University of the Republic

Faculty of Sciences

PEDECIBA

Biology Area

Neuroscience subarea

Thesis for the Degree of Doctor in Biological Sciences

MODULATION OF NEUROBIOLOGICAL AND PSYCHOLOGICAL VARIABLES IN RESPONSE TO MINDFUL SELF-COMPASSION TRAINING IN FEMALE TEACHERS FROM URUGUAY

MODULACIÓN DE VARIABLES NEUROBIOLÓGICAS Y PSICOLÓGICAS EN RESPUESTA AL ENTRENAMIENTO EN MEDITACIÓN MINDFULNESS Y AUTOCOMPASIÓN EN MAESTRAS DE URUGUAY

Author: MSc TAMARA LIBERMAN ROMERO

Director: María E. Castelló Gómez, PhD, Investigadora Grado 4 PEDECIBA, Profesora Agregada de Investigación, Instituto de Investigaciones Biológicas Clemente Estable

Montevideo, Uruguay

July, 2024

TABLE OF CONTENTS

Bibliographic Citation of the Publication

Liberman, T., Bidegain, M., Berriel, A., López, F. M., Ibarra, A., Pisani, M., Polero, S., Brito, G., Pereira, A. C., López, S., & Castelló, M. E. (2024). Effects of a virtual mindful self-compassion training on mindfulness, self-compassion, empathy, well-being, and stress in Uruguayan primary school teachers during COVID-19 times. *Mindfulness*, *15*(6), 1486–1500. https://doi.org/10.1007/s12671-024-02380-z

The present research was supported by the “Fondo Sectorial de Educación: CFE Investiga” and the National Research and Innovation Agency (ANII, FSED_3_2019_1_157921) and PEDECIBA

Use of Artificial Intelligence

Assistance from OpenAI's ChatGPT (OpenAI, 2024) was used as a tool to improve writing quality.

Acknowledgments

Al culminar este manuscrito, son muchos aquellos a quienes deseo agradecer. Todos fueron importantes.

En primer lugar, a mi hija Mila, mi amor más grande, y quien hace que todo tenga sentido.

A mis queridos padres, mi hermana y mi familia toda, que me impulsaron siempre a seguir adelante, confiando en mí. A mi papá en particular, un ser tierno y admirable con quien sostuvimos charlas que fueron cimiente de las preguntas que hoy quiero responder mediante la investigación. Incluyo también a Bellita, que me acompañó por largas horas de trabajo con su gatuna presencia sobre mi falda.

A Gabriela, quien me escuchó y guio a través de todos los momentos, buenos y de los otros.

A Marita, valiente orientadora que se animó a embarcarse y remar junto a mí en esta exploración inicialmente incierta. Por eso y por brindar su conocimiento y su tiempo con enorme generosidad.

A Martín, por dedicar tanto de su tiempo y motivación a este proyecto; por acompañarme y rescatarme en tantos momentos.

A los investigadores de PEDECIBA que escucharon el proyecto de esta tesis y me dieron con entusiasmo su aprobación para incursionar en territorios de la Neurociencia totalmente nuevos en nuestro país.

A Ariel, por ser un gran director. Por comprenderme, alentarme, y defender el espacio que necesitaba para poder desarrollarme y progresar.

A mis compañeros-amigos del departamento. Y especialmente a aquellos que desinteresadamente se sentaron a conversar conmigo tantas veces, que me auxiliaron, que me explicaron, que me aconsejaron, que me escucharon. Son entrañables.

A los investigadores y otros profesionales que compartieron con nosotros sus experiencias y conocimiento para ayudarnos a construir este proyecto. Los tengo a todos presentes.

Al equipo de colaboradores, futuros neurofisiólogos, psicólogos y psicopedagogos, que nos acompañaron con su esmero, dedicación y motivación, integrando un equipo sin el cual todo lo que hicimos no hubiera sido posible.

A los instructores, que llevaron adelante las intervenciones con dedicación y compromiso.

A las maestras participantes, que acogieron esta iniciativa y contribuyeron con entusiasmo al desarrollo de conocimiento científico innovador en nuestro país.

