

## Research paper

# Not all types of meditation are the same: Mediators of change in mindfulness and compassion meditation interventions

Pablo Roca<sup>a,\*</sup>, Carmelo Vazquez<sup>a</sup>, Gustavo Diez<sup>b</sup>, Gonzalo Brito-Pons<sup>b</sup>, Richard J McNally<sup>c</sup>

<sup>a</sup> School of Psychology, Complutense University of Madrid, Spain

<sup>b</sup> Nirakara Lab, Complutense University of Madrid, Spain

<sup>c</sup> Department of Psychology, Harvard University, USA



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## ABSTRACT

**Background:** The general aim of the study was to examine the relative effectiveness and mediators of change in standardized mindfulness and compassion interventions.

**Methods:** A sample of 431 participants enrolled in a Mindfulness-Based Stress Reduction program (MBSR = 277) and a Compassion Cultivation Training (CCT = 154). The assessment before and after the program included a set of outcomes and mediators measures. A three-step data analysis plan was followed: ANCOVAs, Reliable Change Index, and mediations (simple and multiple).

**Results:** Both interventions yielded increased mindfulness, decentering, body awareness, and self-compassion. Yet, present-moment awareness improvements (i.e., decentering, and body awareness) were significantly larger in the MBSR than in CCT, whereas socio-emotional changes (i.e., common humanity and empathic concern) were larger in the CCT than in MBSR. The magnitude of effect sizes ranged from medium to large. Furthermore, both mindfulness and compassion interventions yielded similar changes in psychological distress (i.e., stress, anxiety, and depression), maladaptive cognitive processes (i.e., rumination and thought suppression), and well-being. The mediation models showed that although the MBSR program seemingly relies on changes in present-moment awareness mechanisms (i.e., decentering and body awareness) to reduce psychological distress and to improve well-being, the CCT program seemingly achieves the same positive outcomes through changes in socio-emotional mechanisms (i.e., common-humanity and empathy concern).

**Limitations:** Due to our naturalistic design in real-world community setting, it was infeasible to randomly assign participants to conditions.

**Conclusions:** Our results suggest that mindfulness and compassion programs operate through different pathways to reduce psychological distress and to promote well-being.

## 1. Introduction

Research on meditation has grown exponentially (Kabat-Zinn, 2019), documenting the benefits of Mindfulness-Based Interventions (MBIs) for people with psychological disorders and medical conditions (Goldberg et al., 2018; Greeson and Chin, 2019) as well as for healthy individuals (Sedlmeier et al., 2018). Yet the mechanisms mediating benefits of different MBIs, such as Mindfulness Based Stress Reduction (MBSR) and Compassion-Based Interventions (CBIs) remain understudied (Dahl et al., 2015; Gu et al., 2015; Kirby et al., 2017).

*Mindfulness* signifies attending to one's immediate experience non-judgmentally (Kabat-Zinn, 2003), whereas *compassion* denotes

sensitivity to the suffering of oneself and others with a commitment to prevent it and relieve it (Gilbert and Choden, 2013). "Mind training" as a way to alleviate unnecessary suffering while enhancing flourishing and well-being is central to both mindfulness and compassion practices. However, these MBIs differ in their emphasis (Jinpa, 2019): 1) being in the present moment is the core of mindfulness, whereas compassion includes exercises evoking past and future scenarios; 2) whereas mindfulness mainly trains a nonjudgmental acceptance of one's experience, compassion practice trains the affective and motivational states of empathy, warmth, and kindness toward oneself and others; 3) contemporary mindfulness also promotes the observer's "neutral" standpoint, whereas compassion emphasizes the appraisal of one's "negative/"

\* Corresponding author at: School of Psychology, Universidad Complutense de Madrid, Madrid 28223, Spain.

E-mail address: [pabloroc@ucm.es](mailto:pabloroc@ucm.es) (P. Roca).

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unpleasant” thoughts and feelings; and 4) compassion training has a more prominent ethical component than does mindfulness training.

Hence, mindfulness training emphasizes self-regulation of attention and present-moment awareness (i.e., attentional family), whereas, compassion training emphasizes socio-emotional skills and prosocial qualities (i.e., constructive family) (Dahl et al., 2015). Despite the difference in emphasis, affective and cognitive processes figure in both approaches (Dahl et al., 2016). On the one hand, in mindfulness programs, participants not only learn attentional practices (Lutz et al., 2008), they also learn how to non-reactively monitor of their experiences to control stress and anxiety (Kabat-Zinn, 2013). On the other hand, although compassion programs mainly foster empathy for the suffering of oneself and others while bolstering motivation to alleviate suffering, they also train attention (Strauss et al., 2016).

As meta-analyses have shown, MBIs significantly reduce stress, anxiety, depression, and enhance quality of life (Gotink et al., 2015; Khoury et al., 2015), and psychological well-being (Carmody and Baer, 2008). Meta-analyses also suggest that CBIs significantly increase compassion, mindfulness and well-being, while reducing anxiety, depression and psychological distress (Kirby et al., 2017).

Despite the growing scientific interest in mindfulness and other forms of meditation, few studies have investigated the differential effects of various practices (Dahl and Davidson, 2019). Preliminary evidence suggests that mindfulness and compassion practices yield different psychological effects and involve different mechanisms of change (Fox et al., 2016; Singer and Engert, 2019; Vago et al., 2019). Whereas mindfulness practice (i.e., attention family) increases present-moment awareness, body awareness, and attentional performance, compassion practices (i.e., constructive family) reduce social stress sensitivity and increase ethical-social qualities (e.g., compassion, altruism, and feelings of love) (Singer and Engert, 2019). Hildebrandt et al. (2017) found that present-centered awareness was increased by both attentional and constructive practices. However, only compassion meditation significantly changed socio-emotional and motivational qualities, such as nonjudgmental attitude, acceptance, and compassion for self and others.

