar{x} = 14.02$, $S.E.$ = 1.17).

MRPS Mediation of Mindfulness-Based Chronic Pain Relief

In the largest of the RCT samples (sample 1; N=250) we additionally examined whether the effects of MORE (vs. a SG) on reducing chronic pain severity were mediated by post-treatment MRPS scores, adjusted for baseline MRPS values. Controlling for baseline pain severity, changes in MRPS scores significantly mediated the effect of MORE on pain severity through 9-month follow-up B = −.35, SE = .10, p<.001 (see Figure 3).

DISCUSSION

To advance understanding of the psychological mechanisms of mindfulness-based analgesia, here we developed and validated the Mindful Reappraisal of Pain Sensations (MRPS) scale, comprised of items that assess the capacity to shift from affective to sensory processing of pain sensations via attentional disengagement from and interoceptive exposure to pain. Across multiple samples, the MRPS exhibited excellent psychometric properties via factor analysis, demonstrated convergent validity with related constructs, showed sensitivity to change following mindfulness-based intervention, and was a significant mediator of mindfulness-based pain relief.

In contrast to measures focused on acceptance as a mechanism of mindfulness, the MRPS assesses two distinct attentional stances towards pain—distancing and exposure. When considered in tandem, these mindful attentional stances towards pain may afford a means of reappraising pain from being viewed as a self-referential, emotionally-laden, threatening and anguishing experience to an experience of transitory and innocuous sensation without self-relevance.

These stances may be analogized to a zoom lens on a camera. First, mindfulness may be used to "zoom out" from pain by shifting attention from pain to sensations of respiration, non-painful body sensations distal to the site of injury, and/or to a metacognitive perspective in which the practitioner observes pain from a psychological distance, as a witness. Regarding the latter process, disidentification from pain may attenuate self-referential processing, and thereby disrupt maladaptive pain appraisals, pain catastrophizing, and emotional suffering.

In contrast, mindfulness may be used to "zoom into" pain by engaging attention with the constituent sensations comprising pain experience, and thereby disrupting affective pain appraisals. This meditation technique may facilitate interoceptive exposure to pain sensations (Cayoun et al., 2020), reducing their negative emotional valence through habituation and extinction of conditioned aversive responses (Craske et al., 2011; Flink et al., 2009). Moreover, nuanced and fine-grained use of interoceptive attention to notice the precise distribution, quality, and boundary of sensations labeled as pain may modify pain-related memories and expectations. From the perspective of “pain perception as inference”, inferences and predictions derived from past pain episodes shape and modulate current pain experience (Labrenz et al., 2016; Tabor et al., 2017; Wiech, 2016; Wiech et al., 2014). Recurrent cognitive and emotional reactivity to pain episodes may accrue into cognitive schema that bias perception and interpretation of the current physiological condition of the body, obscuring patients’ interoceptive awareness of non-painful sensations and increasing the likelihood that innocuous sensations will be interpreted as painful (Clauwaert et al., 2018; Durnez & Van Damme, 2015; Strigo et al., 2008; Van Damme et al., 2018; Vanden Bulcke et al., 2013). Hypothetically, mindfulness might reverse this process in the treatment of chronic pain, revealing the impermanent nature of pain experience and allowing patients to identify “spaces” within the painful body area where there is either no pain at all, or potentially, pleasant sensations proximal to painful ones (Garland, 2020; Hanley & Garland, 2019). Thus, using mindfulness to “zoom into” pain may yield insights congruent with classical Buddhist and Trika Shaiva teachings that all experiences (including pain) are comprised of emptiness and bliss (Dyczkowski, 1987; Namgyal, 2006; Nyanaponika, 1998).