A Dios y a la vida, por mostrarme que el amor es lo primero y haberme permitido investigar sobre la autocompasión, que no es otra cosa sino amor.

Resumen

Este estudio tuvo como objetivo evaluar los efectos de una intervención virtual en *Mindfulness* y Autocompasión (*Mindful Self-Compassion*, MSC) en maestras de escuelas de Uruguay sobre las habilidades de autocompasión y *mindfulness*, regulación emocional, empatía, bienestar, estrés y *burnout* durante la pandemia de COVID-19, en comparación con un grupo control activo (Kundalini Yoga, KY). Se obtuvieron medidas psicológicas, conductuales y fisiológicas. Se utilizaron dos diseños experimentales con grupo control activo, uno longitudinal para el análisis de medidas psicológicas y conductuales, y otro post-test para el análisis fisiológico. Las maestras voluntarias fueron asignadas aleatoriamente a uno de los dos entrenamientos virtuales, MSC o KY, de 9 semanas de duración. Las participantes completaron online pruebas psicométricas autorreportadas, y en forma presencial una tarea de empatía por dolor (EPT) antes (pre-entrenamiento), después (post-entrenamiento) y 3 meses más tarde (seguimiento). Post-entrenamiento, las participantes también realizaron una prueba de estrés social (TSST) en formato semi-virtual mientras se registraba su electrocardiograma para analizar la frecuencia cardíaca y su variabilidad (VFC), y posteriormente analizar la relación de los hallazgos fisiológicos con los psicológicos. También completaron autorreportes sobre ansiedad y afecto en relación con la prueba TSST.

El análisis de los autorreportes post-entrenamiento mostró que el grupo MSC, en comparación con el grupo KY, mostró menor supresión emocional (estrategia de regulación emocional) y menor malestar personal (dimensión afectiva de la empatía). En tanto, en el seguimiento el grupo MSC exhibió mayores niveles de observación (factor de *mindfulness*) y habilidades totales de *mindfulness*, y mayor reevaluación cognitiva (estrategia de regulación emocional). En conjunto, estos hallazgos demuestran mejoras en la regulación emocional, la empatía y el *mindfulness* en el grupo MSC. En cuanto a la autocompasión, la comparación dentro del grupo mostró que las tres dimensiones positivas de la autocompasión aumentaron post-entrenamiento en el grupo MSC, pero no en el grupo KY. No obstante, y contrario a lo esperado, no se observaron diferencias significativas en autocompasión entre los grupos post-entrenamiento ni 3 meses más tarde. Con respecto a la tarea EPT, no se encontraron diferencias entre los grupos. El análisis de las medidas fisiológicas con respecto al TSST mostró que el grupo MSC alcanzó una recuperación post-estrés más rápida y sostenida que el grupo KY, con niveles más altos de VFC mediada por acción vagal, lo que indica una capacidad de regulación autonómica más flexible y adaptativa ante el evento estresante. El análisis de variables psicológicas —autocompasión, reevaluación cognitiva y supresión emocional— como predictores de la modificación en la VFC no reveló resultados significativos.

En resumen, estos resultados indican que el entrenamiento virtual en MSC por 9 semanas en maestras de Uruguay aportó beneficios significativos a las participantes a corto como a mediano plazo, tanto a nivel psicológico como fisiológico. Considerando que estos hallazgos se obtuvieron en un contexto global particularmente desafiante, apoyan la pertinencia de realizar el MSC en forma virtual en circunstancias que limiten el entrenamiento presencial y/o durante eventos catastróficos. Consideramos que los aportes de este estudio apoyan la implementación de intervenciones contemplativas destinadas a promover la salud física y mental de las maestras en la formación inicial y continua. Implementar estas intervenciones también contribuiría a crear una convivencia armoniosa en el lugar de trabajo para maestras y estudiantes en Uruguay y más allá.

