Psychological and physiological effects of compassionate mind training: A pilot randomized controlled study

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Abstract

The development of the compassionate self, associated with practices such as slow and deeper breathing, compassionate voice tones and facial expressions and compassionate focusing is central to Compassion Focused Therapy. This study explores the impact of a two-week Compassionate Mind Training (CMT) program on emotional, self-evaluative and psychopathology measures and on heart rate variability (HRV). Participants (general population and college students) were randomly assigned to one of two conditions: CMT (n=56) and Wait-List Control (n=37). Participants in the CMTcondition were instructed to practice CMT exercises during two weeks. Self-report measures of compassion, positive affect, fears of compassion, self-criticism, shame, depression, anxiety and stress, and HRV were collected at pre and post intervention in both conditions. Compared to the control group, the experimental group showed significant increases in positive emotions, associated with feeling relaxed and also safe and content, but not activated; and in self-compassion, compassion for others and compassion from others. There were significant reductions in shame, self-criticism, fears of compassion, and stress. Only the experimental group reported significant improvement in HRV. Developing awareness of the evolved nature and inherent difficulties of our minds allied with practicing CMT exercises has beneficial effects on participants' psychological and physiological well-being.

Key words: Compassion; Intervention; Imagery; Psychopathology; Self-criticism; Heart-rate variability

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Introduction

The last 20 years has seen increasing research exploring the physical and psychological benefits of compassion and prosocial cultivation (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008; Hofmann, Grossman, & Hinton, 2011; Jazaieri et al., 2013; Keltner, Kogan, Piff, & Saturn, 2014; Kirby, 2016; Pace et al., 2009; Ricard, 2015; Schanche, Stiles, McCullough, Svartberg, & Nielsen, 2011; Singer & Bolz, 2012). Compassion has become a central focus for self-help and development (Gilbert, 2000, 2010), with programs such self-compassion training (Neff & Germer, 2013) and compassion cultivation training (Jazaieri et al., 2013). It has also become a focus for psychotherapy (Germer & Siegel, 2012; Gilbert 2000, 2010, 2014; Kirby 2016; Kirby & Gilbert, 2017).

One of these approaches, called Compassion Focused Therapy (CFT), was specifically developed with and for people with high shame and self-criticism and from difficult backgrounds (Gilbert, 2000, 2010; Gilbert & Choden, 2013), with increasing evidence of therapeutic effectiveness (e.g., Kirby, 2016; Leaviss & Uttley, 2014). The therapy focuses on helping people understand that the way the human brain has evolved makes us very vulnerable to rumination, negativity bias and self-critical self-monitoring (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Gilbert, 2009). Such insights shift attention from blaming and shaming the self for these difficulties to how to work with them compassionately (Gilbert & Choden, 2013).

As part of CFT there are a series of compassionate mind training (CMT) practices. These are specific practices to develop physical and mental competencies

that facilitate self-grounding, the ability to slow down and take a compassionate focus and orientation to self, to others, help balance different types of emotion and work with life difficulties. They help people recognise the difference between a threat-focused, competitive-striving self-focus and a compassionate motivation self-focus (Crocker, & Canevello, 2012; Gilbert, 1989/2016, 2009). These exercises involve ways of breathing, forms of mindfulness, orientating oneself to be supportive and helpful, and styles of thinking and behaving that are linked to attachment and affiliative mechanisms and their role in emotion regulation (Brown & Brown, 2015; Cozolino, 2007; Depue & Morrone-Strupinsky, 2005; Gilbert, 2000, 2010).

CMT begins with psychoeducation on the evolved nature and difficulties of the human mind such as tendencies for negativity bias, negative rumination, shame and self-criticism (Baumeister et al 2001; Gilbert, 2009). Individuals are then offered insights into how we can work with our 'tricky brains' using body based and psychological based practices. One important body based practice is called *Soothing rhythm breathing*. Breath awareness and attention focus is basic to vipassana meditation, although here there is no desire to change the depth or rhythm of the breathing. In contrast, soothing rhythm is designed to slow and deepen the breath (to around 5-6 breaths per minute) focusing one's attention on the sensations of 'mind and body slowing down' and body feeling heavier and grounded (in contrast to fast shallow breathing; Gilbert & Choden, 2013). Recent research has shown that this breathing pattern can be beneficial in terms of lowering arousal, activating the parasympathetic nervous system and improving heart rate variability, with feelings of calmness (Lin, Tai, & Fan, 2014; Streeter, Gerbarg, Saper, Ciraulo, & Brown, 2012). This breathing practice helps to activate the vagal parasympathetic nervous system, improves heart rate variability (HRV), is linked to feeling more grounded stable and

less stressed, supports the frontal cortex (Porges, 2007; Thayer, Åhs,, Fredrikson, Sollers, & Wager, 2012) and is associated with affiliative feelings and behaviours (Kogan et al. 2014).

In addition, participants practice certain postures and creating affiliative and friendly facial expressions and voice tones linked to their inner thinking. To note the impact of these deliberate emotion stimulations, individuals can compare and contrast them with neutral, angry or anxious facial expressions and emotional tones to their thoughts. In addition, CFT trains people to pay careful attention to the *emotional textures* and tone of one's thoughts and inner speech, not just content (Gilbert & Choden, 2013). CFT partly began with the recognition that even when people were trying to be supportive of themselves by generating coping thoughts, the emotional texture of them could be hostile and angry. For example, coping thoughts in an anxious situation of "even though I feel anxious, I have succeeded at this before and will again if I go step-by-step" can be created with a supportive caring voice or a frustrated hostile one. Indeed, there is now considerable evidence of the importance of inner speech for cognition, emotional regulation and sense of self (Ald Alderson-Day & Fernyhough, 2015).

CMT uses a variety of mindfulness techniques that are designed to help people become aware of their present moment-to-moment experience (Gilbert & Choden 2013). In the Tibetan (Mahayana) traditions mindfulness is a means by which we hold to our intentionality of bringing compassion to our everyday existence and noticing when we have been called out of that by anger, grasping or aversion (Gilbert & Choden, 2015; Ricard, 2015)

CMT practices offer different imagery practices. Imagery provides an effective route for accessing and altering emotional states because the neural

processes which support imagery overlap with perceptual processing (O'Craven & Kanwisher, 2000). Imagery is a powerful physiological stimulator in a way cognition may not be. There is increasing evidence that compassion-focused imagery impacts on a range of physiological and neurophysiological processes (Klimecki, Leiberg, Lamm, & Singer, 2012).

There are several compassion imagery practices (e.g., Gilbert & Choden, 2013; Kolts, 2016; Tirch, Schoendorf, & Silberstein, 2014), but two of them are central to CMT and of special interest to this study. One relates to imagining a compassionate other directing compassion to the self (compassionate image), while the other focuses on bringing to mind and cultivating compassionate motives and a self-identity; cultivating one's compassionate self and competencies (Gilbert, 2000, 2009, 2010; Gilbert & Choden, 2013). Selcuk et al. (2012) showed that bringing to mind caring attachment figures, in the context of a stressful autobiographical memory significantly reduced the negative affect associated with that memory. Imagining a compassionate other being compassionate to oneself is associated with improved HRV (Rockliff et al., 2008) and increases the effects of oxytocin on feelings of affiliation and connectedness (Rockliff et al., 2011). This effect is attenuated in people with high self-criticism in one off practices (Rockliff et al., 2008, 2011), but produces significant improvements for self-critical people who practice over time (McEwan & Gilbert, 2016).