In sum, not all meditation types are the same. Despite some common elements, mindfulness and compassion practices appear to operate via different mechanisms (Desbordes et al., 2012; Fox et al., 2016). In a meta-analysis of neuroimaging studies, Fox et al. (2016) found that some brain areas are involved across different meditation types (i.e., insula, pre/supplementary motor cortex, dorsal anterior cingulate cortex, and frontopolar cortex). However, they also found dissociable patterns of brain activation and deactivation across meditation types. Furthermore, Desbordes et al. (2012) found evidence of differential changes in brain responses to emotional stimuli after 8-week mindfulness and compassion trainings. The mindfulness group exhibited a decrease in amygdala activation when viewing images of any valence (i.e. negative, positive, or neutral), whereas the compassion group exhibited a marginal increase in amygdala activation when viewing negatively valenced images. Similarly, Roca and Vazquez (2020a) showed that standardized 8-week mindfulness and compassion programs significantly change early stages of the attentional processing of emotional information.

Unfortunately, few studies have directly compared standardized mindfulness and compassion programs. In a pioneering study, Brito-Pons et al. (2018) found that both programs were similarly effective in enhancing well-being, mindfulness, and compassion skills. Yet, the compassion program had a greater impact on compassion-related measures (i.e., self-compassion, empathic concern, and common humanity) than did the mindfulness one. Compassion training significantly reduced symptoms of depression, but not anxiety, whereas mindfulness reduced both. Furthermore, measures of compassion and depression are often negatively correlated (Salinger and Whisman, 2020), and compassion predicts reduction in depression symptoms better than mindfulness does (Van Dam et al., 2011). However, most comparative studies on

meditation modalities have involved relatively small sample sizes and designs incapable of detecting potentially distinct mechanisms of change.

In this study, we examined the relative effectiveness and mediators of change in standardized mindfulness and compassion programs: Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 2013) and Compassion Cultivation Training (CCT; Goldin and Jazaieri, 2017). We tested whether (1) mindfulness and compassion meditation programs enhance mindfulness, compassion, and well-being, while reducing psychological distress (i.e., stress, anxiety, and depression) and maladaptive cognitive processes (i.e., rumination and thought suppression); and (2) whether changes in mindfulness and compassion within each program individually (i.e., simple mediations) and simultaneously (i.e., multiple mediations) mediate changes in psychological distress and well-being. Accordingly, we hypothesized that although both programs should improve levels of mindfulness and compassion, MBSR would be more effective than CCT in boosting mindfulness but less effective in enhancing compassion. Second, we expected that despite an overall improvement in symptoms of distress, MBSR would be more effective than CCT in reducing stress-anxiety but less effective than CCT in diminishing depression, whereas both programs would similarly enhance well-being. Third, we predicted that the mechanisms mediating the relationship between the programs and their effects on psychological distress and well-being would differ between programs. More specifically, we expected that increases in mindfulness, decentering, and body awareness would mediate the relationship between MBSR and its main psychological outcomes, whereas increases in compassion and empathy would mediate the relation between CCT and its main psychological outcomes.

## 2. Method

### 2.1. Participants

We analyzed the data of 431 participants: 277 in MBSR and 154 in CCT (see Fig. 1). Participants' mean age was 45.95 ( $SD=10.16$ ), 73.3% were women, 78% had university studies, 43.9% were married, and 7.5% were unemployed. The mindfulness and compassion groups did not differ in gender ( $\chi^2_{(1)} = .66, p = .42$ ), nationality ( $\chi^2_{(1)} = .32, p = .57$ ), and education ( $\chi^2_{(1)} = .22, p = .64$ ). However, the MBSR group was younger than the CCT group ( $t_{(429)} = -3.61, p < .001$ ;  $MBSR_{age} = 44.65$ ;  $CCT_{age} = 48.29$ ), and reported practicing less weekly formal meditation before starting the program ( $t_{(429)} = -5.09, p < .001$ ;  $MBSR_{practice} = 58.40$  min;  $CCT_{practice} = 130.44$  min). We defined “prior meditation experience” as any formal contemplative practice whereby individuals devoted specific periods to meditation (either sitting or moving). That is, we excluded being merely mindfully aware while conducting one's everyday activities.

Inclusion criteria were as follow: 1) being at least 18 years old; 2) not having any current serious physical illness, psychological disorder, or substance abuse; 3) having completed both pre- and post-assessments; and 4) having attended at least 6 of the 8 sessions (i.e., 75% of the program). G\*Power (v. 3.1) was used to estimate sample size (see Supplementary Materials).

### 2.2. Procedure

Participants were invited to join the study during the registration phase on the university's official website offering the MBSR and CCT programs. Participants then completed an online screening questionnaire on demographics and inclusion criteria and gave their informed consent prior to their inclusion in the study. The procedure included the completion of an online assessment (via Qualtrics software) during the week before starting the program (i.e., pre-assessment) and during the week after its completion (post-assessment). At the end of the last assessment session each participant was debriefed on the goals of the

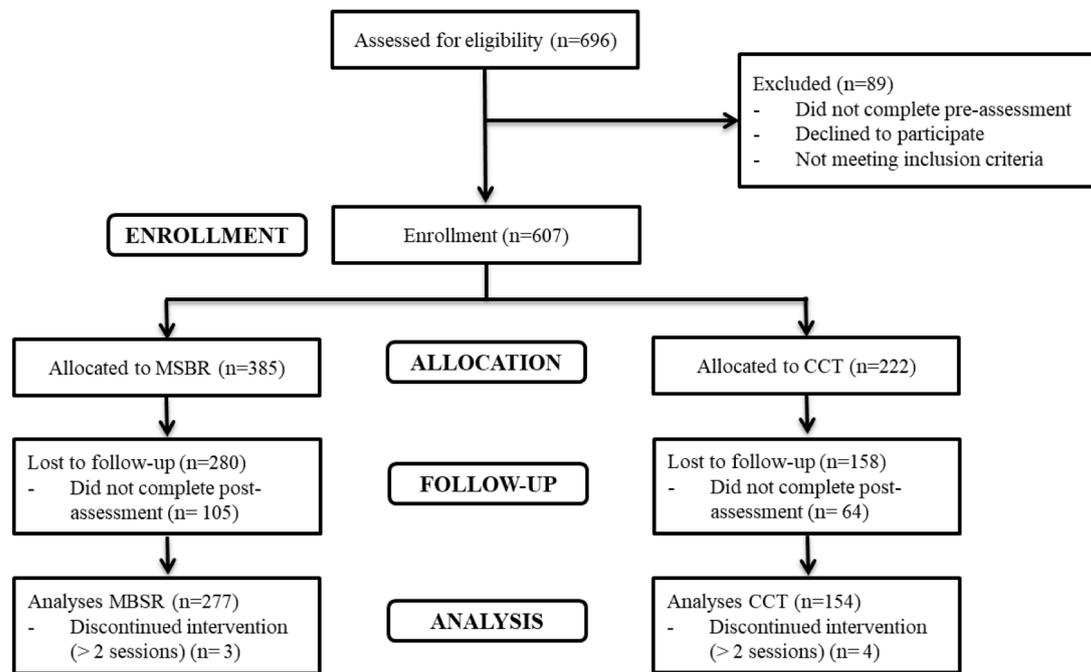


Fig. 1. Participants flow diagram.

study and received a report summarizing his or her pre-post changes on the questionnaire measures. The research was approved by the university ethics committee prior to participant recruitment (Ref 2016/17-016) and was registered at ClinicalTrials.org (NCT03920241).

