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Title: Cultivating the compassionate self:

An exploration of the mechanisms of change in compassionate mind training

Short title: *Mechanisms of change in compassionate mind training*

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Abstract

Objectives The current study aimed to examine the mechanisms of change that mediate the impact of a compassion mind training (CMT) intervention. In particular, whether changes in compassion, fears of compassion and heart rate variability (HRV) would mediate the effects of a brief CMT intervention on psychological vulnerability factors, mental health indicators and positive affect.

Methods Using a longitudinal design, general population participants were randomly assigned to one of two conditions: Compassionate Mind Training ($n=56$) and Wait-List Control ($n=37$). Participants in the CMT condition attended a psychoeducation session and practiced a set of core CMT exercises for two weeks. Self-report measures of compassion, fears of compassion, self-criticism, shame, depression, stress and positive affect were completed, and HRV was assessed at pre and post intervention.

Results Mediation analyses revealed that increases in compassion for self and from others and reductions in fears of compassion for self, for others and from others mediated the effects of CMT on self-criticism and shame. In depression and stress, compassion for the self and from others, and fears of compassion for the self emerged as significant mediators. Compassion for the self and from others, and fears of compassion for self and from others significantly mediated the effect of CMT in safe affect. Compassion for the self, fears of compassion for self and for others and HRV mediated changes in relaxed affect.

Conclusions Cultivating a compassionate mind/self-identity through the core components of CMT may stimulate vagal regulatory activity and positively impact one's ability to experience and be open to compassion, and thus promote emotion regulation, wellbeing and mental health.

Key words: Compassion; Fears of compassion; Heart Rate Variability; Compassionate Mind Training; Mechanisms of change; Mediation

Cultivating the compassionate self: An exploration of the mechanisms of change in compassionate mind training

There is a burgeoning research interest into the nature, process and effects of treating oneself and others with compassion (Gilbert, 2017a; Jinpa, 2015; Ricard, 2015; Seppälä et al., 2017; Singer & Bohls, 2012). These effects are associated with a range of physiological, psychological and social benefits (Bornemann et al., 2016; Crocker & Canevello, 2012; Engert et al., 2017; Kim et al., 2020; Klimecki et al., 2014; MacBeth & Gumley, 2012), and can even influence genetic expression (Fredrickson et al., 2013; Wang et al., 2019). In addition, training in compassion has now become a focus for a range of psychotherapeutic interventions, that have collected mounting empirical support for their beneficial effects on mental and physiological wellbeing, and prosocial behaviour (Kirby & Gilbert, 2017; Kirby et al., 2017a; Kirby et al., 2017b). Specifically, compassion training produces changes in the autonomic nervous system as measured by heart rate variability (Di Bello et al., 2020; Kim et al., 2020; Matos et al., 2017a; Steffen et al., 2020), in the immune system (Pace et al., 2009), and in various cortical areas (Favre et al., 2021; Kim et al., 2020; Singer & Engert, 2019; Weng et al., 2013, 2018).

Although there are some controversies over what compassion actually is (Gilbert, 2017b), according to Buddhist traditions (Dalai Lama, 1995) and evolutionary focused models (Gilbert, 2019), compassion is conceptualized as a prosocial motivation and can be defined by “the sensitivity to suffering in self and others, with a commitment to try to alleviate and prevent it” (Gilbert, 2014, p. 19). This definition emphasizes two major components of compassion: the preparedness to engage with suffering and distress, and the wisdom to work out helpful action. Evolutionary approaches highlight the (*if*) stimulus (*then*) response “algorithm of compassion”, which evolved with the physiological basis of caregiving motivational systems with specific features detecting competencies (being able to detect

signals of distress, need and suffering) and response functions (being able to take appropriate helpful action) (Gilbert, 2020). Thus, operating through a set of evolved integrated circuits (e.g., the myelinated vagus nerve, oxytocin, part of the orbital frontal cortex and anterior cingulate) and psychological mechanisms that underpin caring motives and behaviour (Carter, 2014; Favre et al., 2021; Kim et al., 2020; Porges, 2007; Seppälä et al., 2017), compassion plays a central role in affect regulation, mental states and social behaviour.

Importantly, compassion can be seen as a dynamic intra and interpersonal process that occurs in a social interactional context: there is the compassion we can direct to others, the compassion others can direct to us and our ability to be compassionate towards ourselves (i.e., self-compassion), and these flows of compassion are highly interactive (Gilbert, 2014; Gilbert et al., 2017). These multidimensional flows of compassion, in particular self-compassion and receiving compassion from others, have been associated with mental wellbeing and reduced psychological distress (Gilbert et al., 2017; Matos et al., 2021; Steindl et al., 2018). Even though the flows of compassion can influence each other, they can also be independent, in that one may struggle with being self-compassionate but is able to be compassionate to others (Gilbert et al., 2017; Lopez et al., 2018).

Similar to any other motivation, fears and resistances related to the expression of compassion can lead to reduced compassion. In fact, some individuals can develop and experience fears, blocks and resistances of receiving and giving compassion (Gilbert & Mascaro, 2017; Gilbert et al., 2011), being unable to activate or use caring and compassion motivational systems as affect regulators (Ebert et al., 2018). Fears of compassion do not reflect a lack or absence of a compassionate mindset, but instead they are considered to be an individual difference associated with the fear or avoidance response that individuals can have to compassion. Fears of compassion can be experienced across the three flows (i.e., for others, from others, for self) and may, for example, be linked to the belief that compassion is a self-indulgence or a weakness, if compassionate (to oneself or others) one will become too

distressed or unable to cope, or that oneself or others are not deserving of compassion, or that its consequences are too costly (Gilbert & Mascaro, 2017). Fears of compassion are understood as inhibitors that hinder compassionate motivation of being “turned-on” or “acted on”, because the signal of suffering is either not noticed/avoided or does not result in an action to prevent or alleviate that suffering (Gilbert et al., 2011; Kirby et al., 2019). The development of fears of compassion can be understood in light of evolutionary models, attachment theory, and classical conditioning. In particular, fears of compassion can be rooted in one’s attachment history when, through classical conditioning and emotional learning, caring and prosocial signals and behaviours become associated with aversive outcomes (Gilbert, 2020). For example, fears of compassion for the self, for others and of receiving compassion from others can be rooted in early emotional experiences of shame and lack of safeness and warmth within the family, and increase individuals’ vulnerability to the effects of such experiences on psychological distress (Matos et al., 2017b).