Focusing on oneself as a compassionate person uses a variety of acting techniques to imagine becoming, and living from, the perspective of one's most compassionate self. Participants are invited to imagine and identify personal characteristics they would have if they were at their compassionate best (e.g., with tolerance, warmth, openness) and also three core CFT qualities of compassion:

wisdom (related to the psycho-education, life experience and common humanity), *strength and authority* (related to the breathing and body grounding work and insight), and *compassion commitment* (to be helpful, validating, empathic and supportive to self and others).

The process of inviting individuals to imagine themselves in a certain role is used in acting training and helps create role congruent states of mind that provide for skilled performance (Chubbuck, 2005). There is also evidence that practicing imagining one's 'best possible self' and engaging in various life issues from that position is related to emotional change and increased optimism (Meevissen, Peters, & Alberts, 2011; Peters, Flink, Boersma, & Linton, 2010). Osimo, Pizarro, Spanlang, and Slater (2015) created a virtual reality scenario where participants raised a personal issue and then offered themselves counseling either as themselves or as (a virtual) Sigmund Freud. Giving oneself-counseling 'as Sigmund Freud' reduced depressed feelings significantly more than as self. Falconer et al. (Falconer et al., 2014) developed a virtual reality scenario which enabled individuals to generate compassion in one's virtual body and then experience receiving it from themselves in another virtual body. Developing a compassionate self and, then experiencing it for oneself, significantly reduced self-criticism. This impact was also seen on depression for a depressed group (Falconer et al., 2016). Taken together there is good evidence that imagining ourselves in certain roles and states of being, and imagining how these 'self-constructions' would think and deal with various life events, can have many beneficial effects.

Once individuals have developed this way of grounding themselves and focusing on entering into compassionate states of mind, compassionate self-constructions, and/or imagining themselves at their compassionate best, they can then

bring this to their life difficulties and/or when they notice self-criticism arising. In an uncontrolled trial of these practices, over a short two-week period, there was significant change in self-criticism and depression, anxiety and stress (McEwan & Gilbert, 2016).

While there is growing evidence that Compassion Focused Therapy is effective for a range of people with mental health problems (Kirby, 2016; Leaviss, & Uttley, 2014), there has been no randomized controlled trial of these practices in the general population. In addition, even though the three orientations of compassion - compassion for self, compassion for others and receiving compassion from others - are inter-related and believed to promote one another (Gilbert, 2009, 2015; Gilbert et al., 2017), the improvement of their inter-relationship as a result of an intervention focused on the cultivation of compassion competencies (e.g., sensitivity, distress tolerance, empathy, and problem-solving) is yet to be empirically supported.

Physiologically, CMT practices aim to stimulate the parasympathetic system, and are thought to correspond to adaptive HRV (Kirby, Doty, Petrocchi, & Gilbert, 2017). HRV is an index of adaptive emotion regulation and higher levels of 'safeness-based' positive emotions (Thayer, Åhs, Fredrikson, Sollers, & Wager, 2012). HRV reflects the parasympathetic influence on heart rate mediated by the vagus nerve, and increased HRV is an index of increased parasympathetic activity, a physiological state mediated via vagal pathways which inhibits the reactivity of the sympathetic branch of the autonomic nervous system, facilitating approach motivations such as compassion. Higher resting HRV is a physiological marker of the person's ability to respond to environmental challenges, as well as to regulate their emotional response (Park & Thayer, 2014). Increased HRV is connected to the emotional state of compassion (Stellar, Cohen, Oveis, & Keltner, 2015) and to the

ability to self-soothe in response to self-generated affiliative signals (Rockliff et al., 2008). HRV is therefore an ideal candidate to explore the impact of a CMT intervention (Kirby et al., 2017).

The impact of meditation-based practices on HRV has been investigated in previous studies, but results were mixed. For example, Krygier et al. (2013) found no significant effects of 10-day Vipassana mediation on resting HRV. Similarly, no effect on HRV following MBCT and MBSR training have been reported (Nyklíček, Mommersteeg, Van Beugen, Ramakers, & Van Boxtel, 2013; Wheeler et al., 2014). However, changes in resting baseline HRV over time have been found with less intensive mindfulness meditation training (Tang et al., 2009), and Petrocchi, Ottaviani and Couyoumdjan (2016) reported an increase in HRV after a short self-compassion intervention. Therefore, and given HRV link to vagal regulatory activity and to well-being, the impact of compassion-based interventions on HRV warrants further investigation (Kirby et al., 2017).

The current study developed a protocol for a relatively brief (two weeks) CMT intervention that provided psycho-educational materials and audio CMT exercises. This study aimed to test this CMT intervention in a randomised controlled trial exploring its impact on self-report variables including compassion for self, for others and from others, fears of compassion, shame, self-criticism, self-reassurance, types of positive affect, and depression, anxiety and stress. Furthermore, the present study aimed at exploring how the association between the three compassion orientations improved as a result of the intervention. In addition, the current study aimed to investigate the impact of this CMT intervention on HRV. It is hypothesized that the CMT intervention would produce significant changes in these psychological and

physiological indicators and that the association between the compassion orientations would become stronger after the intervention.

Method

Participants

One hundred and seventeen participants were initially included, and were randomized to one of two conditions: Compassionate Mind Training and a Waiting List Control. The attrition rate was 20.5%, with the dropout rate being higher in the control group (36.21%). The final sample comprised 93 participants who completed the entire Compassionate Mind Training protocol (CMT; n = 56; WLC; n = 37)

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%).

Procedure

The study was approved by the University's Ethical Committee and advertised through announcements posted on Coimbra University' campus, and Faculties' mailing lists as a study investigating the effect of meditation on wellbeing indicators. Individuals interested in taking part in the study contacted the research team via email, and were then informed about the procedures of the study and provided their written informed consent.

Exclusionary criteria were assessed in a brief interview and included major psychiatric problems (e.g., psychosis, major depression, bipolar disorder, suicidal ideation, borderline personality disorder, substance abuse), organic illnesses,

cardiovascular disease, use of drugs/medications that might affect cardiovascular function, obesity (body mass index > 30 kg/m^2), menopause, use of oral contraceptives during the previous 6 months, and pregnancy or childbirth within the last 12 months.

Each participant was randomly assigned to either the compassionate mind training (CMT) condition or a wait-list control condition (WLC). Participants were asked to refrain from a) eating, b) drinking alcohol, tea, or coffee, and c) strenuous exercise 2 hours preceding the scheduled appointment. First, participants came to the laboratory to complete the pre-test self-report measures. Then participants were hooked up with the electrocardiogram (ECG) and asked to relax in a seated position for 5 minutes in order to obtain a measure of resting-state heart rate variability (HRV).

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. The researchers clarified any questions participants had regarding the practices. They 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.