In support of these contentions, present study found that “zooming in and out” of pain, as measured by the MRPS, mediated the effects of mindfulness training (via the MORE intervention) on reduced chronic pain severity in a large sample of patients on long-term opioid therapy. These findings parallel those from earlier RCTs of MORE and MBSR showing that the effects of mindfulness training on reducing chronic pain severity were mediated by increases in scores on the reinterpretation of pain sensations subscale of the CSQ (Garland et al., 2012, 2014). Taken together, these data suggest that mindfulness may alleviate chronic pain by shifting from affective to sensory processing of pain sensation. This notion is paralleled by neuroimaging findings demonstrating that the analgesic effects of mindfulness are associated with corticothalamic modulation of ascending nociceptive input and increased insula activation suggestive of enhanced interoceptive awareness (Zeidan et al., 2011, 2015). Moreover, recent fMRI data indicate that mindfulness reduces pain by decoupling the thalamus from nodes of the default mode network during noxious stimulation (Riegner et al., 2022), suggesting that the analgesic effects of mindfulness stem from disentangling self-referential processing from pain-related sensation. Hypothetically, this process may be reflected by MRPS items assessing the capacity to separate the sense of self from pain-related experience. Future neurophenomenological research could examine the neurocorrelates of changes in MRPS scores occasioned by mindfulness training to gain insight into the mechanisms by which meditation practices with distinct attentional stances (distancing and exposure) reduce pain. Such neuroscience investigations could complement recent clinical studies that have discriminated effects of a distancing practice (i.e., mindful breathing) from an exposure-focused mindfulness of pain practice (Hanley et al., 2021).

Limitations and Future Directions

This study had several limitations. First, the MPRS’ sensitivity to change was examined in response to one type of MBI (MORE). Future studies should test whether other multi-week MBIs (MBSR, MBCT) and brief mindfulness interventions reduce pain by increasing MRPS scores. Second, the attentional stances of distancing versus exposure represented by the MRPS seem at face value to be theoretically distinct facets, but factor analysis in our samples found the MRPS to be underpinned by a single, unitary factor. Future studies should seek to test whether the MRPS is indeed a single factor or whether stable and distinct subscales representing each of these attentional stances toward pain can be derived from the MRPS item set. Moreover, unidimensional Rasch or Item Response Theory models could be used to increase the precision of the MRPS (Hobart & Cano, 2009), and Generalizability Theory could be used to establish the temporal reliability of the MRPS at baseline and post-MBI follow-ups, distinguish between state and trait assessment of mindful reappraisal of pain, and determine the overall generalizability of MRPS scores (Medvedev & Siegert, 2022). Third, common method bias may have limited our assessment of convergent and discriminant validity. That is, presenting multiple-item scales within the same survey may lead to spurious correlations among items due to response styles, social desirability, or priming effects which are independent from any true association among the constructs measured (Podsakoff et al., 2012). Finally, the chronic pain samples in the present investigation were largely Caucasian, opioid-treated, and from the Intermountain West; to increase its generalizability, the MRPS should also be validated in racially and geographically diverse samples of patients with chronic pain.

In conclusion, the MRPS appears to be a psychometrically sound and valid measure of understudied analgesic mechanisms of mindfulness including attentional disengagement from affective pain appraisals and interoceptive exposure to pain sensations. By facilitating precise quantification of these psychological mechanisms of mindfulness, further development and deployment of the MRPS will contribute to the ongoing understanding of mindfulness as a treatment for chronic pain.

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Conflict of interest statement:

ELG is the Director of the Center on Mindfulness and Integrative Health Intervention Development. The Center provides Mindfulness-Oriented Recovery Enhancement (MORE), mindfulness-based therapy, and cognitive behavioral therapy in the context of research trials for no cost to research participants; however, Dr. Garland has received honoraria and payment for delivering seminars, lectures, and teaching engagements (related to training clinicians in mindfulness) sponsored by institutions of higher education, government agencies, academic teaching hospitals, and medical centers. Dr. Garland also receives royalties from the sale of books related to MORE. Dr. Garland has also been a consultant and licensor to BehaVR, LLC. No other authors have any related conflicts of interest to disclose.

Data Availability Statement:

Data are available upon reasonable request to eric.garland@socwk.utah.edu with a signed data access agreement.