Research has indeed indicated that such blocks to compassion and care-focused motives may negatively impact one’s physiological and psychological health (Kirby et al., 2017a). In fact, fears of compassion are associated with difficulties in developing compassion, and with shame, self-criticism and several psychopathology indicators (e.g., Cavalcanti et al., 2021; Gilbert et al. 2011; Gilbert et al., 2014; Matos et al., 2017b; for a review see Kirby et al., 2019). For example, Gilbert et al. (2011) found that fears of receiving compassion were strongly associated with fears and resistances to being self-compassionate, but much less so to being compassionate to others. Studying fears of compassion in the Chinese population Guo et al. (2021) found that fears of compassion were linked to depression, anxiety and stress, and negatively associated with self-acceptance and positive self-evaluation. Hermanto et al. (2016) also found that being less fearful of receiving compassion from others buffers the effect of self-criticism on depression. A number of studies have shown that fears of compassion are prominent in clinical populations and can interfere with therapy if not addressed (Kelly et al.,

2021; Lawrence & Lee, 2014; Pauley & McPherson, 2010). A recent meta-analysis on the association between the fears of compassion and mental health established that fears of compassion for self and of receiving compassion from others reveal the strongest associations with shame, self-criticism and depression (Kirby et al., 2019). These data highlight the fact that to understand how compassion operates as a beneficial process requires a focus on both competencies for giving but also for receiving compassion and on the possible blocks and resistances to experiencing compassion.

Compassion Focused Therapy (CFT; Gilbert, 2010, 2014, 2020) is one of the current compassion interventions that has been gathering increasing empirical support for its beneficial effects in improving mental health, psychological and physiological well-being (e.g., Fox et al., 2020; Kirby et al., 2017b; Kirby & Gilbert, 2017; Leaviss & Uttley, 2015; Steffen et al., 2020). CFT is an evolutionary-based psychotherapeutic approach that integrates attachment theory, psychological science, neuroscience and the wisdom traditions (Gilbert, 2010, 2014). Specifically developed to work with individuals experiencing high levels of shame and self-criticism, CFT uses psychoeducation and skills training approaches to cultivate compassionate engagement and action across the three flows: towards others, from others, and self-compassion (Gilbert & Choden, 2013). CFT seeks to activate and develop the affiliative/soothing system to cultivate care-focused motives (i.e., compassion), intentions and affiliative emotions and thereby down-regulate the threat system (Gilbert, 2009, 2010). . For CFT, compassion emerges from evolved care-focused motivations guided by recently evolved socially intelligent competencies (Gilbert, 2014, 2020).

An integral part of CFT is Compassionate Mind Training (CMT), a set of techniques and practices designed to build one's inner compassion motives and competencies, and to stimulate physiological systems linked to caring, affiliation and affect regulation. Specifically, CMT focuses on conceptualising and engaging with an inner sense of one's compassionate self-identity, with certain qualities (Gilbert, 2010, 2014). CMT practices seek to develop

mental competencies and physiological states that facilitate the two basic processes of compassion. The first is to be able to turn towards suffering, to tolerate and engage with it rather than avoid it or dissociate. The second is learning what to do to be helpful, to alleviate and prevent suffering. CMT begins with psychoeducation on the evolved nature and difficulties of the human mind (e.g., shame, self-criticism, negative rumination and fearful anticipation), and on the functioning of three affect regulation systems of threat-protecting, drive-seeking and safeness-soothing (Gilbert, 2009, 2010, 2020). CMT includes a set body and psychologically based practices that involve slow and deeper breathing at around 5 breaths per minute (i.e., soothing breathing rhythm), the practice of confident friendly body posture, voice tones and facial expressions, and mindfulness. In addition, a range of practices, using cognitive and imagery exercises and behavioural rehearsal, promote people's awareness and cultivation of their own compassion motives and competencies subsumed within a sense of compassionate self-identity. Building the compassionate mind and compassionate self then becomes the focus and intention by which individuals can engage with various life difficulties (Gilbert, 2009, 2010; Matos et al., 2017a).

Growing research has supported the effectiveness of CMT in clinical and non-clinical samples (e.g., Beaumont et al., 2017; Gilbert & Procter, 2006; Irons & Heriot-Maitland, 2020; Mayhew & Gilbert, 2008; Sommers-Spijkerman et al., 2018a; for reviews see Kirby et al., 2017b and Leaviss & Uttley, 2014). In non-clinical samples, in particular, a pilot randomized controlled study (Matos et al., 2017a) examined the impact of a two-week CMT intervention on a range of emotional, self-evaluative and psychopathology indicators and on heart rate variability in a non-clinical sample. Results showed that the CMT intervention produced significant increases in self-compassion, sensitivity to receiving compassion from others, and in safe and relaxed positive affect; and reductions in shame, self-criticism, fears of compassion, depression and stress. In this study, significant improvements in heart rate variability (HRV) were also found in the experimental group. Heart rate variability (HRV) is an

indicator of vagal regulatory activity and a physiological marker of a person's ability to flexibly respond to environment challenges and regulate emotional responses, (e.g., Kirby et al., 2017a; Park & Thayer, 2014). Higher HRV is indicative of higher parasympathetic nervous system outflow via the Vagus nerve activity and is associated with increased states of contentment, calmness and safeness (Porges, 2007; Park & Thayer, 2014). Given its link to overall health and well-being, HRV has been proposed as a primary measure to assess and train compassion (Kirby et al., 2017a). In addition, recent studies have been showing a connection between HRV and the emotional state of compassion, self-compassion, feelings of perceived safeness and warmth and greater ability to self-soothe when stressed (e.g., Porges, 2007; Petrocchi et al., 2016; Stellar et al., 2015; Svendsen et al., 2016).