Palabras Clave
Autocompasión, *Mindfulness*, Estrés, Regulación Emocional, Empatía, Variabilidad de la Frecuencia Cardíaca, Maestras

Abstract

This study aimed to assess the effects of a virtual Mindful Self-compassion (MSC) intervention in female school teachers in Uruguay on mindfulness and self-compassion skills, emotion regulation, empathy, well-being, stress, and burnout, during the COVID-19 pandemic, compared to an active control group (Kundalini Yoga, KY). Psychological, behavioral, and physiological measures were obtained. Two experimental designs with an active control group were used: a longitudinal design for the analysis of psychological and behavioral measures, and a post-test study for physiological analysis. Uruguayan volunteer female teachers were randomly assigned to MSC or KY 9-week virtual trainings. They completed self-reported psychometric tests and an in-person empathy for pain task (EPT) at pre-training, post-training, and follow-up (3 months later). At post-training, they underwent a semi-virtual social stress test (TSST) while being recorded with an electrocardiograph to obtain heart rate and heart rate variability (HRV) for the analysis of physiological outcomes, and ascertain their relation to psychological ones. They also self-reported anxiety and affect in relation to the TSST.

Analysis of self-reports at post-training showed that the MSC, as compared to the KY group, exhibited lower expressive suppression (emotion regulation strategy) and personal distress (affective dimension of empathy). At follow-up, the MSC group exhibited higher observing (mindfulness factor) and total mindfulness skills, and higher cognitive reappraisal (emotion regulation strategy). Taken together, these findings demonstrate improvements in emotional regulation, empathy, and mindfulness in the MSC group. Concerning self-compassion, within group comparison showed that the three self-compassionate dimensions increased post-test in the MSC group, but not in the KY group. However, and unexpectedly, no significant differences in self-compassion between groups were observed in the short and middle term. No differences were found between groups regarding the EPT. Analysis of the physiological measures across the TSST showed the MSC group exhibited a faster and more sustained recovery post-stress than the KY group, reaching higher levels of vagally-mediated HRV, thus indicating a more flexible and adaptive autonomic regulation to a stressful event. Self-compassion, cognitive reappraisal, and expressive suppression were not found to be significant predictors of changes in the HRV.

In summary, the present results indicate that the 9-week virtual MSC training for female school teachers in Uruguay provided significant benefits to the participants both in the short and middle term, and both at a psychological and physiological levels. Considering these findings were obtained in a particularly challenging global context, the results support the suitability of online MSC when circumstances limit in-person training and/or during catastrophic events. We believe that these evidences support the implementation of contemplative interventions aimed at promoting the physical and mental health of teachers in the initial and continuous formation. Implementing these interventions would also contribute to creating harmonious coexistence in the workplace for school teachers and students in Uruguay and beyond.

Keywords

Self-Compassion, Mindfulness, Stress, Emotional Regulation, Empathy, Heart Rate Variability, Teachers

“Gracias a quienes desde la investigación ven a la educación y quienes la llevamos a cabo un vehículo para generar y fomentar el bienestar, así como la importancia de cuidar a quienes cuidan.”

“Me siento con más herramientas para hacer de mi vida y la vida de la gente que me rodea una vida más sana, plena y consciente.”

“Considero necesario y diría imprescindible que llegue a muchas más personas.”