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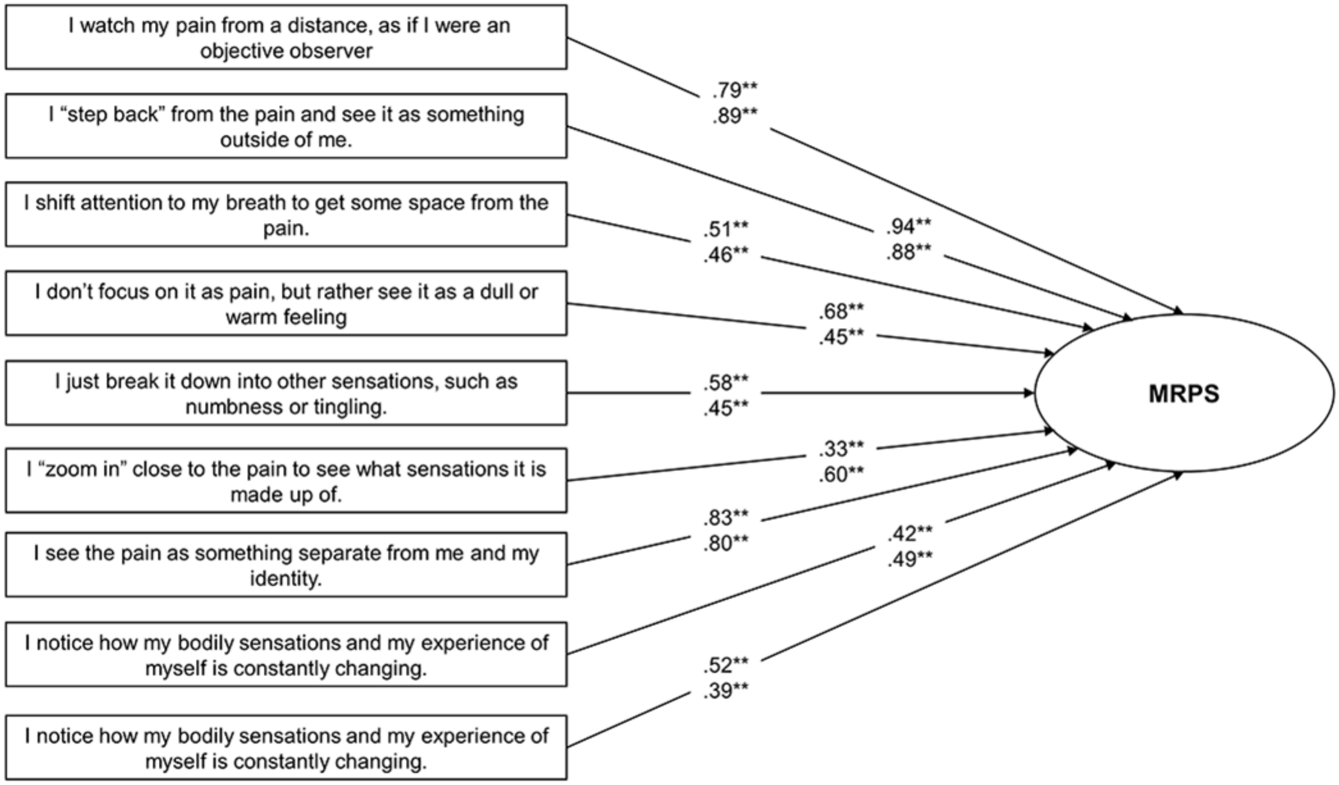

Figure 1.

Factor loadings for each MRPS item (standardized beta coefficients) onto the latent factor for each of the baseline samples. Baseline sample 1 on top and sample 2 on bottom.