Furthermore, Matos et al. (2018) documented that perceiving compassion cultivation practices as helpful and being able to embody the compassionate self in everyday life are critical practice qualities during a CMT intervention that promote increases in self-compassion and receiving compassion from others, as well as to foster feelings of safeness, contentment and calmness. Irons and Heriot-Maitland (2020) have recently extended these findings and reported the beneficial effects of an 8-week CMT group intervention for the general public. In this study, the 8-week CMT increased participants' levels of compassion, self-reassurance, social rank, positive emotions, and well-being, and reduced self-criticism, attachment anxiety, and symptoms of depression and stress, and these changes were maintained at 3-month follow-up (Irons & Heriot-Maitland, 2020). In addition, a randomized controlled trial of CFT as guided self-help in an adult community sample found favorable effects on well-being and psychological distress up to 12 months after baseline (Sommers-Spijkerman et al., 2018a).

Nonetheless, further research is required to better understand how and why CMT/CFT work. Identifying which processes and mechanisms promoted by an intervention are responsible for treatment-induced change is of crucial importance to improve interventions effectiveness and parsimony, and determine the link between which processes are targeted

and promoted in an intervention and the observed outcomes (Kazdin, 2009). Previous research has pointed to the relevance of exploring the processes of change associated with the impact of CFT and CMT interventions. In a feasibility randomized controlled trial of CFT with patients with a schizophrenia-spectrum disorder, increases in compassion were significantly associated with reductions in depression and in perceived social marginalization in the CFT group (Braehler et al., 2012). Sommers-Spijkerman et al. (2018b) examined working mechanisms of a self-help CFT-intervention in a non-clinical sample in relation to changes in well-being and psychological distress. Their findings provide preliminary evidence that the impact of CFT on improving well-being and mental health operates through cultivating self-reassurance, reducing self-criticism and regulating positive and negative affect (Sommers-Spijkerman et al., 2018b). Another study using an 8-week CMT with general population (Irons & Heriot-Maitland, 2020) reported that changes in self-compassion from pre-to-post intervention were linked to changes in self-criticism and well-being outcomes, and that changes in compassion from others were related to changes in well-being and emotional outcomes. However, to advance the development and refinement of CFT/CMT interventions, further investigation on the mechanisms underlying the beneficial effects of CMT on mental health and well-being is of utmost importance, namely by exploring key mediator processes of CMT induced changes.

The present study builds upon a previous randomized controlled study exploring the effectiveness of a two-week CMT intervention, which documented positive impacts of this training on a range of psychological and physiological indicators (Matos et al., 2017a) and the role practice quality variables play on the effectiveness of CMT (Matos et al., 2018). The aim of the current study is to take a more fine-grained microanalysis into the mechanisms of change that may underlie the effects of a brief CMT intervention. In particular, this study set out to explore whether the impact of the CMT on psychological vulnerability factors, mental health indicators and positive affect would be mediated by increases in compassion and

reductions in fears of compassion, and improvements in HRV, key psychological and physiological processes specifically targeted by the brief CMT intervention. In line with the CFT theoretical framework and the nature of the practices (Gilbert, 2010, 2014, 2020; Gilbert & Choden, 2013), and with previous findings on the efficacy of CMT (Irons & Heriot-Maitland, 2020; Matos et al., 2017a), we hypothesized that the CMT intervention would promote increases in compassion for the self and from others, decreases in fears of compassion, along with increases in HRV, which would in turn mediate changes in shame, self-criticism, mental health indicators (i.e., depression and perceived stress) and positive affect (safe and relaxed).

Method

Participants

A total of 131 participants were initially included and assessed for eligibility, of whom 117 met the eligibility criteria and were randomized to one of two conditions: Compassionate Mind Training and a Waiting List Control. The attrition rate in the overall eligible sample was 20.5%, with the dropout rate being higher in the control group (31.5%). The final sample comprised 93 participants who completed the entire Compassionate Mind Training protocol (CMT; $n = 56$; WLC; $n = 37$). Figure 1 displays the flow of participants.

[Insert Figure 1 here]

Figure 1. Flowchart of study participants

Participants were recruited from the general community, and included 9 (9.7%) men and 84 (90.3%) women. Participants' age ranged between 18 and 43, with a mean age of 23.34 ($SD = 4.16$). The years of education mean was 14.99 ($SD = 2.31$). The majority of the sample comprised college students (78.5%). There were no significant differences between the CMT and WLC groups on their baseline measures.