### 2.3. Programs description (MBSR and CCT)

MBSR and CCT are 8-week evidence-based programs that offer secular meditation training, combining insights and techniques from Western psychology and Eastern contemplative practice. The programs were conducted in groups of 20-30 participants, consisted of 2.5-hour of face-to-face sessions per week, and 30-45 minutes of daily practices (formal and informal). The MBSR program aims to cultivate awareness by training participants to attend to, and non-judgmentally accept, any stimulus or thought that comes to mind. During the MBSR participants perform different mindfulness practices including focused attention on one's breath, open monitoring of awareness in body-scanning, and simple yoga postures (for more details see Supplementary Table 1). In contrast, Compassion Cultivation Training (CCT) aims to cultivate compassion and empathy toward oneself and others. During the CCT different compassion exercises are practiced, including loving kindness and compassion for a loved one, for oneself and toward others, as well as active compassion practices (known as *tonglen*), which involve explicit evocation of the altruistic wish to diminish the suffering of others (for more details see Supplementary Table 2). Furthermore, all participants received at the end of the first session a set of pre-recorded audio files and a workbook to support their corresponding daily practices. The MBSR program was guided by three certified instructors of the Mindfulness Center at Brown University (<https://www.brown.edu/public-health/mindfulness/home>) and the CCT program was conducted by two certified instructors of the Center for Compassion and Altruism Research and Education at Stanford University (<http://ccare.stanford.edu>). Program fidelity was continuously supported through regular group supervision meetings.

### 2.4. Measures

Different outcome measures and core mediators were included in the online assessment. The selection of measures was based on a literature

review of the theoretical models of meditation mechanisms of action (Gu et al., 2015; Hölzel et al., 2011; Kirby et al., 2017; Roca et al., 2019), as well as the modules and techniques included in both programs. Table 1 lists the outcome measures, the mediators of change measures, and their internal consistency scores (i.e., Cronbach's alpha) from the original validation research as well as for our sample.

The core motivation of all meditation-based interventions is to reduce unnecessary suffering and to promote well-being by training people to master contemplative practices. Participants learn to monitor and regulate attention, perceptions, thoughts, emotions, and physiology (Fox and Cahn, 2018; Lutz et al., 2008; Tang et al., 2015). Most theoretical models suggest that meditation enhances different cognitive, emotional and attitudinal processes (Malinowski, 2013; Shapiro et al., 2006) which, in turn, promote several positive outcomes, including mental health, behavioral changes, and well-being. Therefore, we selected cognitive (e.g., attention to the present moment, decentering, body awareness) and emotional-motivational (e.g., common humanity, kindness, empathy) variables as the potential mediators in the analyses and psychological distress and well-being as the outcomes.

### 2.5. Data analysis

The data analysis plan was conducted following three successive steps (see further details in Supplementary Materials). First, following O'Connell et al. (2017) recommendations, we conducted analyses of covariance (ANCOVAs) on post-treatment scores after adjusting for pre-treatment scores. ANCOVAs allowed us to test whether the outcomes and mediators differed between MBSR and CCT at the end of the programs, once post-treatment scores have been statistically adjusted by potential baseline differences. ANCOVA assumptions were tested, effect size and power analysis were calculated, and Bonferroni-corrected comparisons were used for post-hoc analysis. Second, following Britton's (2019) suggestions to improve individual-level analysis and the detection of potential adverse effects in meditation studies (Cebolla et al., 2017), we computed the Reliable Change Index (RCI; Jacobson and Truax, 1991). The RCI characterizes changes in outcomes (i.e., stress, anxiety, depression, and well-being) in terms of clinically meaningful gains and deteriorations.