The CMT practices 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. Once they had listened to the instructions on the audio files and understood the practices they were free to use the audio files or not when practising. They were encouraged to bring compassion into their everyday life -- especially when they encountered life difficulties or upsets. After the two-weeks, all participants were invited back to the laboratory to complete the post-test measurements (self-report measurements, a questionnaire assessing the frequency, nature and intensity of their practices, and inviting them to provide general feedback on the tasks, and HRV). 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 Attributes and Actions Scales CAAS (Gilbert et al., 2017) Compassion is typically regarded as having two core components 1. As a sensitivity to the suffering of self and others; 2. A commitment to try to alleviate and prevent suffering (Gilbert & Choden, 2013). The CAAS measures different elements of these

two psychologies. In regard to the *engagement* scale, it measures the degree to which individuals are (for example) motivated to engage with suffering, distress tolerance, and empathy. In regard to *trying to alleviate and prevent suffering*, the scale measures (for example) people's ability to solve problems and behave in ways that are helpful. There are three scales measuring compassion to self, compassion to others, and experiencing/being aware of the compassion from others. Each scale can be analysed in terms of the 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 sensitivity to the compassion from others) as a single factor. In their original study, the CAAS showed good internal consistencies and temporal reliability (Gilbert et al., 2016)

Self-Compassion Scale (SCS; Neff, 2003). This is a 26-item scale with 6-point Likert scored self-evaluative factors, three positive: Self-Kindness, Common Humanity and Mindfulness; and three negative: Self-Judgement, Isolation and Over-Identification. Participants indicate how often they engage in these ways of self-relating on a 5-point Likert scale. The SCS has good internal consistency (Cronbach alpha scores ranging from .75 to .81), and test-retest correlations over three weeks are high (ranging from .80 to .88).

Fears of Compassion Scale (Gilbert, McEwan, Matos, & Rivis, 2011). This study used the recently developed fears of compassion scales (Gilbert et al., 2011). Fear of compassion *for Self* scale comprises 15 items (e.g. "Getting on in life is about being tough rather than compassionate"); fear of compassion *from Others* scale comprises 13 items (e.g. "Wanting others to be kind to oneself is a weakness"); fear of compassion *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 five-point

Likert scale (0 = Don't agree at all, 4 = Completely agree). These scales showed good reliability with Cronbach's alpha's of .92 *for self*, .85 *from others*, and .84 *for others* in a student sample.

Types of Positive Affect Scale (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 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.

Other as Shamer scale (Goss, Gilbert, & Allan, 1994). This scale was developed from Cook's (1993) Internalized Shame Scale by Allan, Gilbert and Goss (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 0.92. Because the scale asks about how often people think this way, it measures thought frequency.

Forms of Self Criticising/Attacking and Self Reassuring Scale (FSCRS; Gilbert, Clarke, Kempel, Miles, & Irons, 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 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's 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 reliability of the scale (e.g, Baião, Gilbert, McEwan, & Carvalho, 2014; Castilho, Pinto-Gouveia, & Duarte, 2013; Kupeli, Chilcot, Schmidt, Campbell, & Troop, 2013).

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 0 – 3. (0 = Did not apply to me at all, 3 = Applied to me very much, or most of the time). The DASS-21 subscales have Cronbach's alphas of .94 for Depression, .87 for Anxiety and .91 for Stress (Antony, Bieling, Cox, Enns, & Swinson, 1998). Statements include 'I was aware of dryness of my mouth', 'I tended to over-react to situations' and 'I couldn't seem to experience any positive feeling at all'.

Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 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's α between .84 and .86 were reported in the original study.

Practices feedback questionnaire. At the end of each week, participants were asked to complete a imagery experience measure, assessing the frequency, nature and intensity of their imagery experience and inviting them to provide general feedback on the tasks.

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 21. Data was analysed using SPSS version 19 and 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) with skewness values ranging from -.69 to 2.02 and kurtosis values ranging from -.63 to 5.08. Only significant ($p < .05$) results are reported.

Independent samples t-tests were performed to analyse differences between the two groups at baseline. The study employed a 2 x 2 mixed ANOVA design with the two conditions (compassionate mind training vs. control condition) as the between-group factor and time (before and after the CMT practice) as the within-group factor investigating different effects between conditions. Where significant time x group interactions were found, paired samples t-tests were performed to explore differences between pre and post-test for both groups separately. Descriptive analyses regarding the feedback on the imagery experience were conducted. Effect sizes for the time effects and time x group effects were calculated using partial eta squares (η^2_p), with $\eta^2_p = .01$ referring to a small effect size, .06 to a medium effect size and .14 to a large effect size (Tabachnick & Fidell, 2013). The effect sizes for the paired samples t-tests were calculated using Cohen *d,* with 0.2 indicating a small effect, 0.5 a medium effect and 0.8 a large effect (Cohen, 1988).

Results

There were no significant differences between the groups at baseline regarding demographics and the study variables (all *ps* > .05).

Regarding the impact of CMT on the three orientations of compassion, there were significant main effects of time on compassion for self, compassion for others

and compassion from others, and significant time x group interaction effects were found for compassion for self and compassion from others. In terms of the positive sub-factors of the SCS, there was a significant main effect of time on self-kindness, but not on common humanity and mindfulness, and significant time x group interaction effects on self-kindness and common humanity. Although approaching significance, the main effect of time and the time x group interaction on reassured self were not significant. Mean scores, standard deviations and statistics for both groups at pre and post-intervention are reported in Table 1.

Post-hoc paired samples t-tests indicated that CMT group significantly increased compassion for self, awareness of compassion from others, self-kindness and common humanity.

_____insert Table 1 about here_____

In terms of the association between the three orientations of compassion, in the original scale development study of the CAAS (Gilbert et al., 2017), compassion for self, for others and being sensitive to compassion from others were not that highly correlated ($r < .5$). We therefore explored if CMT would result in increased correlations between these different orientations of compassion. Before CMT the correlations ranged from $r = .10$ (n.s.) to $r = .32$ ($p = .010$). After the two-week training the correlations between the orientations of compassion were stronger in magnitude: $r = .54$, $p < .001$ between compassion for self and compassion for others, $r = .56$ $p < .001$ between compassion for self and receiving compassion from others and $r = .71$, $p < .001$ between compassion for self and openness to receive compassion from others.

In terms of the impact of CMT on positive affect, there was a significant main effect of time on relaxed positive affect, safe positive affect, and activated positive affect. Significant time x group interaction effects were found only for the relaxed and safe positive affect. In the CMT group there was a significant increase in the relaxed and safe positive affect. In the control group there were no significant differences from pre to post test.

As to the impact of CMT on fears of compassion, there was a significant main effect of time on fears of compassion for the self and for others, and a significant time x group interaction effect for self, for others and from others. In the CMT group there was a significant decrease in all three fears of compassion. In the control group there were no significant changes from pre to post test.

In regard to the impact of CMT on self-criticism, there was a significant main effect of time and time x group interaction on self-criticism. In the CMT group there was a significant decrease on self-criticism and no significant differences were found for the control group. Regarding shame, the effect of time was non-significant but there was a significant time x group interaction, which may be explained by the fact that, while there were significant decreases in the CMT group there were also increases (although non-significant) in the control group. In terms of the negative sub-factors of the SCS, a significant main effect of time was found for self-judgment. Furthermore, significant time x group interaction effects were found for self-judgment, isolation and over-identification, with scores in the CMT group significantly decreasing from pre to post test.

The results regarding the impact of the intervention on depression, anxiety and stress showed that there was a significant effect of time on depression and perceived stress. The time x group interaction effects were significant for stress and perceived

stress. In the CMT group there was a significant decrease in stress and perceived stress. In the post hoc analyses, the two stress measures showed a significant decrease. No significant differences were found for the control group.

Finally, regarding the impact of CMT on heart rate variability, a significant time x group interaction emerged for HRV (RMSSD; see Figure 1). In the CMT group there was a significant increase in HRV. In the control group there were no significant differences from pre to post test.