Procedure

The sample recruitment procedures and intervention conditions used in the current study have been described in detail in Matos et al. (2017a). The study was approved by the Ethics Committee of the Faculty of Psychology and Educational Sciences (CEDI08.01.2015), University of Coimbra and advertised through announcements posted on Coimbra University' campus, and Faculties' mailing lists as a study investigating the effect of meditation on wellbeing indicators. Interested participants contacted the research team via email, and were informed about the procedures of the study. Exclusion criteria were major psychiatric or cognitive problems, psychotic or organic illnesses, substance abuse, cardiovascular disease, use of drugs/medications that might affect cardiovascular function, obesity (body mass index > 30 kg/m²), menopause, use of oral contraceptives during the previous 6 months, and pregnancy or childbirth within the last 12 months. After eligibility assessment, participants provided their written informed consent. Eligible participants were then randomly assigned to either the CMT condition or a WLC condition. Participants assigned to the CMT condition were invited to attend a 2-hour group session where they were introduced to the concept of compassion, emotion regulation systems, and the CMT practices. They were then provided a written manual outlining the evolutionary theory behind the compassionate mind training, with explanations of emotion regulation and the value of compassion (the manual is available on request). They also provided audio files of the CMT practices for subsequent independent practice. These included: 1. A soothing rhythm breathing practice that stimulates the vagal system at around 5-6 breaths per minute (Lin et al., 2014); 2. A practice focused on creating friendly facial expressions and voice tones as part of compassion (Porges, 2007); 3. A practice aimed to develop mindfulness and increase attention to one's current mental state; 4. A practice aimed to develop the sense of a compassionate self that is based upon feelings of wisdom, strength and commitment to be supportive and helpful to self and others; 5. An imagery practice aimed to develop a compassionate image of another mind that has caring intent towards the self; 6. A practice aimed to develop a compassionate self that has caring

intent towards the self and how to use compassion focusing to work with self-criticism and life difficulties (Gilbert & Choden, 2013).

Participants were encouraged to practice these different exercises over the following two weeks and the importance of doing so for the research was highlighted. They were encouraged to bring compassion into their everyday life - especially when they encountered life difficulties or setbacks. Participants from both the CMT and WLC groups completed the self-report measures and their HRV was assessed before and after the two-week intervention period. Participants received a compensation for their participation (15€ voucher).

Measures

Demographics form: Participants were asked to complete a socio-demographic form, which included items regarding gender, age, level of education, height and weight for BMI calculation, and smoking habits ("are you a smoker?" Yes/No).

Compassionate Engagements and Actions Scales (CEAS; Gilbert et al., 2017). Compassion is typically regarded as having two core components 1. A sensitivity to the suffering of self and others; 2. A commitment to try to alleviate and prevent it (Gilbert & Choden, 2013). The CEAS measures compassion competencies in relation to these two components. The CEAS *compassionate engagement* subscale measures the degree to which individuals are (for example) motivated and able to engage with suffering, tolerate distress, feel moved and be empathic and non-judgmental in relation to distress. The CEAS *compassionate action* subscale measures (for example) people's ability to pay attention, solve problems and behave in ways that are helpful. The CEAS encompasses three scales measuring the three flows of compassion: compassion for self, compassion to others, and receiving compassion from others, with 13 items each. Each scale measures different elements of compassion *Engagement* (6 items and 2 filler items) and *Action* (4 items and 1 filler item). Participants are asked to rate each item on a 10-point Likert scale, based on how frequently it occurs, from 1 ("never") to 10 ("always"). Each scale can be analysed in terms of the

compassionate engagement and action aspects separately or as a single factor. Here we will use each of the three orientations (compassion for self, compassion for others and receiving compassion from others) as a single factor scales. In their original study, the CEAS showed good internal consistencies and temporal reliability (Gilbert et al., 2017). In the current study, Cronbach' alphas were .86 for CEAS for self scale and .93 for CEAS from others scale.

Fears of Compassion Scales (FCS; Gilbert et al., 2011). The FCS are widely used self-report instrument to assess fears, blocks and resistances to compassion across the three flows (Gilbert et al., 2011). The *FCS for self* scale comprises 15 items (e.g., "Getting on in life is about being tough rather than compassionate"); the *FCS from others* scale comprises 13 items (e.g., "Wanting others to be kind to oneself is a weakness"); *FCS for others* scale comprises 10 items (e.g., "I fear that being too compassionate makes people an easy target"). The items were rated on a 5-point Likert scale (0 = "Don't agree at all", 4 = "Completely agree"). These scales showed good reliability with Cronbach' alphas of .92 *for self*, .85 *from others*, and .84 *for others* in a student sample. In the present study, the FCS presented good internal consistencies (FCS for self $\alpha = .91$, FCS for others $\alpha = .87$, FCS from others $\alpha = .90$).

Types of Positive Affect Scale (ToPAS; Gilbert et al., 2008). This scale was developed to measure the degree to which people experience different positive emotions. Respondents are asked to rate 18 "feeling" words on a 5-point Likert scale to indicate how characteristic it is of them (0= "not characteristic of me" to 4 = "very characteristic of me"). Factor analysis revealed three factors or subscales, these are: Activated Positive Affect (e.g., "excited", "dynamic", "active"); Relaxed Positive Affect (e.g., "relaxed", "calm", "peaceful") and Safeness/contentment Positive Affect (e.g., "safe", "secure", "warm"). The scale showed good psychometric properties with Cronbach' alphas of .83 for Activating Positive Affect and Relaxed Positive Affect, and .73 for Safeness/contentment Positive Affect (Gilbert et al., 2008). In this study, the ToPAS subscales revealed good internal consistencies (ToPAS Activating $\alpha = .87$, ToPAS Relaxed $\alpha = .92$, ToPAS Safeness $\alpha = .80$).

Other as Shamer scale (OAS; Goss et al., 1994). This scale was developed from Cook's (1993) Internalized Shame Scale by Allan et al. (1994) and Goss et al. (1994). It assesses global judgments of how people think others see them (e.g. "I think other people see me as inadequate") thus focusing on external shame rather than internalized shame. The scale consists of 18 descriptions of feelings or experiences and respondents indicate the frequency on a 5-point Likert scale from 0 ("never") to 4 ("almost always"). Goss et al. (1994) found the scale to have a good Cronbach' alpha of .92. In the current study, the OAS showed a Cronbach' alpha of .94.