Finally, mediation analyses examined whether mindfulness and

**Table 1**  
Outcomes and mediators measures used in this study.

Outcome measures
<p><b>Depression Anxiety Stress Scales (DASS-21, 21 items; Lovibond and Lovibond, 1995).</b> A 21-item scale widely used to measure depression, anxiety and stress symptoms during the past week. The DASS-21 use a 4-point Likert scale from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). Cronbach's alpha of the original scale was <math>\alpha_{\text{depression}} = .91</math>, <math>\alpha_{\text{anxiety}} = .81</math>, and <math>\alpha_{\text{stress}} = .89</math>. In the present study, the internal consistency before the programs was <math>\alpha_{\text{depression}} = .91</math>, <math>\alpha_{\text{anxiety}} = .79</math>, and <math>\alpha_{\text{stress}} = .84</math>. The internal consistency after the programs was <math>\alpha_{\text{depression}} = .87</math>, <math>\alpha_{\text{anxiety}} = .79</math>, and <math>\alpha_{\text{stress}} = .79</math>.</p> <p><b>Pemberton Happiness Index (PHI, 11 items; Hervás and Vázquez, 2013).</b> An integrative measure of psychological well-being. In this study only the remembered well-being subscale was included, measuring happiness and satisfaction level based upon people' memory and judgment of their lives. This scale consist of 11 items using a scale from 0 (fully disagree) to 10 (fully agree). Cronbach's alpha of the original scale was <math>\alpha = .84</math>. In the present study, the internal consistency was <math>\alpha_{\text{pre}} = .92</math>, and <math>\alpha_{\text{post}} = .92</math>.</p>
Mediators of change measures
<p><b>Five-Facet Mindfulness Questionnaire-Short Form (FFMQ, 20 items; Baer et al., 2006).</b> A widely used measure of mindfulness including five factors (describing, acting with awareness, observing, non-judging of inner experience, and non-reactivity to inner experience) and a total score. The scale consist of 20 items rated on a 5-point Likert scale ranging from 1 (never or very rarely true) to 5 (very often or always true). In the present study, the internal consistency was <math>\alpha_{\text{pre}} = .89</math>, and <math>\alpha_{\text{post}} = .89</math>.</p> <p><b>Experiences Questionnaire (EQ, 11 items; Fresco et al., 2007).</b> A measure of the capacity to observe our feelings and thoughts without being attached to them (i.e., decentering). The scale consist of 11 items rated on a 5-point Likert scale ranging from 1 (never) to 5 (always). Cronbach's alpha of the original scale was <math>\alpha = .90</math>. In the present study, the internal consistency was <math>\alpha_{\text{pre}} = .90</math>, and <math>\alpha_{\text{post}} = .92</math>.</p> <p><b>Multidimensional assessment of interoceptive awareness (MAIA, 32 items; Mehling et al., 2012).</b> A multidimensional measure of interoceptive body awareness that includes eight dimensions (noticing, not distracting, not worrying, attention regulation, emotional awareness, self-regulation, body listening, and trusting) and a total score. The scale consist of 32 items rated on a 6-point Likert scale ranging from 0 (never) to 5 (always). In the present study, the internal consistency was <math>\alpha_{\text{pre}} = .95</math>, and <math>\alpha_{\text{post}} = .95</math>.</p> <p><b>Self-Compassion Scale-Short Form (SCS-SF, 12 items; Raes et al., 2011).</b> A measure of compassion to oneself that includes three main components: mindfulness, self-kindness, and common humanity. The scale consist of 12 items rated on a 5-point Likert scale ranging from 1 (never) to 5 (always). Cronbach's alpha of the original scale was <math>\alpha_{\text{self-kindness}} = .54</math>, <math>\alpha_{\text{common-humanity}} = .62</math>, and <math>\alpha_{\text{mindfulness}} = .69</math>. In the present study, the internal consistency before the programs was <math>\alpha_{\text{self-kindness}} = .86</math>, <math>\alpha_{\text{common-humanity}} = .67</math>, and <math>\alpha_{\text{mindfulness}} = .76</math>. The internal consistency after the programs was <math>\alpha_{\text{self-kindness}} = .83</math>, <math>\alpha_{\text{common-humanity}} = .62</math>, and <math>\alpha_{\text{mindfulness}} = .77</math>.</p> <p><b>Interpersonal Reactivity Index (IRI, 7 items; Davis, 1980).</b> A multidimensional measure of empathy towards others. In this study only the Empathic Concern scale was included, defined as the emotion of caring for others who are suffering. This scale consist of 7 items rated on a 5-point Likert scale from 1 (doesn't describe me at all) to 5 (describes me very well). Cronbach's alpha of the original scale was <math>\alpha = .71</math>. In the present study, the internal consistency was <math>\alpha_{\text{pre}} = .68</math>, and <math>\alpha_{\text{post}} = .69</math>.</p> <p><b>Ruminative Response Style (RRS, 22 items; Nolen-Hoeksema and Morrow, 1991).</b> Rumination is defined as the chronic tendency to focus on the causes and consequences of our distress without moving into active problem-solving. This measure includes two factors: cognitive reflection and brooding. The scale consist of 22 items rated on a 4-point Likert scale from 1 (almost never) to 4 (almost always). Cronbach's alpha of the original scale was <math>\alpha = .89</math>. In the present study, the internal consistency was <math>\alpha_{\text{pre}} = .92</math>, and <math>\alpha_{\text{post}} = .91</math>.</p> <p><b>White Bear Suppression Inventory (WBSI, 10 items; Wegner and Zanakos, 1994).</b> It measures, chronic thought suppression (i.e., a tendency to suppress unwanted intrusive thoughts). The scale consist of 10 items rated on a 5-point Likert scale from 1 (totally disagree) to 4 (completely agree). Cronbach's alpha of the original scale was <math>\alpha = .89</math>. In the present study, the internal consistency was <math>\alpha_{\text{pre}} = .88</math>, and <math>\alpha_{\text{post}} = .88</math>.</p>

compassion changes after the program mediated the effectiveness of the programs on psychological distress and well-being changes. Both simple mediation (i.e., one mediator) and multiple mediation (i.e., more than one mediator tested simultaneously) were conducted on change scores (i.e., post-pre scores), by using pre-intervention outcomes scores and pre-intervention mediators scores as covariates in the analysis to control for baseline differences between groups. Thus, in our analyses, X was the program (coded 0 for MBSR and 1 for CCT), Y was the post-pre changes in outcomes measures (i.e., psychological distress and well-being), M was the post-pre changes in mediation measures (i.e., mindfulness and compassion-related measures), and covariates were pre-intervention

outcomes and mediator scores for each analysis (i.e., CV). These pre-intervention scores were covaried against the X, the M, and the Y. Standardized regression coefficients ( $b$ ) were computed for each path in the mediation model: *path a* represents the prediction of X on M, *path b* represents the prediction of M on Y, *path c* represents the total prediction of X on Y, and *path c'* represents the direct prediction of X on Y controlling the effect of M (see Fig. 2). Furthermore, the *indirect effect* of X on Y through M was computed as the *path a* and *path b* product ( $ab$ ), of which 95% Bias Corrected Confidence Intervals (BC 95% CIs) were based on 10.000 bootstrapped samples. In simple mediation, only one indirect effect is calculated, whereas in multiple mediation several indirect effects are calculated for each mediator in the model (taking the correlation with the other mediators into account). We followed the Zhao et al. (2010) topology of mediation to interpret our results. Furthermore, data were screened before the mediation following Tabachnick et al.'s (2007) recommendations.

SPSS 25 was employed for all analyses. We used the PROCESS macro tool (version 3.4) for mediation analyses, following Hayes's (2018) technical recommendations. The data are available at <https://github.com/nirakara-lab/MBSR-vs-CCT.git> (doi: 10.5281/zenodo.4056691).