_____insert Figure 1 about here_____

Participants' qualitative feedback on the practices was also examined. The majority of the participants (42.1%; *n* = 36) reported that they practiced 3 or 4 times per week, and 28.6% (*n* = 18) practiced 5 times or more per week. The majority of participants (75.4%; *n* = 48) found the practices moderately to very helpful. Eighty-three per cent (*n* = 53) indicated that they recalled acting or feeling as their best compassionate self over the weeks. Participants were also asked to rate how often did they act or feel as their best compassionate self, on a scale ranging from Not at all (1) to A lot of the time (10) and results revealed a mean of 6.54 (*SD* = 1.49). Regarding the question of how powerful were the compassionate feelings, the mean was 6.34 (*SD* = 1.39). In regards to the question of how easy was it to act or feel as their best compassionate self, the mean was 6.18 (*SD* = 1.72).

Discussion

This study explored the impact of a series of compassionate mind training practices over two weeks in a nonclinical population. Results showed that these

practices significantly improved people's experiences of compassion for themselves and of compassion from others, as measured by the newly developed Compassionate Attributes and Actions Scales (CAAS; Gilbert et al., 2017). Interestingly, both the experimental and the control group increased in compassion for others (time effect) thus resulting in a non-significant Time x Group effect.

Although other studies have not used these particular scales as change measures, these findings are in line with other studies that show how specific compassion training can improve self-compassion and compassion for others (Fredrickson, et al., 2008; Hofmann, et al., 2011; Jazaieri, et al., 2013; Keltner, et al., 2014; Pace et al., 2009; Ricard, 2015; Schanche, et al., 2011; Singer & Bolz, 2012). Furthermore, the two-week CMT training significantly improved the positive dimensions of self-compassion: self-kindness and common humanity, as measured by the SCS scale. Changes in the people's abilities to be self-reassuring improved, but not significantly.

One interesting question is the degree to which the different orientations of compassion are related; so if you are high/low on one you will be high/low on another. Interestingly, in the original CAAS development, Gilbert et al. (2017) found that the different orientations of compassion were not that highly correlated. After the two-weeks training the correlations between the three orientations of compassion significantly changed from non-significant or weak in magnitude to strong at post intervention. A possible explanation for this finding might be that the CMT intervention promoted the development of the caring motivational system as a whole, which enables people to be more open and in tune with the different flows of compassion (Gilbert, 2009, 2015). This result might also reflect the fact that the compassion practices used in this brief intervention targeted the three orientations of

compassion: compassion directed at the self, at others and openness to the compassion from others. Furthermore, because the CMT intervention had a significant effect on heart rate variability (as discussed later), this might be linked to improvements in vagal tone which are associated with increases in prosocial emotions and traits, and sociability in general (Kogan et al., 2014)

We explored change in different types of positive emotions and affective states distinguishing between activated positive affect (feeling energised, enthusiastic, excited), relaxed affect (feeling tranquil and relaxed) and safe and content affect. Interestingly, only the safe/contentment affect and relaxed affect significantly increased within the CMT group, but not the activated positive affect. This is relevant, given the focus of CFT on care-focused motivation and affiliation which supports feeling safe (Gilbert, 2009). In fact, it is the safeness and contentment types of positive affect that have been specifically linked to less depression, anxiety and self-criticism, as well as more self-reassurance and secure attachment (Gilbert et al., 2008). Importantly, the breathing practices in particular try to generate a sense of grounding and slowing down, the opposite of excited activation.

Fears, blocks and resistances (FBRs) of compassion can interfere with people's abilities to be open to the helpfulness of others, experience affiliative emotion and benefit from compassion and hence increasing their vulnerability to mental health problems (Gilbert et al., 2011). Indeed, FBRs of compassion are often the focus of CFT (Gilbert, 2010). Hermanto et al (2016) found that low fear of compassion from others weakened the depressogenic effect of self-criticism, while high fear of compassion from others exacerbated the effect. Importantly then CMT (using the psycho-education and audio guided CMT practices) significantly reduced all three forms of fears of compassion in comparison to the control group. The least

affected process was compassion from others. It is possible that helping people to become more trustworthy and open of others helpfulness requires longer work and has resistances located in early life history. Hence, even if people (especially self-critical people) might at first be resistant and respond to compassion with a threat response (Rockliff et al., 2008), as they learn more about the evolved nature of mind, the nature of compassion (as courage), and with compassion and practice, their fears and resistances settle. This is in line with Jazaieri, et al. (2013) who also found that compassion cultivation training can significantly reduce fears of compassion.

We explored three negative dimensions of negative self-evaluation: self-criticism (summing inadequate and hated self), external shame, and the negative sub-factors of the SCS (self-judgment, isolation and over-identification). Compared to the control group, CMT reduced participants' scores on self-criticism, shame, self-judgment, isolation and over-identification.

Although there. was a trend in the positive direction, there were no significant effects of the CMT of depression and anxiety scores, but the training significantly reduced stress and perceived stress. The non-significant impact of the training on depression and anxiety might be due to floor effects. The non-clinical nature of the sample might account for this finding.

While self-report measures are indicators of change, we also wanted to explore physiology processes associated with compassion. As noted in the introduction HRV is an ideal candidate to explore the impacts of CMT. Therefore, we were encouraged to find a significant HRV increase in the CMT group, while no significant differences were found in the control group from pre to post test. This is in line with previous studies reporting changes in resting baseline HRV over time with less intensive

mindfulness meditation training (Tang et al., 2009), and after a brief compassion-focused intervention (Petrocchi, Ottaviani & Couyoumdjan, 2016).

Strengths and Limitations

Although an RCT, CMT was not compared against a potential viable control such as mindfulness or loving kindness mediations (Frederickson et al., 2008). However, as a first study it was important to establish its acceptability and effectiveness in a general population. In addition, we did not study in detail the impacts of individual components such as psycho-education, breathing and imagery and focusing practices. Such questions may be important for future research to address. Another possible limitation of this study was the use of self-report measures assessing constructs that were directly targeted by the intervention, which may increase the risk for potential demand characteristics on participants. Nonetheless the finding that the intervention was effective on increasing HRV further supports the validity of the intervention.

This study has potential clinical implications by empirically supporting the effectiveness of CFT core components. In particular, this study offers evidence that helping people understand the problems we have with the way our brains have evolved, and then following a series of body focused and mind focused compassion practices has a range of beneficial effects on psychological and physiological processes. Therefore these findings encourage the implementation of CFT based interventions to other community samples and to clinical populations, in which issues of shame and self-criticism may be more prominent.

Compliance with Ethical Standards

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Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee 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 paper. CD assisted with the design and implementation of the study, data analyses and writing of the paper. JD assisted with the design and implementation of the study, data analyses and writing of the paper. JPG collaborated with the design of the study and discussion of results. NP analyzed the HRV data and wrote part of the results. JB collaborated in the writing and editing of the final manuscript. PG designed the study, collaborated in the data analyses and discussion of results and wrote the paper.

References

Allan, S., Gilbert, P. & Goss, K. (1994). An exploration of shame measures-II: Psychopathology. *Personality and Individual Differences*, *17*(5), 719-722.

Ald Alderson-Day, B. & Fernyhough, C. (2015) 'Inner speech: Development, cognitive functions, phenomenology, and neurobiology. *Psychological Bulletin, 141*, 931-965.

Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric Properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment*, *10*(2), 176-181.

Baião, R., Gilbert, P., McEwan, K., & Carvalho, S. (2014). Forms of self-criticising/attacking & self-reassuring scale: Psychometric properties and normative study. *Psychology and Psychotherapy: Theory, Research and Practice*, *88*, 438-452.

Baumeister, R.F., Bratslavsky, E., Finkenauer, C., & Vohs, K.D. (2001). Bad is stronger than good. *Review of General Psychology*, 5, 323-370

Brown, S. L. & Brown, R. M. (2015). Connecting prosocial behavior to improved physical health: Contributions from the neurobiology of parenting. *Neuroscience and Biobehavioral Reviews*, *55*, 1–17. doi:10.1016/j.neubiorev.2015.04.004

Chubbuck. I. (2005). *The Power of the Actor: The Chubbuck Technique.* New York: Gotham Books.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). New Jersey: Lawrence Erlbaum.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, *24*(4), 385-396.

Cozolino, L. (2007). *The neuroscience of human relationships: Attachment and the developing brain*. New York: Norton.

Crocker, J. & Canevello, A. (2008). Creating and undermining social support in communal relationships: The role of compassionate and self-image goals. *Journal of Personality and Social Psychology, 95*, 555-575.

Crocker, J., & Canevello, A. (2012). Consequences of self-image and compassionate goals. In P. G. Devine, and A. Plant (Eds.), *Advances in experimental social psychology* (pp. 229–277). New York: Elsevier.

Depue, R. A., & Morrone-Strupinsky, J.V. (2005). A neurobehavioral model of affiliative bonding: Implications for conceptualizing a human trait of affiliation. *Behavioral and Brain Sciences, 28,* 313-395. doi:10.1017/s0140525x05000063.

Falconer, C.J., Rovira, A., King, J.A., Gilbert, P., Antley, A., Fearon, P., Ralph, N., Slater, M., &. Brewin C.R (2016) Embodying self-compassion within virtual reality and its effects on patients with depression. *British Journal of Psychiatry, 2* (1) 74-80. doi: 10.1192/bjpo.bp.115.002147

Falconer, C.J, Slater, M., Rovira, A., King, J.A, Gilbert ,P., Antley, A, et al. (2014) Embodying compassion: A virtual reality paradigm for overcoming excessive self-criticism. *PLoS One, 9,* e111933.

Fredrickson, B. L., Cohn, M. A., Coffey, K. A., Pek, J., & Finkel, S. M. (2008). Open hearts build lives: Positive emotions, induced through loving-kindness meditation, build consequential personal resources. *Journal of Personality and Social Psychology*, *95*(5), 1045-1062.

Germer, C. K., & Siegel, R. D. (2012). *Wisdom and Compassion in Psychotherapy*. New York: Guilford.

Gilbert, P. (1989/2016). *Human Nature and Suffering*. London: Routledge.

Gilbert, P. (2000). Social mentalities: Internal 'social' conflicts and the role of inner warmth and compassion in cognitive therapy. In, P. Gilbert & Bailey K.G (eds.) *Genes on the Couch: Explorations in Evolutionary Psychotherapy* (p.118-150). Hove: Brenner-Routledge.

Gilbert, P. (2009). *The compassionate mind: A new approach to life's challenges*. London: Constable & Robinson.

Gilbert, P. (2010). C*ompassion focused therapy: The CBT distinctive features series*. London: Routledge.

Gilbert, P. (2014). The origins and nature of compassion focused therapy. *British Journal of Clinical Psychology, 53*, 6–41. doi: 10.1111/bjc.12043.

Gilbert. P. (2015). The evolution and social dynamics of compassion. *Journal of Social & Personality Psychology Compass, 9*, 239–254. doi: 10.1111/spc3.12176.

Gilbert, P., Catarino, F., Duarte, C., Matos, M., Kolts, R., Stubbs, J., Ceresatto, L., Duarte, J., & Pinto-Gouveia, J. (2017). Three orientations of compassion and the development of their self-report measures. *Journal of Compassionate Health Care*. (In press).

Gilbert, P., & Choden. (2013). *Mindful compassion*. London, UK: Constable-Robinson.

Gilbert, P., Clarke, M., Kempel, S. Miles, J. N. V. & Irons, C. (2004). Criticizing and reassuring oneself: An exploration of forms style and reasons in female

students. *British Journal of Clinical Psychology, 43*, 31-50. doi:0.1348/014466504772812959.

Gilbert, P., McEwan, K., Matos, M., & Rivis, A. (2011). Fears of Compassion: Development of three self-report measures. *Psychology and Psychotherapy: Theory, research and practice, 84*, 239–255. doi: 10.1348/147608310X526511

Gilbert, P., McEwan, K., Mitra, R., Franks, L., Richter, A., & Rockliff, H. (2008). Feeling safe and content: A specific affect regulation system? Relationship to depression, anxiety, stress, and self-criticism. *The Journal of Positive Psychology*, *3*, 182-191.

Gilbert, P. & Procter, S. (2006). Compassionate mind training for people with high shame and self-criticism: overview and pilot study of a group therapy approach. *Clinical Psychology and Psychotherapy, 13*, 353–379. doi: 10.1002/cpp.507

Goss, K., Gilbert, P. & Allan, S. (1994) An exploration of shame measures-I: The Other As Shamer Scale. *Personality and Individual Differences*, *17*(5), 713-717.

Hofmann, S. G., Grossman, P., & Hinton D. E. (2011). Loving-kindness and compassion meditation: Potential for psychological intervention. *Clinical Psychology Review, 13*, 1126–1132. doi:10.1016/j.cpr.2011.07.003

Jazaieri, H., Jinpa, G. T., McGonigal, K., Rosenberg, E., Finkelstein, J., Simon-Thomas, E., & Goldin, P. R. (2013). Enhancing compassion: A randomized controlled trial of a compassion cultivation training program. *Journal of Happiness Studies, 14*, 1113–1126. doi: 10.1007/s10902-012-9373-z.

Keltner, D., Kogan, A., Piff, P. K., & Saturn, S. R. (2014). The sociocultural appraisals, values, and emotions (SAVE) framework of prosociality: Core processes from gene to meme. *The Annual Review of Psychology*, *65,* 425–460. doi: 10.1146/annurev-psych-010213-115054

Kirby, J.N. (2016). Compassion interventions: The programs, the evidence, and implications for research and practice. *Psychology and Psychotherapy: Theory, Research, and Practice*. Advance online publication. doi: 10.1111/papt.12104

Kirby, J., Doty, J., Petrocchi, N. & Gilbert P (2017). The Current and Future Role of Heart Rate Variability for Assessing and Training Compassion. *Frontiers Public Health 5*, 40. doi: 10.3389/fpubh.2017.00040

Kirby.J & Gilbert, P. (2017). The emergence of the compassion focused therapies. In: P. Gilbert (ed). *Compassion: Concepts, Research and Applications*. (p.258-285). London: Routledge

Klimecki, O.M., Leiberg, S., Lamm, C & Singer, T. (2012). Functional neural plasticity and associated changes in positive affect after compassion training. *Cerebral Cortex,* Advance publication (June 1st) doi:10.1093/cercor/bhs142

Kogan, A., Oveis, C., Carr, E. W., Gruber, J., Mauss, I. B., Shallcross, A., … Keltner, D. (2014). Vagal activity is quadratically related to prosocial traits, prosocial emotions, and observer perceptions of prosociality. *Journal of Personality and Social Psychology, 107*, 1051–1063.