Forms of Self Criticising/Attacking and Self Reassuring Scale (FSCRS; Gilbert et al., 2004). This 22-item scale measures people's critical and self-reassuring self-evaluative responses to setbacks or disappointments. Participants rate on a 5-point Likert scale (ranging from 0 = "not at all like me" to 4 = "extremely like me") how they might typically think and react when things go wrong for them. The scale measures two forms of self-criticism: Inadequate self, which focuses on a sense of personal inadequacy (e.g., "I am easily disappointed with myself") and Hated self, which measures the desire to hurt or persecute the self (e.g., "I have become so angry with myself that I want to hurt or injure myself"). In this study a total of Self-criticism was used by summing Inadequate self and Hated self scores. In addition, the scale measures self-reassuring and supportiveness when things go wrong (e.g., "I am able to care and look after myself"). The scale had Cronbach' alphas of .90 for inadequate self, .86 for hated self and .86 for reassured self (Gilbert et al., 2004). A number of replication studies have supported the structure and reliability of the scale (e.g., Baião et al., 2014; Castilho et al., 2013; Halamova et al., 2019). In our study, the total of self-criticism revealed an excellent internal consistency ($\alpha = .92$).

Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995). This 21-item shortened version of the DASS-42 consists of three subscales measuring depression, anxiety and stress. Participants rate how much each statement applied to them over the past

week, on a 4-point Likert scale ranging from 0 (0 = “Did not apply to me at all”) to 3 (3 = “Applied to me very much, or most of the time”). The DASS-21 subscales have Cronbach’ alphas of .94 for Depression, .87 for Anxiety and .91 for Stress (Antony et al., 1998). For the purpose of this study only the Depression subscale was used, which presented a Cronbach’ alpha of .85.

Perceived Stress Scale (PSS; Cohen et al., 1983). This scale is a self-report measure to evaluate the level of perceived stress during the last month. The 10-item version was used in this study, which consists of six negative and four positive items. The negative items are intended to assess lack of control and negative affective reactions, while the positive items measure the degree of ability to cope with existing stressors. Each item is rated on a 5-point scale from 0 = “never” to 4 = “very often”, covering the preceding month. The total score is calculated by finding the sum of 10 items, reverse coding questions 4, 5, 7, and 8. Higher scores correspond to higher perceived stress. Cronbach’ alpha between .84 and .86 were reported in the original study. In this study, the PSS presented a Cronbach’ alpha of .90.

Psychophysiological measures. The electrocardiogram (ECG) was monitored (eMotion; Mega Electronics) with a standard electrode configuration (right clavicle and precordial site V6). Two disposable Ag- AgCl electrodes were used. The ECG signal was digitized at 1000 Hz and inspected offline. Raw data (R-R intervals) was imported into Kubios (version 2.1, 2012, Biosignal Analysis and Medical Imaging Group, University of Kuopio, Finland, MATLAB). Successive R waves (identified by an automatic beat detection algorithm) were visually inspected, and any irregularities were edited. Heart rate and a time domain measure of HRV (Root Mean Square Successive Difference; RMSSD) were then obtained for pre and post-intervention in both groups using HRV Analysis Software (Niskanen et al., 2004). According to the Task Force guidelines, the RMSSD reflects the integrity of vagus nerve-mediated autonomic control of the heart (Task Force, 1996).

Data analyses

The analyses were carried out using SPSS Version 23 and data were checked for normality of distribution and outliers. There were no extreme outliers. No variable had indicators of severe violations to the normal distribution ($Sk < | 3 |$ and $Ku < | 10 |$; Kline, 2005) and statistical significance was set at .05.

A between-subjects' mediation analysis using PROCESS macro for SPSS (Hayes, 2012, 2013) was conducted. This macro computes direct and indirect effects using a series of ordinary least squares regressions and the bootstrapping procedure. The significance of the indirect effects, based on bias-corrected confidence intervals (CI) derived from 5,000 bootstrap resamples, is indicated when the CI values do not cross zero. In these models, condition (1 = CMT; 0 = WLC) was the independent variable (X), post-test scores of the outcomes (i.e., self-criticism, shame, depression, perceived stress, safe positive affect, relaxed positive affect) were the dependent variables (Y), and changes in compassion for the self, compassion from others, fears of compassion (for self, for others, from others) and HRV were the proposed mediators (M). The compassion for others subscale was not used in this study since there were no significant changes in this variable as a result of the intervention (Matos et al., 2017a). Pretest values of the mediators and outcomes in all models were controlled for and entered as covariates. Unstandardized coefficient (B) and standard error (SE) for each regression equation are reported to indicate the predicted change in the dependent variable given a one-unit change in the independent variable, while controlling for the other variables in the equation.

Results

Descriptive statistics and intervention efficacy results for all variables are reported in detail in Matos et al. (2017a). To explore possible mediators of the effect of the CMT intervention on the outcomes, several between-subjects' mediation analysis were tested. In the mediation models, condition (1 = CMT and 0 = WLC) was the independent variable and

self-criticism, shame, depression, perceived stress, safe positive affect and relaxed positive affect were entered as outcomes, with the pretest scores of these outcomes entered as covariates. Each mediator (i.e., compassion for the self, compassion from others, fears of compassion for self, for others and from others, and HRV) was tested separately in each model. The conceptual model for the mediation analyses is depicted in Figure 2.

[Insert Figure 2 here]

Processes underlying effects on self-criticism and shame

Self-criticism. Increases in compassion for self ($B = -1.41$, $BootSE = 0.70$ 95% CI [-3.22 to -0.34]) and in compassion from others ($B = -0.88$, $BootSE = 0.58$ 95% CI [-2.47 to -0.07]) mediated the decrease in self-criticism as a result of the CMT intervention. Reductions in fears of compassion for the self ($B = -2.32$, $BootSE = 0.88$ 95% CI [-4.49 to -0.93]), for others ($B = -1.63$, $BootSE = 0.88$ 95% CI [-3.47 to -0.16]), and of receiving compassion from others ($B = -1.14$, $BootSE = 0.67$ 95% CI [-3.02 to -0.19]), significantly mediated the impact of the CMT on self-criticism.