### 3. Results

#### 3.1. Hypothesis 1 and 2: changes in outcomes and mediators after MBSR and CCT programs (ANCOVA and RCI)

The ANCOVA assumptions were fulfilled for all measures (see Supplementary Materials). Regarding present-moment awareness measures, the ANCOVAs showed a significant group effect for decentering ( $F(1, 428) = 4.13, p = .004, \eta^2_p = .01; 1-\beta = .53$ ) and body awareness ( $F(1, 428) = 16.57, p < .001, \eta^2_p = .04; 1-\beta = .98$ ). Pairwise Bonferroni corrected comparisons indicated that decentering and body awareness scores were significantly higher in MBSR than in CCT at post-intervention (see Supplementary Table 3). However, no significant group effect emerged for present moment awareness ( $F(1, 428) = .54, p = .47$ ).

Regarding socio-emotional measures, there was a significant group effect for common humanity ( $F(1, 428) = 12.83, p < .001, \eta^2_p = .03; 1-\beta = .95$ ) and empathic concern ( $F(1, 428) = 6.67, p = .01, \eta^2_p = .02; 1-\beta = .73$ ). Pairwise Bonferroni corrected comparisons indicated that common humanity and empathic concern scores were significantly higher in CCT than in MBSR at post-intervention (see Supplementary Table 3). However, no significant group effects were found in self-kindness ( $F(1, 428) = .54, p = .47$ ) and mindful self-compassion ( $F(1, 428) = .23, p = .64$ ).

For psychological distress and maladaptive cognitive processes, no significant group differences were found for any of the measures: stress ( $F(1, 428) = .14, p = .71$ ), depression ( $F(1, 428) = .23, p = .63$ ), anxiety ( $F(1, 428) = .39, p = .07$ ), rumination ( $F(1, 428) = 1.19, p = .28$ ), and thought suppression ( $F(1, 428) = .52, p = .47$ ). However, within-group effect sizes revealed significant pre-post changes for all outcomes and mediators in the expected direction after both programs, with medium to large effect sizes (see Fig. 3).

The RCI analyses indicated that no significant differences between MBSR and CCT in terms of clinically significant change in stress ( $\chi^2_{(3)} = 3.42, p = .33$ ), depression ( $\chi^2_{(3)} = 3.23, p = .36$ ), and well-being ( $\chi^2_{(3)} = 4.52, p = .21$ ). Yet, for anxiety, the MBSR program had significantly fewer participants with no changes than did the CCT program [41.1% vs 53.2%; ( $\chi^2_{(3)} = 8.76, p = .033$ )] (see further details in Supplementary Materials and Supplementary Figure 1).

#### 3.2. Hypothesis 3.1: mediators of change in MBSR and CCT (single mediation models)

The meditation assumptions were fulfilled for all the measures (see Supplementary Materials). Supplementary Table 4 shows the standardized regression coefficients for changes in stress, anxiety, depression, and psychological well-being after MBSR and CCT. The percentage of

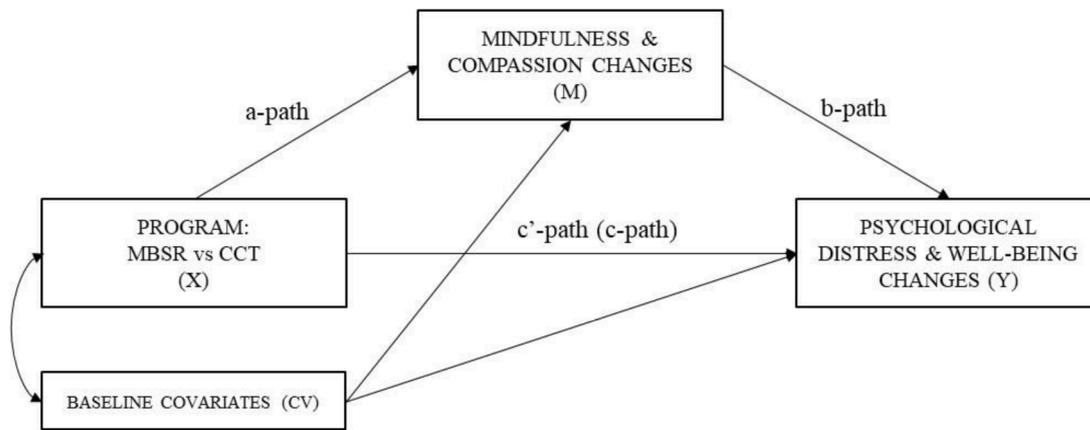


Fig. 2. Simple mediation model path diagram.

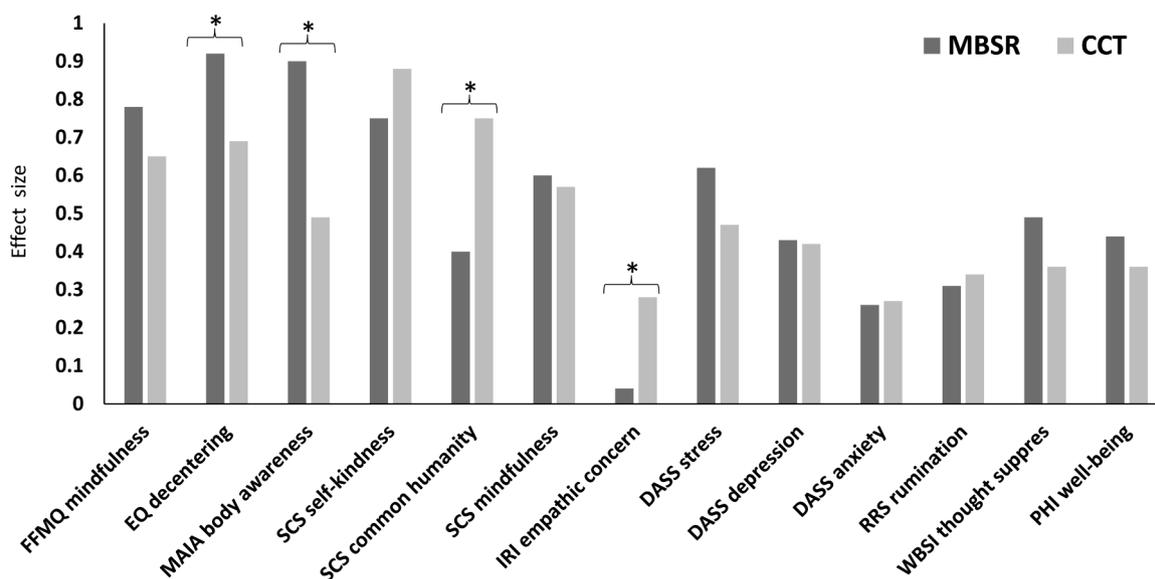


Fig. 3. Absolute values of within group effect sizes in MBSR and CCT programs.

variance ( $R^2$ ) explained by differences between MBSR and CCT was quite high, exceeding 45% for stress, anxiety, and depression symptoms, and with values between 25-40% for well-being. More specifically, our analyses showed that the effects of MBSR and CCT programs on stress and depression symptoms were entirely mediated by EQ Decentering, MAIA body awareness, and SCS Common Humanity. EQ decentering and SCS Common Humanity also mediated the effects of the programs on anxiety symptoms. Finally, the effects of MBSR and CCT on psychological well-being were entirely mediated by EQ Decentering, MAIA body awareness, SCS Common Humanity, and IRI empathic concern.