General Introduction

Psychosocial Stress

The concept of psychosocial stress has emerged from evidence that the stress response can be triggered by emotional stimuli (Lu et al., 2021). It can be defined as “the result of a cognitive appraisal or interpretation of a psychosocial stressor that taxes or exceeds the coping capabilities of an individual” (Vanhollebeke et al., 2022). Research into the influence of psychosocial stress and social interactions on physiological variables, health and well-being has gained significant interest in the past three decades (Danielsson et al., 2012; Gaidica & Dantzer, 2020; Vaidya et al., 2024). The stress response is complex and comprises autonomic, neuroendocrine and behavioral responses (Gaidica & Dantzer, 2020). When an organism is exposed to stimuli that threaten either its physiological or psychological integrity, the brain - particularly amygdala and hypothalamus- rapidly trigger a stress response which involves the dual activation of a nervous pathway, namely the sympathetic adrenomedullary (SAM) axis, and an endocrine pathway, comprising the hypothalamic-pituitary-adrenal (HPA) axis. The nervous pathway stimulates the adrenal medulla to release noradrenaline and epinephrine into the bloodstream, triggering the body's fight-or-flight response. The endocrine pathway involves the release of the hypothalamic corticotropin-releasing hormone (CRH), which stimulates the adenohypophysis to release adrenocorticotropic hormone (ACTH). This, in turn, induces the adrenal cortex to produce and release the glucocorticoid cortisol into the bloodstream (Schommer et al., 2003; Goldstein & Kopin, 2007; O'Connor et al., 2021). Although the stress response leads to increased alertness and energy availability to cope with the stressor, it can be detrimental and maladaptive if presented excessively in intensity, duration, or frequency, and impact both physical and mental health (James et al., 2023; Kemeny, 2003; Piazza et al., 2013). As discussed by Goldstein & Kopin (2007), it is now accepted that the stress response varies depending on such factors as the challenge to homeostasis, the perception of the stressor, and the conscious or unconscious ability to cope with it. The National Research Council (US) Committee on Recognition and Alleviation of Distress in Laboratory Animals (2008) defines distress as “an aversive, negative state in which coping and adaptation processes fail to return an organism to physiological and/or psychological homeostasis.” Concerning the cognitive recognition of a condition as aversive, the notion of distress would be a more appropriate term (Lu et al., 2021; Selye, 1936; Goldstein & Kopin, 2007). Nevertheless, due to its extended use, the term stress will be used in this thesis work to represent distress.

Challenging social factors have been shown to significantly affect cardiovascular, neuroendocrine, and immune responses (Cacioppo, 2002; Vanman et al., 2021). The experience of stress is subjective, involving the appraisal of perceived threats and the evaluation of personal coping resources (Lazarus, 1966; Paradies, 2010). From the perspective of social neuroscience, which integrates social, cognitive and biological approaches, and posits that social behavior has a biological basis, there is a specific interest in unraveling the neural mechanisms underlying human social processes. Social neuroscience also focuses on understanding how psychosocial stress threatens homeostasis, potentially triggering pathophysiological and pathopsychological processes (Society for Social Neuroscience, n.d.; Muscatell & Eisenberg, 2012; Vanman et al., 2021; Cacioppo, 2002). From this viewpoint, the dynamics of the autonomic nervous system (ANS) represent a valuable variable to assess emotions, cognitive processes and social interactions (Massaro & Pecchia, 2019; Cacioppo et al., 2000).

Porges (2007) introduced the polyvagal theory, suggesting that physiological states shape behavioral responses and foster engagement in social interactions. This theory introduces the concept of neuroception, a neural process by which mammals discriminate between safe and dangerous contexts and may mediate the expression and inhibition of positive social behavior, emotion regulation and visceral homeostasis. The evolution of the mammalian autonomic nervous system involved the need for adaptive behavioral strategies and the regulation of social behavior. Accordingly, three ANS circuits critical in regulating physiological states were described: the ventral vagal branch, associated with calm, safety and social bonding; the dorsal vagal branch, the most primitive component, associated with immobilization and defensive preparation responses; and the sympathetic-adrenal system, which integrates the mobilization system for fighting responses. This theoretical framework establishes a link between the evolutionary development of the ANS and affective experience, emotional expression, communication and social behavior (Porges, 2007, 2009), including those involved in the response to psychosocial stress.

Stress in Teachers

The teaching profession is widely recognized as one of the most demanding and stressful, with teachers facing higher levels of stress compared to other occupations (Kyriacou, 2001; Corbin et al., 2019). Identified as particularly exposed to occupational stress, teachers must possess social and emotional skills to foster an optimal classroom environment for learning (Cambón & De León, 2007; Jennings & Greenberg, 2009). Work-related stress, which can be exacerbated by challenges such as excessive responsibilities and hostile workplace environments, can negatively impact teachers' health, well-being, and their relationships with students (Moriana & Herruzo, 2004; Spilt et al., 2011; Corbin et al., 2019; Unterbrink et al., 2008; Troman & Woods, 2001). Physical and mental health issues can arise from an imbalance between effort and perceived reward, hindering performance (Unterbrink et al., 2007; Bauer et al., 2006, 2007; Bellingrath et al., 2010). Furthermore, stressors like low self-efficacy and oppositional behavior in students can further strain the teacher-student relationship and lead to burnout (McCormick & Barnett, 2011; Yu et al., 2015). Chronic work-related stress, particularly burnout, is associated with a higher risk of cardiovascular disease, anxiety, and depression (Honkonen et al., 2000; Melamed et al., 2006; Agyapong, 2022). Stress and emotional fatigue directly impact teaching quality and engagement, which in turn affects student outcomes (Wong et al., 2017).