Shame. Increases in compassion for the self ($B = -1.07$, $BootSE = 0.69$ 95% CI [-2.92 to -0.06]), and in compassion from others ($B = -1.55$, $BootSE = 0.85$ 95% CI [-3.70 to -0.26]) mediated the decrease in feelings of shame from pre to post CMT intervention. Decreases in fears of compassion for the self ($B = -2.89$, $BootSE = 1.13$ 95% CI [-5.65 to -1.14]), for others ($B = -2.03$, $BootSE = 1.09$ 95% CI [-4.63 to -0.28]), and of receiving compassion from others ($B = -2.70$, $BootSE = 1.09$ 95% CI [-5.59 to -1.04]) significantly mediated the impact of the CMT on shame.

Processes underlying effects on psychopathology indicators

Depression. Increases in compassion for the self ($B = -0.54$, $BootSE = 0.25$ 95% CI [-1.24 to -0.18]), and the sensitivity to receiving compassion from others ($B = -0.31$, $BootSE = 0.24$ 95% CI [-1.03 to -0.03]) mediated the decrease in depressive symptoms from pre to post

intervention. Decreases in fear of compassion for the self ($B = -0.66$, $BootSE = 0.29$ 95% CI [-1.33 to -0.16]) significantly mediated the effect of the CMT intervention on depression.

Perceived stress. Increases in compassion for the self ($B = -1.25$, $BootSE = 0.59$ 95% CI [-2.76 to -0.36]) and receiving compassion from others ($B = -0.76$, $BootSE = 0.45$ 95% CI [-1.97 to -0.10]) mediated the decrease in perceived stress as a result of the CMT intervention. Reduction in fear of compassion for the self ($B = -1.10$, $BootSE = 0.63$ 95% CI [-2.71 to -0.09]) significantly mediated the impact of the intervention on stress symptoms.

Processes underlying effects on positive affect

Safe positive affect. Increases in compassion for the self ($B = 0.15$, $BootSE = 0.06$ 95% CI [0.05 to 0.30]), and in the experience of compassion from others ($B = 0.07$, $BootSE = 0.04$ 95% CI [0.01 to 0.18]) mediated the increase in feelings of safeness from pre to post CMT intervention. Decreases in fears of compassion for the self ($B = 0.12$, $BootSE = 0.06$ 95% CI [0.03 to 0.26]) and of receiving compassion from others ($B = 0.09$, $BootSE = 0.05$ 95% CI [0.02 to 0.21]) significantly mediated the impact of the CMT on feelings of contentment.

Relaxed positive affect. Increases in compassion for self ($B = 0.11$, $BootSE = 0.07$ 95% CI [0.01 to 0.29]) mediated the increase in relaxed positive affect as a result of the CMT intervention. Reductions in fears of compassion for the self ($B = 0.18$, $BootSE = 0.08$ 95% CI [0.07 to 0.39]), and for others ($B = 0.12$, $BootSE = 0.07$ 95% CI [0.02 to 0.28]) significantly mediated the impact of the CMT on feelings of peacefulness. Increases in heart rate variability ($B = -0.05$, $BootSE = 0.04$ 95% CI [-0.14 to -0.02]) significantly mediated the effect of the intervention on feelings of relaxation and calmness.

In sum, improvements in compassion for the self and from others, and decreases in fears of compassion, mediated the effect of the CMT intervention on the outcome measures: diminished self-criticism, shame, depression and stress symptoms, and increased feelings of safeness and calmness. In addition, increases in HRV significantly mediated CMT-induced changes in relaxed positive affect.

Discussion

The current study aimed to examine the role of compassion, fears of compassion and heart rate variability as psychological and physiological mediator mechanisms of change underlying the effects of CMT on psychological vulnerability factors, mental health indicators and positive affect. This study used data from a previous randomized controlled study investigating the effectiveness of a two-week CMT intervention in an adult community sample (Matos et al., 2017a), which showed that this intervention produced significant increases in self-compassion and sensitivity to the compassion from others, promoted feelings of safeness and calmness, and improved participants' HRV. The CMT intervention also decreased fears of compassion (for self, for others and from others), shame, self-criticism, depressive and stress symptoms. The current study built upon these findings and explored whether changes in compassion, fears of compassion and HRV, the psychophysiological processes targeted by the core components of the CMT intervention, would mediate the beneficial changes in psychological vulnerability factors (of shame and self-criticism), mental health indicators and positive affect from pre to post intervention.

In line with the hypotheses, increases in the ability to be compassionate towards the self and in the sensitivity to receiving compassion from others, as well as decreases in fears of experiencing compassion for the self, for others and from others, promoted by the CMT intervention, mediated the reductions in feelings of shame and self-criticism from pre to post-intervention. Improvements in compassion for the self and from others, and decreases in fear of compassion for the self also mediated the effects of the intervention on decreasing depressive and stress symptoms. In terms of positive affect, increases in feelings of safeness and contentment from pre to post CMT were mediated by increased compassion for the self and from others and by reduced fears of compassion for the self and from others. Finally, changes in feelings of relaxation and peacefulness were mediated by improvements in HRV and compassion for self and decreases in fear of compassion for self and for others.

A number of findings are worth highlighting here. One key finding is that increased self-compassion and decreased fears of self-compassion emerges as the common mechanisms of change through which CMT operates when it comes to producing changes in all the mental health indicators assessed. These findings lend support to the CFT/CMT theoretical framework (Gilbert, 2014, 2019, 2020), and suggest that diminishing one's resistances and blocks to experience compassion for oneself while also developing one's competencies to be sensitive to and engage with one's own distress alongside promoting one's commitment and ability to skilfully work with their own distress to try to prevent and alleviate their suffering, are two critical mechanisms underlying the effectiveness of CMT. The cultivation of such self-compassionate motives and competencies together with the weakening of fears and resistances to experience self-directed compassion through core CMT techniques and practices may lay the ground for the creation of an internal secure base and safe haven and the fostering of grounding and self-soothing abilities, which are linked to the activation of the safeness-soothing system and the dampening of the threat-protection system (Gilbert, 2014, 2019, 2020; Porges, 2007; Thayer & Lane, 2000).