Kolts, R. L. (2016). *CFT Made Simple: A Clinician's Guide to Practicing Compassion-Focused Therapy*. New Harbinger Publications.

Krygier, J., Heathers, J., Shahrestani, S., Abbott, M., Gross, J., & Kemp, A. (2013). Mindfulness meditation, well-being, and heart rate variability: A preliminary investigation into the impact of intensive Vipassana meditation. *International*

Journal Of Psychophysiology, 89(3), 305-313. http://dx.doi.org/10.1016/j.ijpsycho.2013.06.017

Kupeli, N., Chilcot, J., Schmidt, U. H., Campbell, I. C., & Troop, N. A. (2013). A confirmatory factor analysis and validation of the Forms of Self-criticism/Self-reassurance Scale. *British Journal of Clinical Psychology*, *52*(1), 12-25.

Leaviss, J., & Uttley, L. (2014). Psychotherapeutic benefits of compassion focused therapy: An early systematic review. *Psychological Medicine*, *45*, 927–945. doi:10.1017/S0033291714002141.

Lin, M., Tai, L.Y, & Fan, S.Y. (2014) Breathing at a rate of 5.5 breaths per minute with equal inhalation-to-exhalation ratio increases heart rate variability *International Journal of Psychophysiology, 91,* 206-11. http://www.ncbi.nlm.nih.gov/pubmed/24380741#

Lovibond, P. & Lovibond, H. (1995). The structure of negative emotional states: comparison of the depression anxiety stress scales (DASS) with Beck depressive and anxiety inventories. *Behaviour Research and Therapy, 3,* 335–343.

McEwan, K., & Gilbert, P. (2015). A pilot feasibility study exploring the practising of compassionate imagery exercises in a nonclinical population. *Psychology and Psychotherapy: Theory, Research and Practice*, *89*, 239–243. doi:10.1111/papt.12078

Meevissen, Y.M.C, Peters, M.L & Alberts, H.J.E.M. (2011). Become more optimistic by imagining a best possible self: Effects of a two week intervention. *Journal of Behavior Therapy and Experimental Psychiatry*, *42,* 371-378.

Neff, K. D. (2003). The development and validation of a scale to measure self-compassion. *Self and Identity, 2*, 223-250.

Neff, K. D., & Germer, C. K. (2013). A pilot study and randomized controlled trial of the mindful self-compassion program. *Journal of Clinical Psychology, 69*, 28–44. doi: 10.1002/jclp.21923.

Niskanen, J., Tarvainen, M. P., Ranta-Aho, P. O., & Karjalainen, P. A. (2004). Software for advanced HRV analysis. *Computer Methods and Programs in Biomedicine, 76*, 73–81.

Nyklíček, I., Mommersteeg, P., Van Beugen, S., Ramakers, C., & Van Boxtel, G. (2013). Mindfulness-based stress reduction and physiological activity during acute stress: A randomized controlled trial. *Health Psychology, 32(10)*, 1110-1113. http://dx.doi.org/10.1037/a0032200

O'Craven, K., & Kanwisher, N. (2000). Mental imagery of faces and places activates corresponding stimulus-specific brain regions. *Journal of Cognitive Neuroscience, 12*, 1013-1023.

Osimo, S. A., Pizarro, R., Spanlang, B., & Slater, M. (2015). Conversations between self and self as Sigmund Freud—A virtual body ownership paradigm for self counselling. *Nature Scientific Reports*, 5, 13899. doi: 10.1038/srep13899

Pace, T. W. W., Negi, L. T., Adame, D. D., Cole, S. P., Sivilli, T. I., Brown, T. D., ... Raison, C. L. (2009). Effect of compassion meditation on neuroendocrine, innate immune and behavioral responses to psychosocial stress. *Psychoneuroendocrinology, 34,* 87-98. doi:10.1016/j.psyneuen.2008.08.011

Park, G., & Thayer, J. (2014). From the heart to the mind: cardiac vagal tone modulates top-down and bottom-up visual perception and attention to emotional stimuli. *Frontiers in Psychology*, *5*. http://dx.doi.org/10.3389/fpsyg.2014.00278

Petrocchi, N., Ottaviani, C., & Couyoumdjian, A. (2016). Compassion at the mirror: Exposure to a mirror increases the efficacy of a self-compassion manipulation in enhancing soothing positive affect and heart rate variability. *The Journal of Positive Psychology, 1-12*. http://dx.doi.org/10.1080/17439760.2016.1209544

Porges, S. W. (2007). The polyvagal perspective. B*iological Psychology*, 74, 116-143.

Peters, M. L., Flink, I.K., Boersma, K., Linton, S.J. (2010). Manipulating optimism: Can imagining a best possible self be used to increase positive future expectancies? *The Journal of Positive Psychology, 5,* 204-211

Rockliff, H., Karl, A., McEwan, K., Gilbert, J., Matos, M., & Gilbert, P. (2011). Effects of intranasal oxytocin on compassion focused imagery. *Emotion*, *11*, 1388–1396. doi:10.1037/a0023861

Rockliff, H., Gilbert, P., McEwan, K., Lightman S., & Glover, D. (2008). A pilot exploration of heart rate variability and salivary cortisol responses to compassion-focused imagery. *Journal of Clinical Neuropsychiatry, 5*, 132-139.

Schanche, E., Stiles, T. C., McCullough, L., Svartberg, M., & Nielsen, G. H. (2011). The relationship between activating affects, inhibitory affects, and self-compassion in patients with cluster C personality disorders. *Psychotherapy: Theory, Research, Practice, Training, 48*, 293-303. doi: 10.1037/a0022012

Schussel, L & Miller, (L (2013) Best visualisation methods with high-risk youth . *Journal Clinical Psychology*, *69*, 836–845,

Selcuk, E., Zayas, V., Gunaydin, G., Hazan, C., & Kross, E. (2012). Mental representations of attachment figures facilitate recovery following upsetting autobiographical memory recall. *Journal of Personality and Social Psychology*, *103*(2), 362-378. http://dx.doi.org/10.1037/a0028125

Singer, T., & Bolz, M. (Eds.) (2012). *Compassion: Bridging practice and science.* http://www.compassion-training.org/

Stellar, J. E., Cohen, A., Oveis, C., & Keltner, D. (2015). Affective and Physiological Responses to the Suffering of Others: Compassion and Vagal Activity. *Journal of Personality and Social Psychology*, *108*, 572-585

Streeter, C.C. Gerbarg, P.L., Saper, R.B., Ciraulo, D.A., & Brown, R.P. (2012). Effects of yoga on the autonomic nervous system, gamma-aminobutyric-acid, and allostasis in epilepsy, depression, and post-traumatic stress disorder. *Medical Hypotheses, 78*, 571–579.

Tabachnick, B., & Fidell, L. (2013). *Using multivariate statistics, (6th ed.)*. Boston: Pearson.

Tang, Y.Y., Ma, Y., Wang, J., Fan, Y., Feng, H., Wang, J., Feng, A., Lu, Q., Hu, B., Lin, Y., Li, J., Zhang, Y., Wang, Y., Zhou, L., Fan, M., 2009. Central and autonomic nervous system interaction is altered by short-term meditation. *Proceedings of the National Academy of Sciences of the United States of America, 106*, 8865–8870.

Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. (1996). Heart rate variability: Standards of measurement, physiological interpretation, and clinical use. *Circulation, 93*, 1043–1065.

Tirch, D., Schoendorff, B., & Silberstein, L. R. (2014). *The ACT practitioner's guide to the science of compassion: Tools for fostering psychological flexibility*. New Harbinger Publications.

Thayer, J. F., Åhs, F., Fredrikson, M., Sollers, J. J., & Wager, T. D. (2012). A meta-analysis of heart rate variability and neuroimaging studies: implications for

heart rate variability as a marker of stress and health. *Neuroscience & Biobehavioral Reviews*, *36*(2), 747-756. doi: 10.1016/j.neubiorev.2011.11.009

Wheeler, A., Denson, L., Neil, C., Tucker, G., Kenny, M., Beltrame, J. F., & ... Proeve, M. (2014). Investigating the effect of mindfulness training on heart rate variability in mental health outpatients: A pilot study. *Behaviour Change, 31(3)*, 175-188. doi:10.1017/bec.2014.14

Table 1. Mean scores, standard deviations and statistics for both groups at pre and post-intervention

Compassion variables						
		CMT Group ***n* = 56**	**WLC Group** ***n* = 37**	**Time**	**Time X Group**	**Significant Post-hoc Paired t-test**
Measures	**Time**	**Mean (*SD*)**	**Mean (*SD*)**			**CMT Group: T2 > T1**
Compassion for self	T1	66.23 (11.8)	61.59 (12.69)	$F_{(1,91)} = 12.76$, p = **.001**, $\eta^2 p$ = .12	$F_{(1,91)} = 5.24$, p = **.024**, $\eta^2 p$ = .05	$t_{(55)} = -4.10$, $p < .001$, 95% CI [-11.22; -3.85], d = .59
	T2	73.77 (13.5)	63.24 (15.06)			
Compassion for others	T1	77.71 (11.13)	76.00 (9.38)	$F_{(1,91)} = 19.21$, p **<.001**, $\eta^2 p$ =.17	$F_{(1,91)} = .21$, p = .646, $\eta^2 p$ = .00	
	T2	82.05 (10.58)	79.51 (9.54)			
Compassion from others	T1	66.02 (14.36)	66.84 (12.34)	$F_{(1,90)} = 3.98$, p =**.049**, $\eta^2 p$ =.04	$F_{(1,90)} = 4.89$, p = **.030**, $\eta^2 p$ = .05	**CMT Group: T2 > T1**
	T2	71.80 (14.64)	67.54 (15.01)			$t_{(54)} = -3.14$, $p = .003$, 95% CI [-9.48; -2.89], d = .40
Self-kindness (SCS)	T1	15.27 (4.19)	14.51 (3.91)	$F_{(1,90)} = 5.88$, p = **.017**, $\eta^2 p$ =.06	$F_{(1,90)} = 10.57$, p **= .002**, $\eta^2 p$ = .11	**CMT Group: T2 > T1**
	T2	17.13 (4.06)	14.24 (4.33)			$t_{(54)} = -4.14$, $p < .001$, 95% CI [-2.75; -0.96], d = .56

Common humanity (SCS)	T1	13.13 (3.55)	12.65 (3.53)	$F_{(1,91)} = 1.07$, $p = .304$, $\eta^2 p = .01$	$F_{(1,91)} = 7.47$, $p =$ **.008**, $\eta^2 p = .08$	**CMT Group: T2 > T1** $t_{(55)} = -2.83$, $p = .007$, 95% CI [-1.74; -0.30], $d = .38$
	T2	14.14 (3.63)	12.19 (3.37)			
Mindfulness (SCS)	T1	12.95 (3.42)	12.16 (3.18)	$F_{(1,90)} = 1.97$, $p = .164$, $\eta^2 p = .02$	$F_{(1,90)} = 2.84$, $p = .095$, $\eta^2 p = .03$	
	T2	13.84 (3.11)	12.08 (3.45)			
Reassured Self	T1	21.25 (5.82)	20.17 (6.95)	$F_{(1,87)} = 3.27$, $p = .074$, $\eta^2 p = .04$	$F_{(1,87)} = 3.02$, $p = .086$, $\eta^2 p = .03$	
	T2	22.44 (5.28)	20.20 (6.69)			
Positive emotions						
		CMT Group ***n* = 56**	**WLC Group** ***n* = 37**	**Time**	**Time X Group**	**Significant Post-hoc Paired t-test**
Measures	**Time**	**Mean (*SD*)**	**Mean (*SD*)**			
Activated PA	T1	2.80 (0.68)	2.89 (0.65)	$F_{(1,91)} = 3.89$, $p =$ **.052**, $\eta^2 p = .04$	$F_{(1,91)} = 1.05$, $p = .307$, $\eta^2 p = .01$	
	T2	2.96 (0.67)	2.94 (0.75)			
Relaxed PA	T1	2.17 (0.83)	1.88 (0.90)	$F_{(1,91)} = .15.54$, $p <$ **.001** , $\eta^2 p = .15$	$F(_{1,91)} = 5.42$, $p =$**.022** , $\eta^2 p = .06$	**CMT Group: T2 > T1** $t_{(55)} = -4.54$, $p < .001$, 95% CI [-.63; -.24], $d = .61$
	T2	2.61 (0.76)	2.00 (0.86)			
Safe PA	T1	2.41 (0.85)	2.26 (0.88)	$F_{(1,91)} =. 6.15$, $p =$ **.015**, $\eta^2 p = .06$	$F_{(1,91)} = 6.15$, $p =$ **015**, $\eta^2 p = 06$	**CMT Group: T2 > T1** $t_{(55)} = -3.63$, $p = .001$, 95% CI [-.50; -.14], $d = .48$
	T2	2.73 (0.71)	2.26 (0.79)			

Fears of compassion						
		CMT Group ***n* = 56**	**WLC Group** ***n* = 37**	**Time**	**Time X Group**	**Significant Post-hoc Paired t-test**
Measures	**Time**	**Mean (*SD*)**	**Mean (*SD*)**			
Fears of Compassion for the self	T1	10.00 (9.63)	10.97 (9.30)	$F(1,90) = 4.07$, $p =$ **.047,** $\eta^2 p = .04$	$F(1,90) = 14.88$, $p <$ **.001** ,$\eta^2 p = .14$	**CMT Group: T2 < T1** $t_{(54)} = 4.28$, $p < .001$, 95% CI [2.16; 5.95], $d = .58$
	T2	5.95 (6.82)	12.24 (11.59)			
Fears of Compassion For others	T1	15.95 (7.86)	13.25 (8.44)	$F(1,90) = 8.33$, $p =$ **.005**, $\eta^2 p = .09$	$F(1,90) = 21.07$, $p <$ **.001** ,$\eta^2 p = .19$	**CMT Group: T2 < T1** $t_{(55)} = 5.33$, $p < .001$, 95% CI [3.12; 6.88], $d = .71$
	T2	10.95 (6.82)	14.39 (8.00)			
Fears of Compassion From others	T1	14.20 (10.33)	15.16 (9.34)	$F(1,90) = 2.39$, $p = .126$, $\eta^2 p = .03$	$F(1,90) = 6.88$, $p =$ **.010**, $\eta^2 p = .07$	**CMT Group: T2 < T1** $t_{(54)} = 2.84$, $p = .006$, 95% CI [1.01; 5.89], $d = .38$
	T2	10.75 (9.27)	16.05 (10.51)			
Negative self-evaluation variables						
		CMT Group ***n* = 56**	**WLC Group** ***n* = 37**	**Time**	**Time X Group**	**Significant Post-hoc Paired t-test**
Measures	**Time**	**Mean (*SD*)**	**Mean (*SD*)**	$F_{(1,88)} = 15.89$, $p <$ **.001**, $\eta^2 p = .15$	$F_{(1,88)} = 6.87$, $p =$ **.010**, $\eta^2 p = .07$	**CMT Group: T2 < T1** $t_{(54)} = 4.89$, $p < .001$, 95% CI [2.94; 7.02], $d = .66$
Self-criticism	T1	20.53 (11.52)	19.31 (10.01)			
	T2	15.55 (8.83)	18.29 (9.95)			
External Shame	T1	21.73 (13.24)	20.22 (12.79)	$F_{(1,91)} = 2.23$, $p = .139$, $\eta^2 p$	$F_{(1,91)} = 8.27$, $p =$ **.005**, $\eta^2 p = .08$	**CMT Group: T2 < T1**