Despite being particularly exposed to occupational stress, teachers must possess social and emotional skills to foster an optimal classroom environment for learning (Cambón & De León, 2007; Jennings & Greenberg, 2009). Teachers' emotional well-being and mental resilience are crucial factors in improving the effectiveness and quality of teaching, given that the classroom is a social and emotional environment in which teachers need to maintain regulated social interactions (Xu, 2013). Resilience, self-regulation, and effective coping mechanisms can mitigate stress and contribute to better mental health outcomes and teaching quality (Klusmann et al., 2008). But, as Mahmoodi-Shahrebabaki (2019) argues, teacher education programs have prioritized teachers' cognition and content knowledge over their emotions and affect. Improving the work environment through supportive coping strategies is essential to promote teachers' well-being and resilience to stress (Pietarinen et al., 2013). Therefore, further research into interventions that foster teachers' self-regulation is warranted to address the challenges of balancing stress resilience with work demands (Klusmann et al., 2008).

A study conducted in Montevideo revealed a high prevalence of burnout syndrome among female teachers, with 21.4% of participants affected, marking one of the highest rates documented in Latin American studies (Silva et al., 2015). Robalino & Körner (2005) assessed working conditions and health in Latin American teachers and reported that teachers in Montevideo faced mental health challenges such as stress, depression and grief, due to poor material and social conditions alongside demanding job requirements. These studies conclude by suggesting the need to implement intervention programs for teachers in our country and formulate recommendations to improve the conditions of teachers' work, which would result in better job performance and student learning processes (Silva et al., 2015). Additionally, a study in Montevideo revealed burnout indicators among 60% of teachers, due to emotional involvement in vulnerable contexts and performance pressure in favorable contexts, with common factors such as inadequate infrastructure, high pupil numbers, low remuneration, work-life intrusion, and limited training opportunities (Cambón & De León, 2007). According to Cambón & De León (2007), it is important for teachers to feel respected and valued both in their professional role and as individuals. Gil-Monte (2011) found that primary school female teachers facing excessive demands relative to personal resources were more prone to burnout. A recent report on the state of education in Uruguay between 2019 and 2020 (INEEd, 2021a) showed that teachers perceive job demands as too challenging for their own personal resources. Particularly, females in preschool and public primary schools experience overwhelming job demands, leading to cognitive and emotional overload, stress symptoms, burnout, and diminished well-being, alongside increased illness prevalence (INEEd, 2021a, 2020).

The COVID-19 pandemic posed new challenges, increasing difficulties and requiring increased social skills in teachers (OECD, 2020; Holguín, 2021). This impacted teachers' personal, professional, and emotional lives, leading to physical, mental, and social health problems (Holguín, 2021; McMakin, 2022). This was especially true for females, who manage double presence and caregiving duties (INEEd, 2021a). Consequently, teachers underlined the urgent need for enhanced competencies in fostering coexistence, emotional education, and relationships (INEEd, 2021b). Klusmann et al. (2008) argue that teachers' coping mechanisms, which involve high levels of engagement, resilience, and self-regulation, are linked to better mental health outcomes and higher evaluations of teaching quality. They advocate for further investigation into approaches fostering teachers' self-regulation, aimed at harmonizing professional responsibilities with resilience against stress.