Hence this is mirrored in the changes produced by the CMT intervention both in terms of diminished perceived stress and depressive symptoms, and in the experience of heightened feelings of safeness, contentment, peacefulness and calmness. Furthermore, the fading of one's resistances to self-compassion and the development of self-compassionate motives and competencies are also crucial mechanisms through which CMT operates to reduce one's subjective experience of social threat and feelings of external shame (i.e., negative perceptions of how others see and judge the self) and to deactivate harsh self-criticism when suffering setbacks or disappointments. Thus, these results seem to reflect a down-regulation of threat processing and decreased sympathetic arousal, and a stimulation of the safeness-soothing system through the activation of the parasympathetic system (Gilbert, 2019; Thayer & Lane, 2000).

These results are in line with those of a previous study where, using a distinct but related construct to that of self-compassion, Sommers-Spijkerman et al. (2018b) found that self-reassurance, the cognitive self-relating style used when adopting a compassionate-mind, was a mediator mechanism of the effects of a self-help CFT-intervention in well-being and anxiety symptoms in a nonclinical sample. These findings also expand upon a recent study that, after an 8-week CMT intervention in an adult community sample, reported significant correlations between pre-to-post changes scores in self-compassion and changes in self-criticism, well-being and psychological distress (Irons & Heriot-Maitland, 2020). Similarly, a randomized controlled trial of CFT in psychosis also described that increases in compassion in the CFT group were associated with reductions in depression and perceived social marginalization (Braehler et al., 2012).

Another finding worth highlighting is that increases in one's perception of and openness to receiving compassion from others appear as important mechanisms underpinning the positive effects of CMT on feelings of safeness and contentment, and on reductions in shame, self-criticism, and in symptoms of depression and stress. In light of the CFT framework, CMT techniques aim to help facilitate our evolved caring motivation and our affiliative systems that help regulate distress (Gilbert, 2010, 2019, 2020). Particularly, the core components of CMT are designed to stimulate physiological processes related to the caring motives and affiliative relating (e.g., the myelinated vagal nerve part of the parasympathetic system, related to human's capacities to connect and coregulate each other's emotions and engage in prosocial behaviour), thus fostering interpersonal safeness and facilitating the engagement with and the alleviation of suffering (Kirby et al., 2017a; Gilbert, 2009, 2010, 2020). Our results indicate that the CMT intervention may stimulate the caring motive and that may sensitize people to be more open and motivated to receive compassion from other people. This may allow one to experience interpersonal social relating and affiliative behaviors as a source of soothing and calmness in times of distress, thereby, reducing psychological distress, social threat and

negative self-evaluation, and fostering emotional experiences of safeness, contentment and relaxation. In accordance with our data, previous research has demonstrated that openness to receive compassion from others buffers against mental health difficulties (e.g., Cavalcanti et al., 2021; Hermanto et al., 2016; Matos et al., 2017b; Steindl et al., 2018; for a review see Kirby et al., 2019). Our findings extend the results of a recent study showing significant associations between pre-to-post changes in compassion from others and changes in depression, stress and well-being, but not self-criticism, after an 8-week CMT intervention (Irons & Heriot-Maitland, 2020).

Interestingly, our results also underscore that the two flows of compassion where the self is the recipient of compassion might be operating similarly, despite coming from distinct internal (self) and external (others) sources, and emerge as crucial mechanisms behind the beneficial effects of CMT. Having compassion directed towards oneself, either from within or from others, might generate the opportunity to experience a heightened sense of connection and interpersonal safeness, along with creating an internal safe haven and secure base, hence promoting affect regulation and cultivating self-soothing abilities in the face of distress.

In regard to the other flow of compassion - compassion directed to others, we found that reductions in fears of compassion for others played a significant mediator role in explaining CMT-induced decreases in shame and self-criticism and increases in feelings of relaxation, but not psychopathological symptoms. Although no significant changes in compassion to others were found in the experimental group after the CMT intervention (Matos et al., 2017a), the core components of CMT may mitigate the threat response to being compassionate towards other people, thereby reducing inhibitors of compassion to others, which may in turn diminish the experience of social threat and self-devaluation, and promote feelings of calmness. Our results advance those of Irons and Heriot-Maitland (2020) who, although not having assessed fears of compassion, found no significant correlations between pre-to-post changes in compassion to others and changes in self-criticism, well-being and

psychological distress. In fact, whilst compassion to others has been linked to mental health benefits and stronger social connections (Cozolino, 2006; Crocker & Canevello, 2012), fear of compassion to others has consistently revealed weaker associations with mental health difficulties, in comparison to the other flows of fears of compassion (see Kirby et al., 2019 for a review), and seems to be related to dimensions of prosocial versus antisocial behavior instead (Basran et al., 2019). More research is needed to better understand how lifting the barriers to being compassionate to others might be an important mechanism behind the impact of CMT on both social and interpersonal outcomes and on indicators of psychological adjustment.