	T2	18.14 (11.63)	21.35 (14.29)	=.02		$t_{(55)}$ = 3.16, p = .003, 95% CI [1.32; 5.86], d =.42
Self-judgment (SCS)	T1	14.82 (4.53)	14.67 (4.38)	$F_{(1,90)}$ = 5.51, ***p* = .021**, $\eta^2 p$ =.06	$F_{(1,90)}$ = 10.54, p = **.002**, $\eta^2 p$ = .11	**CMT Group: T2 < T1** $t_{(55)}$ = 4.09, p < .001, 95% CI [1.06; 3.09], d =.55
	T2	12.75 (3.97)	15.00 (4.49)			
Isolation (SCS)	T1	11.64 (3.67)	11.05 (3.67)	$F_{(1,91)}$ = 0.37, p= .544, $\eta^2 p$ =.00	$F_{(1,91)}$ = 10.54, p = **.002**, $\eta^2 p$ = .10	**CMT Group: T2 < T1** $t_{(55)}$ = 2.78, p = .007, 95% CI [0.36; 2.24], d =.36
	T2	10.34 (3.72)	11.95 (3.93)			
Over-identification (SCS)	T1	11.80 (3.46)	12.14 (3.83)	$F_{(1,90)}$ = 2.56, p= .113, $\eta^2 p$ =.03	$F_{(1,90)}$ = 10.10, p = **.002**, $\eta^2 p$ = .10	**CMT Group: T2 < T1** $t_{(54)}$ = 3.57, p = .001, 95% CI [0.72; 2.56], d =.49
	T2	10.16 (3.06)	12.68 (3.35)			
Psychopathology						
		CMT Group *n* = 56	**WLC Group *n* = 37**	**Time**	**Time X Group**	**Significant Post-hoc Paired t-test**
Measures	**Time**	**Mean (*SD*)**	**Mean (*SD*)**			
Depression	T1	3.82 (4.02)	3.86 (3.67)	$F_{(1,91)}$ = 11.92, p = **.001**, $\eta^2 p$ = .12	$F_{(1,91)}$ = 2.08, p =.153, $\eta^2 p$ = .02	
	T2	2.36 (3.20)	3.27 (3.06)			
Anxiety	T1	3.00 (3.58)	3.14 (3.68)	$F_{(1,91)}$ = 2.63, p = .109, $\eta^2 p$ =	$F_{(1,91)}$ = 3.35, p =.071, $\eta^2 p$ = .04	

	T2	2.11 (3.07)	3.19 (4.03)	.03		
Stress	T1	7312 (4.58)	7.58 (5.10)	$F_{(1,90)} = .91$, $p = .342$, $\eta^2 p = .01$	$F_{(1,90)} = 6.16$, $p =$ **.015**, $\eta^2 p = .06$	**CMT Group: T2 < T1** $t_{(55)} = 2.67$, $p = .010$, 95% CI [.37; 2.63], $d = .35$
	T2	5.63 (3.90)	8.25 (5.26)			
Perceived stress	T1	28.91 (8.07)	28.68 (7.40)	$F_{(1,91)} = 4.05$, $p =$ **.047**, $\eta^2 p = .04$	$F_{(1,91)} = 6.99$, $p =$ **.010**, $\eta^2 p = .07$	**CMT Group: T2 < T1** $t_{(55)} = 3.40$, $p < .001$, 95% CI [1.14; 4.43], $d = .45$
	T2	26.13 (6.64)	29.05 (6.70)			
HRV						
HRV (RMSSD; ms^2)	T1	41.83 (18.11)	45.53 (21.85)	$F_{(1, 90)} = 2.01$, $p = .16$, $\eta^2 p = .02$	$F_{(1, 90)} = 3.52$, $p =$ **.054**, $\eta^2 p = .04$	**CMT Group: T2 > T1** $t_{(52)} = -2{,}17$, $p = .035$, 95% CI [-16.91; -.66], $d = .30$
	T2	50.61 (28.7)	44.12 (23.31)			
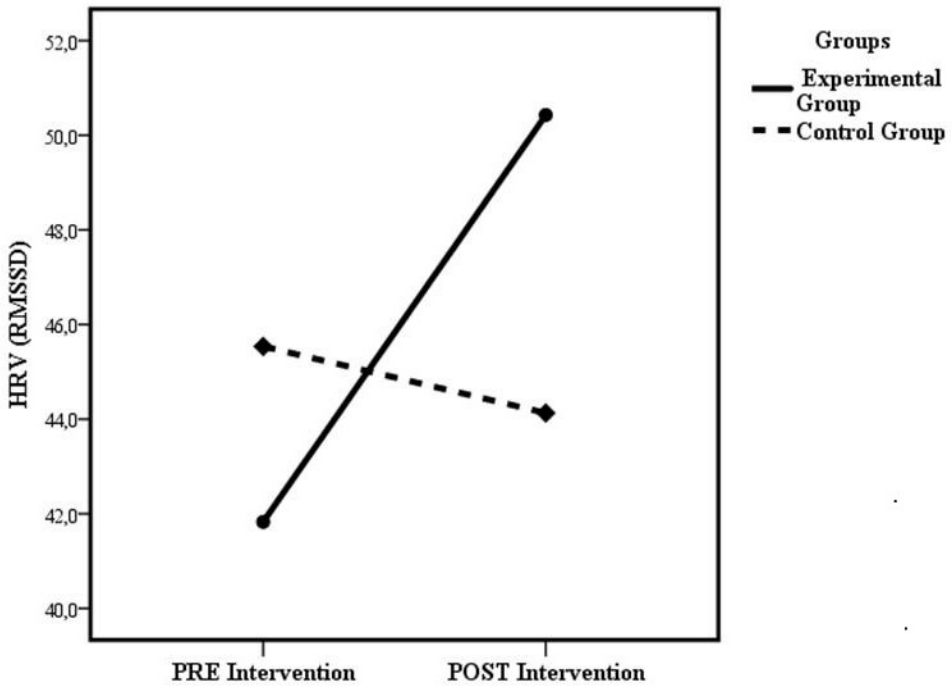
Figure 1. Time x Group interaction for HRV (RMSSD; ms^2).