Heart Rate Variability as a Stress Index

In the field of stress research involving humans, several measures ranging from self-reports to physiological assessments are utilized due to their accessibility and non-invasive nature. Among physiological measures, cortisol, alpha-amylase and heart rate variability (HRV) are frequently employed. While the hormone cortisol can be measured in urine, saliva and even hair to assess the stress response of the HPA axis, the salivary enzyme alpha-amylase can be measured to access the SAM axis (Nater et al, 2005; Cantus et al, 2019; Gormally & Romero, 2020). HRV, in turn, is a measure of neurocardiac function, reflecting heart-brain interactions and autonomic nervous system (ANS) dynamics (Shaffer et al., 2014).

The sinoatrial node myocardial cells spontaneously initiate heartbeats, serving as pacemakers, with an intrinsic rate of approximately 110 beats per minute (Jose & Taylor, 1969). However, the influence of both sympathetic and parasympathetic nerves tonically pace the heart in an adaptive manner according to demands, and resting heart rate (HR) is dominated by vagal effects to maintain a healthy cardiac dynamic function (Schaffer et al., 2014; Larkin et al, 2021; Ernst, 2017). The regulation of the heart rhythm by the ANS and the predominance of its sympathetic or parasympathetic branches in different moments can be measured by the HRV). This is a measure of the variation in time of the intervals between consecutive heartbeats, known as interbeat intervals (IBIs) (Gullett et al., 2023; Shaffer & Ginsberg, 2017). Increasing attention has been directed to the HRV as reflecting the activity of the ANS (Thayer et al., 2012; Larkin et al., 2021). The autonomic stress response induces heightened inotropism and HR, mediated by catecholaminergic effects on adrenergic receptors, accompanied by vagal withdrawal for sympathetic dominance (Gaidica & Dantzer, 2020; Motiejunaite et al., 2021). Such sympathetic dominance results in increased regularity of HR and IBIs, which translates into reduced HRV. In a healthy functioning system, return to baseline HR and HRV levels occurs post-stress through parasympathetic actions involving acetylcholine (Jentsch & Wolf, 2020; Schiweck et al., 2018). A low HRV beyond the stress response may indicate a potentially maladaptive state (Gaidica & Dantzer, 2020).

In their model of neurovisceral integration, Thayer & Lane (2000, 2009) addressed the interplay between the central nervous and the ANS, proposing that there is a central nervous integration center that functions as a super-system, which detects safety and threat signals from outside and inside the organism and respond adaptively and flexibly to challenges. The HRV is suggested as a physiological marker indicative of the autonomic nervous system's actions. This is because the brain regions involved—specifically the medial prefrontal cortex and the amygdala, which send signals to the hypothalamus and brainstem nuclei to directly regulate the heart—are linked to HRV (Kim et al., 2018; Thayer et al., 2012). According to this model, when processes within a system are mutually constrained, the system as a whole tends to oscillate spontaneously, allowing flexible responses to incoming inputs. However, if this balance is lost and a particular process becomes dominant, this flexible responsiveness is disrupted. Noting that the HR of a healthy and regulated heart oscillates spontaneously rather than following a rigid pattern, they suggest that by measuring HRV it is possible to monitor the status of a healthy and flexible control of the brain's integrative system over the periphery (Thayer & Lane, 2000, 2009).

Based on the mounting evidence that supports the critic vagal neuroregulatory role in the body’s response to stress (Larkin et al., 2021), it is argued that cardiac vagal tone may reflect the functional balance of neural networks involved in emotion and cognition, and the HRV measure is proposed as an index of stress, adaptability and health, representing a valuable research tool (Gaidica & Dantzer, 2020; Motiejunaite et al., 2021; Kim et al., 2018; Thayer & Lane, 2000; Ernst, 2017). To approach the state of both heart and brain and draw inferences on the ANS state and its dynamics, HRV analysis can be performed by using time-domain, frequency-domain, and nonlinear measures (Kim et al., 2018; Ernst, 2017; Massaro & Pecchia, 2019; Larkin et al., 2021), as will be further explained in chapter II.