Notably, increases in HRV were significant in mediating the positive impact of the CMT intervention on feeling relaxed, peaceful and calm. HRV is a physiological marker of vagal tone and parasympathetic activation, with high levels being associated with increased states of contentment, calmness, safeness, and indicative of adaptive emotion regulation and ability to self-soothe in the face of distress (e.g., Kirby et al., 2017a; Park & Thayer, 2014; Petrocchi et al., 2017). Therefore, it seems that the core CMT techniques and practices may develop one's ability to physiologically regulate threat emotional states and reduce sympathetic arousal through parasympathetic activation, thus facilitating the access to the safeness-soothing affect regulation system and producing a type of positive affect characterized by feelings of relaxation, peacefulness and calm. This result provides empirical support of the vagal mediated physiological pathways through which CFT/CMT operate to generate changes in wellbeing, emotion regulation and psychological distress (Gilbert, 2014, 2020). In support of our finding that HRV has a mediating impact on the effects of CFT on relaxed positive affect, a number of studies have recently demonstrated that cultivating compassion through different CMT/CFT practices is associated with increased parasympathetic response as measured by increases in HRV (e.g., Arch et al., 2014; Kim et al., 2020; Matos et al., 2017a; Petrocchi et al., 2016; Rockliff et al., 2008). Surprisingly though, HRV did not emerge as a

significant mediator in relation to the effects of the CMT intervention on the other mental health indicators. A possible explanation for this might be related to the brief duration of this particular CMT program or to the use of a nonclinical sample. Future studies should pursue exploring HRV as a potential mechanism of change in longer formats of CMT, and with specific target groups from the general population particularly vulnerable to heightened psychological distress (e.g., teachers) and clinical samples (e.g., individuals with clinical or subclinical levels of depression or anxiety).

Another possible explanation is that resting HRV might not be the best indicator of the increased physiological flexibility CMT seems to produce; in fact, other indexes, such as HRV reactivity, might be better ways to assess vagal flexibility. For example, Steffen et al. (2021) found that even if resting HRV did not significantly change over the course of a 12-session group CFT intervention, reliable change in self-compassion predicted increased HRV reactivity to self-critical and self-compassion writing tasks following the intervention, indicating greater engagement with the task and a strengthened ability to engage with difficult emotions. Indeed, also a recent paper by Di Bello et al. (2021) suggested that it is simplistic to link compassion with higher HRV: experiencing empathic sensitivity, the first component of compassion, is indexed by reduced HRV, while engaging in compassion-motivated actions is ultimately associated with increased HRV. This emphasises the importance of adopting a nuanced perspective on the complex physiological regulation that underlies compassion. As suggested by Petrocchi and Cheli (2019) baseline resting HRV could be more systematically tested as a potential moderator of the effectiveness of the intervention, while HRV reactivity as an indexed of improved compassionate responding due to a CFT treatment.

Limitations and future directions

Although our results are promising and may inform future research and intervention development, this study has a several limitations that should be taken into account when interpreting these findings. A limitation of this study was the use of self-report questionnaires

assessing constructs that were directly targeted by the CMT intervention, which may increase the risk for potential demand characteristics on participants. Another limitation is that change in mediators was not measured before change in the outcomes, and the temporal ordering of mediator and outcome variables is important to establish causal mediation (Kazdin, 2009). Future research should further explore these findings by measuring mediators and outcomes at different time points throughout a CMT intervention to establish whether it is changes in the compassion, fears of compassion and HRV across the intervention that lead to changes in self-evaluation, and psychopathology and positive affect at post-intervention.

Furthermore, incoming studies could explore the inter-relationship between changes in compassion and changes in fears of compassion, that is, how these two processes coexist and interactively change during a CMT intervention. In particular, it would be interesting to explore whether the CMT intervention leads to decreases in fears of compassion (e.g., through psychoeducation, experiencing the practices) and thus reduces the threat-based responses to compassion and opens oneself to develop one's compassionate self. Or whether it is the experiencing of the compassionate based feelings and actions, cultivated through CMT practices, that stimulate parasympathetic activation and the development of the safeness-soothing system, which allow for the cultivation of compassion and weaken the threat processing and responses associated with it (i.e., fears of compassion).

Notwithstanding the abovementioned caveats, the current findings may offer relevant insights for the flourishing field of compassion-based interventions by providing an empirical validation of some of the theoretical underpinnings of CFT/CMT. Our results suggest that the core components of the CMT intervention (including psychoeducation, physiologically based practices for slowing down the body and grounding the mind, and compassion cultivation imagery practices) seem to be effective in improving parasympathetic regulatory activity, promoting the cultivation of compassion motives and competencies directed towards oneself along with while also lessening fears, blocks and resistances to the experience of compassion

for the self and for others and of receiving compassion from others. In turn, being open to and experiencing compassion for oneself and from others seem to underly the beneficial effects of the CMT intervention on shame, self-criticism, psychopathological symptoms and, along with improved HRV, positive affect.

Therefore, these results emphasize the importance of working both with the facilitators and inhibitors of compassion to create the conditions for cultivating and manifesting a compassionate self/mind. In support of the CFT theoretical framework (Gilbert, 2010, 2014, 2020), this study suggests that it is through breaking the barriers and inhibitors to access and develop the compassion motivational system, by cultivating compassion motives and competencies, alongside stimulating the parasympathetic system via vagal regulatory activity, that the safeness-soothing affect regulation system may be strengthened, and the threat-protection system and sympathetic arousal downregulated; thus reducing shame, self-criticism and psychological distress, and promoting safe and relaxed positive affect.

Data availability statement:

The data that support the findings of this study are available upon reasonable request from the authors.

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Compliance with Ethical Standards

Ethical Approval. All procedures performed in studies involving human participants were in accordance with the ethical standards of the Ethics Committee of the Faculty of Psychology and Educational Sciences, University of Coimbra, and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards

Informed Consent. Informed consent was obtained from all individual participants included in the study.

Conflict of Interest. The authors declare that they have no conflict of interest.

Author Contributions

MM designed and executed the study, performed the data analyses and wrote the original draft of the manuscript and subsequent review and editing. CD assisted with the design and implementation of the study and data analyses. JD assisted with the design and implementation of the study and data analyses. JPG collaborated with the design of the study and discussion of results. NP analysed the HRV data and collaborated in the review and editing of the final manuscript. PG designed the study, collaborated in the discussion of results and in the writing, review and editing of the final manuscript.

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