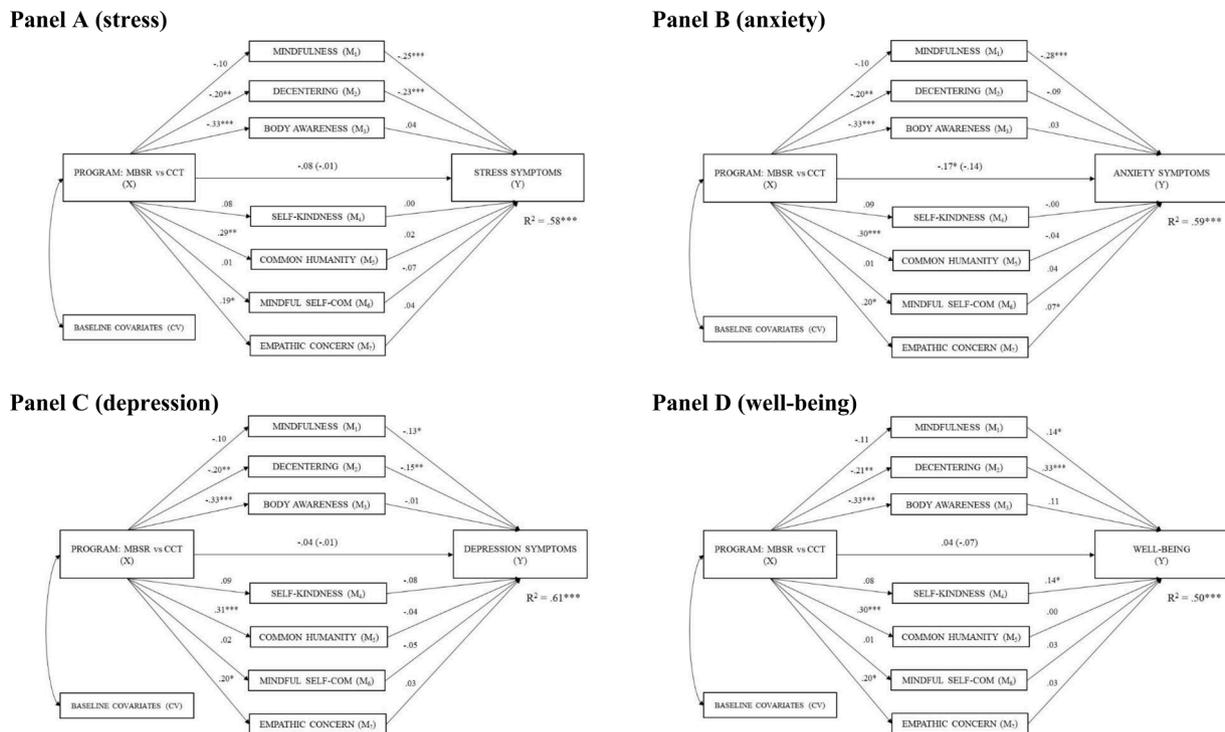
These results suggest several conclusions. First, regarding the a-path, the MBSR significantly predicted greater increases on measures of decentering and body awareness, whereas CCT significantly predicted greater increases on measures of common-humanity and empathy. Second, regarding the b-path, mediators were negatively related to psychological distress outcomes (i.e., stress, anxiety, and depression) and positively related to psychological well-being. Hence, increases in mindfulness and compassion were significantly associated with lower stress, anxiety, and depression and increased well-being.

### 3.3. Hypothesis 3.2: mediators of change in MBSR and CCT (multiple mediation models)

Finally, we conducted mediational analyses including all mindfulness and compassion total scores as mediators in the model, controlling for baseline levels. Fig. 4 shows the standardized regression coefficients for changes in stress, anxiety, depression, and well-being after MBSR and CCT.

For all four models, the a-path was significant for decentering, body awareness, common humanity, and empathic concern. The b-path in stress and depression was significant for mindfulness and decentering, and for well-being, self-kindness was also significant. Regarding anxiety, the b-path was significant for mindfulness and empathic concern. The direct and total effects (c'-path and c-path) were nonsignificant for stress, depression, and well-being. However, for anxiety the direct effect (c'-path) was significant. The model explained considerable variance in the differences between MBSR and CCT in symptom reduction – stress (58%), anxiety (59%), and depression (61%) – plus 50% of the improvement in well-being.

Only the indirect effect of decentering was significant for stress ( $ab = 0.05$ ;  $s.e. = 0.02$ ; 95% CI [0.01, 0.10]), depression ( $ab = 0.03$ ;  $s.e. = 0.02$ ; 95% CI [0.01, 0.08]), and well-being ( $ab = -0.07$ ;  $s.e. = 0.03$ ; 95% CI [-0.13, -0.02]), suggesting that the relationship between the



**Fig. 4.** Multiple mediation model of stress (Panel A), anxiety (Panel B), depression (Panel C) and well-being (Panel D) changes after the MBSR and CCT programs. The c-path is provided in brackets. Note: \*  $p < .05$ ; \*\*  $p < .01$ ; and \*\*\*  $p < .001$ .

programs, the reductions in stress and depression symptoms, and the improvements in well-being were indirect-only mediated by changes in decentering. However, no significant indirect effects were found for anxiety.