Emotional Regulation Mediating Stress as Measured by the HRV

An individual's response to stress and the subsequent recovery depend partly on their ability to regulate emotions (Jentsch & Wolf, 2020). Emotion regulation involves strategies to influence which, when and how emotions are experienced or expressed, thereby altering the emotional experience and its impacts (Gross, 1998). The two most studied strategies for regulating emotions are cognitive reappraisal and expressive suppression. Reappraisal involves changing the valorization of the unpleasant emotion to reduce its impact (Gross & John, 2003; Lazarus & Alfert, 1964), while suppression involves efforts to modulate the expression of the current emotional state (Gross, 1998, Gross & John, 2003). These strategies can elicit opposed results in the neuroendocrine, cardiovascular and psychological dimensions (Jentsch & Wolf, 2020).

Reappraisal fosters regulatory flexibility and facilitates dynamic physiological adjustment to changing environmental demands (Jentsch & Wolf, 2020; Kim et al., 2018; Balzarotti et al., 2017). When applying this strategy, a phasic vagal withdrawal during acute stress is followed by a rapid vagal tone increase to baseline values post-stress, evidencing flexible and healthy psychophysiological adaptation, as measured by HRV (Jentsch & Wolf, 2020; Kim et al., 2018; Balzarotti et al., 2017, Schiweck et al., 2018). Contrarily, a slow cardiovascular recovery has been associated with poor and maladaptive emotional regulation strategies (Balzarotti et al., 2017; Smith et al., 2020). Interestingly, adaptive emotion regulation success has been associated with weaker connectivity between emotion-eliciting prefrontal cortex regions and the amygdala, and greater amygdala inhibition (Etkin, 2015; Buhle et al, 2013). In contrast, suppression increases cortisol levels, and activation of the sympathetic nervous system (SNS), the amygdala and other emotion-generating brain regions (Jentsch & Wolf, 2020; Goldin et al., 2008; Tyra et al., 2023), while diminishing positive emotions and exacerbating stress, anxiety, and depression symptoms (Lopez & Denny, 2019). Therefore, frequent use of emotion suppression is deemed maladaptive (Goldin et al., 2008; Jentsch & Wolf, 2020). Hence, the HRV is increasingly being used not only as an index of the ANS activity for cardiovascular and physical health monitoring but also as a measure of mental health, affective states and emotional regulation (Balzarotti et al., 2017; Svendsen et al, 2016; Perna et al., 2020; Jentsch & Wolf, 2020; Gullett et al., 2023).

Contemplative Practices, Affect and Cardiac Vagal Tone

Contemplative neuroscience is an emerging field of research that integrates neuroscience, psychology and meditative practices, to shed light on the effects of secularized versions of ancient traditional contemplative practices on the body, brain, and mind (Roeser & Zelazo, 2012; Goldberg & Davidson, 2024). Its focus extends to clinical, psychological, and neurological outcomes (Brandmeyer et al., 2019). A key focus of contemplative science involves exploring the potential of contemplative practices to alleviate stress, promote well-being, and develop mental habits beneficial both for oneself and others (Roeser & Zelazo, 2012; Goldberg & Davidson, 2024). Mindfulness practices, initially introduced in clinical settings, were developed by Dr. John Kabat-Zinn for chronically ill patients unresponsive to traditional medical treatments (Kabat-Zinn, 1982; Kabat-Zinn, 1990). Contemplative practices focus on self-awareness, self-regulation, and self-inquiry through mental training and sometimes also physical movement and dialogue exercises, aiming at psychological transformation (Davidson & Dahl; 2017). Cultivating contemplative practices through intentional training has shown to promote present moment awareness -namely mindfulness- and self-compassion skills, well-being, improve emotional regulation and cognitive and affective processes, as well as reducing stress, thus improving mental and physical health (Creswell, 2017;

Dahl et al., 2020; Dorjee, 2016; Lv et al., 2023). Prosocial behavior has also been shown to increase with such practices, thus favoring interpersonal functioning (Creswell, 2017; Berkovich-Ohana et al., 2019). Mental contemplative training focusing either on slow-paced breathing, present-moment awareness, compassion, loving kindness, or perspective-taking, showed enhanced vagal influence on the heart, as measured by vagally-mediated HRV (vmHRV) (Bornemann et al., 2019). Furthermore, other empirical evidence accounts for long-lasting plastic changes in the neural circuits involved in cognitive, affective and social processes associated with contemplative practice (Brandmeyer, et al., 2019; reviewed by Davidson & McEwen, 2012).