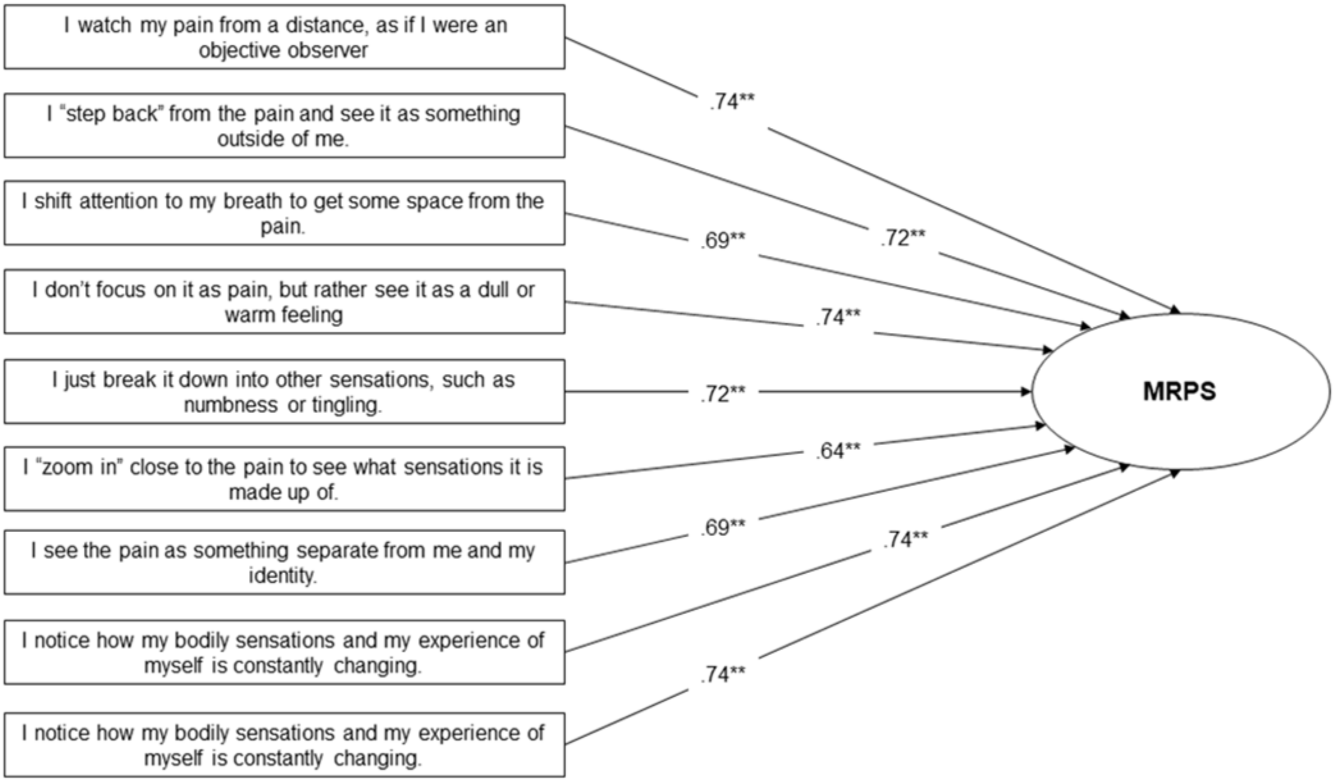

Figure 2.
Factor loadings (standardized beta coefficients) for each of the MRPS items onto the latent factor for the post-mindfulness training sample.

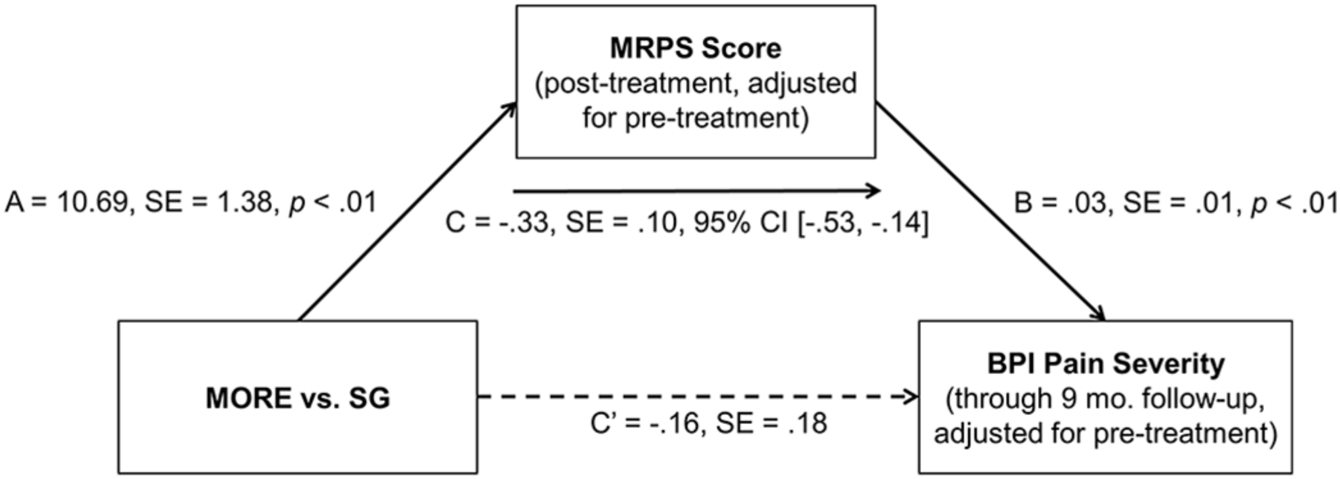

Figure 3.