The 95% CIs of the post-hoc pairwise contrasts between the indirect effects of the different mediators showed that decentering was the strongest mediator in all models. Regarding stress, decentering was stronger than body awareness ( $ab = 0.06$ ;  $s.e. = 0.03$ ; 95% CI [0.01, 0.13]), self-kindness ( $ab = 0.05$ ;  $s.e. = 0.03$ ; 95% CI [0.00, 0.10]), and mindful self-compassion ( $ab = 0.05$ ;  $s.e. = 0.02$ ; 95% CI [0.01, 0.10]). Regarding depression, decentering was stronger than self-kindness ( $ab = 0.04$ ;  $s.e. = 0.02$ ; 95% CI [0.01, 0.08]), and mindful self-compassion ( $ab = 0.03$ ;  $s.e. = 0.02$ ; 95% CI [0.00, 0.07]). Finally, regarding well-being, decentering was stronger than self-kindness ( $ab = -0.08$ ;  $s.e. = 0.03$ ; 95% CI [-0.14, -0.03]), common humanity ( $ab = -0.07$ ;  $s.e. = 0.03$ ; 95% CI [-0.14, -0.01]), mindful self-compassion ( $ab = -0.07$ ;  $s.e. = 0.03$ ; 95% CI [-0.13, -0.02]), and empathic concern ( $ab = -0.07$ ;  $s.e. = 0.03$ ; 95% CI [-0.14, -0.02]).

#### 4. Discussion

The general aim of the study was to examine the relative effectiveness and mediators of change in standardized mindfulness and compassion interventions. Specifically, we assessed whether mindfulness (MBSR) and compassion (CCT) programs enhanced mindfulness, compassion, and well-being scores while reducing psychological distress (i.e., stress, anxiety, and depression) and rumination. Moreover, we explored whether changes in levels of mindfulness and compassion, regardless of overall differences in effectiveness between both programs, mediated changes in psychological distress and well-being that could differ in MBSR and CCT.

Based on previous studies (Brito-Pons et al., 2018; Singer and Engert, 2019), we hypothesized that both programs would improve levels of mindfulness and compassion, but that MBSR would be more effective than CCT at improving mindfulness but less effective in enhancing compassion. Analyses of variance showed that both programs

increased mindfulness, decentering, body awareness, and self-compassion scores. Yet, present-moment awareness improvements (i.e., decentering and body awareness) were significantly larger in the MBSR program, whereas socio-emotional changes (i.e., common humanity and empathic concern) were larger in the CCT than in the MBSR. Furthermore, the magnitude of effect sizes ranged from medium to large.

Hence, some common beneficial effects occur following both programs, whereas certain ones seem specific to MBSR and CCT, respectively, as others have found (Brito-Pons et al., 2018; Hildebrandt et al., 2017). Both MBSR and CCT improved core ‘cognitive’ and ‘emotional’ aspects of functioning. Neither program is wholly “cognitive” nor wholly “affective” (Grossman, 2019). Indeed, mindfulness plays a foundational role for other meditation practices (Dahl and Davidson, 2019) and attending to one’s experience is common to all of them. In contemporary MBSR, compassion is taught implicitly as an attitudinal foundation of mindfulness and is modeled by the instructors’ behaviors and attitudes (Neff and Dahm, 2015). In the same manner, mindfulness is formally practiced during the first week of CCT as a foundation for subsequent compassion meditations (Jinpa, 2010), and compassion exercises demand different cognitive operations such as being able to pay close attention to different aspects of one’s internal and external experience and to reappraise suffering and hardship (Dahl et al., 2016).

Considering the similarities and differences between mindfulness and compassion practices (Jinpa, 2019), as well as the changes in clinical outcomes found in both programs (Houry et al., 2015; Kirby et al., 2017), we hypothesized that despite an overall improvement in symptoms of distress, MBSR would be more effective than CCT in reducing stress and anxiety symptoms but less effective in diminishing depression, whereas both programs would enhance well-being. The results did not support this hypothesis. Both mindfulness and compassion interventions similarly reduced psychological distress (i.e., stress, anxiety, and depression) and maladaptive cognitive processes (i.e., rumination and thought suppression) while increasing well-being. Also, RCI analyses indicated that the groups did not differ on this index (except for anxiety). The variable showing the largest proportion of beneficial change was well-being (i.e., 75.4%), perhaps because our participants were not

clinical patients. Finally, only a tiny fraction of participants exhibited any deterioration from baseline, which is an important result considering the potential adverse effects of meditation practice in some individuals (Cebolla et al., 2017). Our results are broadly consistent with previous work (Brito-Pons et al., 2018; Khoury et al., 2015; Kirby et al., 2017).

Finally, our third hypothesis concerned whether the core mechanisms mediating the relation between the mindfulness and compassion programs and the outcomes (i.e., psychological distress and well-being) would differ in each program. Specifically, we expected that changes in mindfulness, decentering, and body awareness would mediate the relationship between MBSR and the main psychological outcomes, whereas changes in compassion and empathy would mediate the relationship between CCT and these outcomes. The results suggest that psychological distress and well-being were entirely mediated by mindfulness and compassion-related measures after we controlled for baseline differences. The effects of mindfulness and compassion interventions on stress, anxiety, depression, and well-being were entirely mediated by decentering, body awareness, common humanity (self-compassion), and empathic concern (only in the case of well-being). The mediation models showed that the MBSR program significantly predicted higher decentering and body awareness increases after the program, whereas the CCT significantly predicted higher common-humanity and empathic concern increases. All mindfulness and compassion mediators significantly predicted psychological distress reductions and well-being improvements after the program.

Regarding the second and the third hypotheses, the results suggest that several mechanisms mediate change in the same psychological outcomes. Although both programs significantly changed the same mediators, the magnitude of change in these mediators differed between programs. Thus, each seemingly operates through different pathways to reduce psychological distress and to promote well-being. Although the MBSR seemingly relies on changes in present-moment awareness mechanisms (i.e., decentering and body awareness), CCT seems to foster the same positive outcomes through changes in socio-emotional mechanisms (i.e., common-humanity and empathy concern). The similarities in psychological outcomes after mindfulness and compassion interventions may obscure important differences in mechanisms, and such comparative analyses are essential for the next wave of research in the field (Crane et al., 2017). For example, as others have observed (Rosekrantz et al., 2019), both mindfulness training and aerobic exercise improve mood and sleep quality, but the mechanisms through which they produce these changes are quite different (i.e., regulation of autonomic arousal, decreased worry and rumination, and increased acceptance in the case of mindfulness versus thermoregulatory processes, cytokine release, and changes in circadian rhythms in the case of aerobic exercise).

As Fried (2015) has argued, sum scores on self-report measures (e.g., of depression) are too coarse-grained or insufficiently reliable to identify subtle differences in interventions, and in meditation in particular (Grossman, 2019). Thus, future research should use behavioral and biological measures to programmatically analyze differences between meditation types (Desbordes et al., 2012; Roca and Vazquez, 2020b), employing more sophisticated analysis (such as network analysis) to explore these differences (Roca et al., 2019).

Multiple mediational models, introducing simultaneously all the mindfulness and compassion mediators, showed that decentering was the strongest predictor and the only mediator with significant indirect effects on stress, depression, and well-being (after controlling for baseline differences). This result suggests that the relationship between mindfulness and compassion interventions and the changes in these variables were indirectly mediated by changes in decentering only. MBSR significantly predicted greater increases in decentering than CCT, which, in turn, predicted significant reductions of stress and depression symptoms and a significant increase in well-being. Furthermore, the multiple mediation model explained around 50-60% of the variance in

psychological distress and well-being changes after the programs. No significant differences between MBSR and CCT were found for anxiety symptoms. These results seem robust because the intercorrelations among the dependent variables were from low to moderate (see Supplementary Table 7), indicating no significant overlap of measures.

Decentering denotes the meta-cognitive ability to observe stimuli arising in awareness (i.e., thoughts, emotions, and sensations), with psychological distance (Fresco et al., 2007). Decentering may be a key mediator of change across a variety of meditation-based interventions (Bernstein et al., 2015; Dahl et al., 2015; Vago and Silbersweig, 2012; Wallace and Shapiro, 2006), being an essential component of mindful-emotion regulation processes (Crane et al., 2017; Hölzel et al., 2011). Moreover, improvements in decentering have been associated with enduring treatment changes for major depression and anxiety disorders (Farb et al., 2018; Hayes-Skelton and Lee, 2018), mediating also the well-being increases associated with mindfulness practice (van der Velden et al., 2015). It is likely that designing or refining meditation interventions with a focus on decentering may enhance their effects (Bernstein et al., 2019).

Our study has limitations. First, it was infeasible to randomly assign participants to MBSR and CCT. Indeed, participants self-selected into these programs. Accordingly, we cannot isolate MBSR and CCT as the cause of the beneficial changes occurring in the respective programs. Although randomized controlled trials (RCTs) remain the gold standard for causal inference, even RCTs can have limitations. For example, in one study comparing the relative efficacy of imipramine, pill placebo, and cognitive behavioral therapy for panic disorder, nearly half of the patients qualifying for the trial refused to be randomized either because they feared receiving medication or they were unwilling or unable to discontinue their current medication (Hofmann et al., 1998). This finding implies that the patients who participated in this RCT were biased in favor of CBT or least neutral regarding their views of the relative efficacy of medication versus psychosocial treatment. The upshot is that RCTs can have self-selection biases operating *prior* to randomization whereby a segment of the relevant population removes itself from consideration. Yet self-selection into a program can overestimate its potency relative to how it performs in an RCT (Lyubomirsky et al., 2011). Nevertheless, non-randomized comparisons still have probative value. Although studies such as ours fall short of testing the relative efficacy of MBSR and CCT, they can provide an estimate of their relative effectiveness in the “real world.” Future studies might include active control conditions to examine the relative efficacy and mechanisms of change in MBIs, as for example the Health Enhancement Program (MacCoon et al., 2012).

However, some experts have suggested the need for moving from tightly controlled randomized control trials to trials in real-world community settings (Dimidjian and Segal, 2015; Greeson and Chin, 2019) to determine barriers and benefits outside idealized academic settings. Furthermore, in most cases the control groups do not match the contextual elements of the meditation interventions (e.g., motivation and expectation effects, group effects, teacher competency, or differences between experts and novices). For this reason, non-inferiority trials could be a feasible alternative to compare the effects of meditation interventions (Hoge et al., 2019).

Another limitation was that some participants had previous meditation experience from different traditions, although the degree of practice was statistically controlled in the analyses performed. Future studies should examine the influence of different meditation types at baseline. Similarly, baseline differences in other variables related to the participants (e.g., age, meditation experience, or the amount of home practice) and the courses (e.g., cycles nested within the intervention, time of the day when courses are offered, or instructors' gender) might be also a potential sources of variance to be addressed. Furthermore, future studies should also use other statistical approaches for modeling the complex relationships and pathways through which meditation produce its effects, such as multi-group structural equation modeling

(Ryu and Cheong, 2017) and network analysis (Roca et al., 2020). Finally, the study did not include a follow-up to analyze the maintenance of the changes over time and the intersession changes during the intervention, essential steps to test causal and temporal pathways.

Our study has important strengths. Enrolling a large number of participants, we compared two active interventions rather than merely comparing one against a wait list control condition. Hence, we followed recent recommendations for improving the methodology of MBI studies (Dahl and Davidson, 2019; Van Dam et al., 2018). Two well-controlled standardized meditation interventions (i.e., highly structured formats and time-limited), taught by certified instructors, also improves the methodological control of external variables that could affect the results. Furthermore, we used a broad set of outcomes and mediators measures relevant to theoretical models of mechanisms of action (Gu et al., 2015; Hölzel et al., 2011; Kirby et al., 2017; Roca et al., 2019). Finally, we used a rigorous mediation analysis based on the latest developments in the field (Hayes, 2018), and we used several covariates to control for baseline differences and third variables. Its limitations notwithstanding, our study illuminates the psychological mechanisms differentially mediating the beneficial impact of two popular contemplative interventions.

## Preferences

Double-blind review.

## Authors' contribution

PR and CV developed the study conception and design. Testing and data collection were performed by PR and GD. Data analysis and interpretation was performed by GD and PR. The first draft of the manuscript was written by PR, under the close supervision of CV and RM. PR, CV, and RM drafted the manuscript. All the authors approved the final version of the manuscript for submission.

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## Declaration of Competing Interest

None.

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## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.jad.2021.01.070](https://doi.org/10.1016/j.jad.2021.01.070).

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