Path model demonstrating that the effect of MORE on reducing chronic pain severity (Brief Pain Inventory-BPI) was statistically mediated by increases scores on the MRPS. The (A) pathway represents the effect of treatment condition (MORE vs. supportive group [SG] therapy) on MRPS scores (the mediator). The (B) pathway represents the effect of MRPS scores (the mediator) on pain severity through 9-month follow-up (the dependent variable). The (C) pathway represents the indirect (mediational) effect, with the confidence interval not spanning zero indicating the significance of the indirect effect. The (C') pathway represents the direct effect of treatment condition on pain severity in the presence of the mediator. Unstandardized beta coefficients (indicated by B) are reported.

Table 1.

A Comparison of the original CSQ items and the adapted MRPS items.

CSQ	MRPS
I try to feel distant from pain, almost as if the pain was on somebody else's body	I "step back" from the pain and see it as something outside of me.
I don't think of it as pain, but rather as a dull or warm feeling	I don't focus on it as pain, but rather see it as a dull or warm feeling.
I just think of it as some other sensation, such as numbness	I just break it down into other sensations, such as numbness or tingling.
I try not to think of it as my body, but rather as something separate from me	I see the pain as something separate from me and my identity.
I imagine that the pain is outside of my body	I am aware that my experience of myself is bigger than any one pain or sensation.
I pretend it's not a part of me	I watch my pain from a distance, as if I were an objective observer.
Additional Items	
	I shift attention to my breath to get some space from my pain.
	I notice how my bodily sensations and my experience of myself is constantly changing.
	I "zoom in" close to the pain to see what sensations it is made up of.

Table 2.

Demographic and Clinical Characteristics of Baseline Samples

	Baseline Sample 1 n = 450	Baseline Sample 2 n = 95
Age, M±SD	54.2 ± 12.6	56.5 ± 11.9
Gender, n(%)		
Female	195 (43%)	60 (66.7%)
Male	250 (56%)	28 (31.1%)
Transgender or Other	5 (1%)	2 (2.2%)
Race/ethnicity, n(%)		
White or Caucasian	389 (86.4%)	81 (90%)
Hispanic or Latinx	28 (6.2%)	3 (3.3%)
Black or African American	11 (2.4)	0
American Indian or Alaska Native	9 (2%)	0
Asian or South Asian	2 (.4%)	1 (1.1%)
Hawaiian or Pacific Islander	3 (.7%)	1 (1.1%)
Other or Multiracial	8 (1.8%)	4 (4.4%)
Highest Level of Education, n(%)		
Did not complete high school	22(4.9%)	4 (4.4%)
Completed high school or G.E.D.	228(50.6%)	39 (43.4%)
2-year college degree or trade school	73(16.2%)	12 (13.3%)
4-year college degree	83(18.5%)	20 (22.3%)
Completed graduate degree	43(9.6%)	15 (16.6%)
Est. Household Income, n(%)		
≤ $25,000	163 (36.2%)	33 (36.7%)
$25–49,999	141 (31.3%)	30 (33.3%)
$50–74,999	66 (14.7%)	12 (13.3%)
$75–99,999	33 (7.3%)	5 (5.6%)
$100–149,999	33 (7.3%)	5 (5.6%)
≥ $150,000	13 (2.9%)	5 (5.6%)
Primary Pain Type or Location, n(%)		
Back Pain	203 (45%)	41 (45.6%)
Hip/Leg/Knee/Ankle/Foot Pain	99 (22%)	18 (20%)
Neck/Shoulder/Arm/Wrist Pain	53 (11.8%)	12 (13.3%)
Arthritis/Global Joint Pain	21 (4.7%)	3 (3.3%)
Head/Migraine	17 (3.8%)	2 (2.3%)
Fibromyalgia	24 (5.3%)	6 (6.7%)
Stomach/Bladder/Liver/Uterus	13 (2.9%)	2 (2.3%)
Other Pain Type or Location	20 (4.4%)	6 (6.7%)
Mean Pain Severity (0–10), M±SD	5.51 ± 1.53	5.34 ± 1.56
Mean Pain Interference (0-10), M±SD	6.13 ± 2.11	5.74 ± 2.17
Daily Opioid Dose (MME), M±SD	117.83 ± 265.43	67.78 ± 92.04

Table 3.

Means, Standard Deviations, Factor Loadings, and Item-Total Correlations for the Mindful Reinterpretation of Pain Scale in a Baseline Sample.

	Scale Item	*M*	*SD*	F	I-T
1.	I watch my pain from a distance, as if I were an objective observer.	0.83	1.27	.639	.51
2.	I “step back” from the pain and see it as something outside of me.	0.76	1.20	.717	.58
3.	I shift attention to my breath to get some space from my pain.	2.14	1.80	.595	.55
4.	I don’t focus on it as pain, but rather see it as a dull or warm feeling.	0.89	1.29	.593	.54
5.	I just break it down into other sensations, such as numbness or tingling.	1.06	1.39	.561	.52
6.	I “zoom in” close to the pain to see what sensations it is made up of.	1.31	1.66	.412	.40
7.	I see the pain as something separate from me and my identity.	1.03	1.49	.668	.58
8.	I notice how my bodily sensations and my experience of myself is constantly changing.	1.83	1.80	.594	.59
9.	I am aware that my experience of myself is bigger than any one pain or sensation.	2.04	1.93	.501	.48

Note. All scores based on Sample 1 data (n=245). Items were introduced by the following: “Below is a list of things that people have reported doing when they feel pain. For each activity, please indicate, using the scale below, how much you engage in that activity when you feel pain. Please mark the number that indicates how often you do the thing listed in the question.” A 7-point scale was used, anchored by 0 = “Never do that” and 6 = “Always do that” along with a midpoint anchor 3 = “ Sometimes do that.”

M = mean; SD = standard deviation; F = factor-loading; I-T = item-total correlation.

Table 4.

Fit Indices for the MRPS 1-Factor Model for Two Baseline Study Samples of Opioid-Treated Chronic Pain Patients (n = 450, n = 95).

	χ^2	p	CFI	TLI	RMSEA	SRMR	α
Sample 1	23.25	.11	.993	.983	.047	.029	.87
Sample 2	26.21	.20	.986	.975	.053	.063	.87

Table 5.

Means, Standard Deviations, Factor Loadings, and Item-Total Correlations for the Mindful Reinterpretation of Pain Scale in Post Sample of Participants Experienced in Mindfulness

	Scale Item	*M*	*SD*	F	I-T
1.	I watch my pain from a distance, as if I were an objective observer.	2.17	1.69	.724	.76
2.	I “step back” from the pain and see it as something outside of me.	2.28	1.71	.722	.77
3.	I shift attention to my breath to get some space from my pain.	3.95	1.48	.691	.64
4.	I don’t focus on it as pain, but rather see it as a dull or warm feeling.	2.18	1.71	.737	.71
5.	I just break it down into other sensations, such as numbness or tingling.	2.45	1.63	.717	.69
6.	I “zoom in” close to the pain to see what sensations it is made up of.	2.65	1.74	.640	.61
7.	I see the pain as something separate from me and my identity.	2.27	1.83	.685	.69
8.	I notice how my bodily sensations and my experience of myself is constantly changing.	3.09	1.62	.744	.65
9.	I am aware that my experience of myself is bigger than any one pain or sensation.	3.46	1.64	.743	.69

Note. All scores based on post sample data (N=222). A 7-point scale was used, anchored by 0 = “Never do that” and 6 = “Always do that” along with a midpoint anchor 3 = “Sometimes do that.”

M = mean; SD = standard deviation; F = standardized factor-loading; I-T = item-total correlation.

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Table 6.

Fit Indices for the Confirmatory Factor Analysis with Post-Mindfulness Training Data from Sample of Opioid-Treated Chronic Pain Patients Participating in MORE (n = 222).

	χ^2	p	CFI	TLI	RMSEA	SRMR	α
Post-Mindfulness Training Sample	25.12	.197	.996	.992	.034	.023	.91

Table 7.

Convergent and discriminant validity of the MRPS.

	Sample 1 n=450	Sample 2 n=95
CSQ: Reinterpretation	.72***	.74***
ERQ: Cognitive Reappraisal	.25***	.25*
CSQ: Pain Catastrophizing	.08	−.04
ERQ: Expressive Suppression	.09	.09
MAIA: Noticing	.29***	.28**
MAIA: Not-Distracting	−.22***	−.18
MAIA: Not-Worrying	.01	.08
MAIA: Attention Regulation	.29***	.34**
MAIA: Emotional Awareness	.33***	.36***
MAIA: Self-Regulation	.37***	.51***
MAIA: Body Listening	.41***	.45***
MAIA: Trusting	.13**	.10
MAIA: Total Dispositional Mindfulness	.02	.29**
FFMQ: Observing	.30***	.38***
FFMQ: Describing	−.05	.19
FFMQ: Acting with Awareness	−.08	.03
FFMQ: Non-Judging	−.16**	.05
FFMQ: Non-Reacting	.10*	.28**