The practice of self-compassion and mindfulness is of particular interest for this investigation, in the knowledge that these skills can be cultivated together (Creswell, 2017; Neff, 2023). Germer & Neff (2019) proposed that by incorporating self-compassion into the practice of mindfulness it is possible to achieve not only a loving awareness of the present experience but also a loving awareness towards ourselves. This approach emphasizes holding ourselves in tender awareness before extending this awareness to our experiences. According to Kabat-Zinn (1982), mindfulness meditation is “The awareness that arises from paying attention, on purpose, in the present moment and non-judgmentally”, and can be cultivated through training loving-kindness, equanimity, compassion, generosity, and gratitude (Kabat-Zinn, 1994, 2003; Grossman, 2015). Self-compassion involves treating oneself kindly, with acceptance, care and understanding (Neff, 2003a, 2003b; Neff et al., 2007). It comprises three interrelated components: 1) self- kindness –being kind and understanding to oneself, avoiding self-criticism and self-judgment–, 2) common humanity, – viewing personal experiences as part of human experience instead of feeling isolated–, and 3) mindfulness, –observing one's thoughts and feelings with awareness without over-identifying–. Interestingly, the sense of shared humanity, recognizing the connection with the rest of humanity, facilitates being compassionate to others (Neff, 2003a, 2003b). Self-compassion protects against self-reproach, a strong predictor of anxiety and depression (Blatt, 1995; Neff, 2023; Neff, et al., 2007), while it correlates positively with happiness, optimism, and motivation, and negatively with neuroticism and negative affect (Heffernan et al., 2010; Hollis-Walker & Colosimo, 2011; Neff, 2023). In their theory of social self-preservation, Dickerson and Kemeny (2004) propose that self-threats and self-reproaches heighten vulnerability to non-adaptive biological stress responses, prolonging recovery time. As a form of prosocial behavior, compassion involves identifying, alleviating and preventing suffering; interestingly, it is not only directed to help others but also to oneself (Gilbert & Van Gordon, 2023; Neff, 2023). Mindfulness-based meditation and compassionate behaviors foster parasympathetic activation, facilitating emotional regulation and resilience to stress, which permits better coping with others’ sufferings and enhances prosocial behaviors (Gilbert & Procter, 2006; Kok et al., 2013; Luberto et al., 2018; Neff, 2023). Increased mindfulness and self-compassion, coupled with reduced stress levels, significantly correlate with heightened empathy (Wallmark et al., 2013).

Studies addressing the impact of mindfulness training on the ANS by using HRV, showed that HRV parameters reflecting the parasympathetic action significantly increased post-training, associated with well-being (Tung & Hsieh, 2019). As reported in Di Bello et al. meta-analysis (2020), mounting evidence supports a positive association between compassion and increased cardiac vagal tone, as measured by vmHRV, particularly for sensitivity to suffering and caring. This was true both when being compassionate to others and to oneself. Self-compassionate individuals have shown higher resting vmHRV (Svendsen et al, 2016), as well as greater flexibility to adapt to stressful events, with less negative affect (Luo et al., 2018). Interestingly, when confronting social evaluative threats, those with high self-compassion initially experienced a reduction in vmHRV, followed by a swift return to baseline levels, coupled with reduced negative affect. Authors highlight the role of self-compassion in flexibly modulating both physiological and emotional responses to stressors (Luo et al., 2018).

Mindful Self-Compassion for Teachers' Stress Reduction, Emotion Regulation and Well-Being

Mindfulness-based practices in teachers have been shown to promote mindfulness and pro-social skills, improve emotional regulation and well-being, reduce stress and burnout, and increase mindfulness in the classroom (Berkovich-Ohana et al., 2019; de Carvalho et al., 2021; Hwang et al., 2017; Hidajat et al., 2023; Janssen et al., 2023; Jennings et al., 2017; Klingbeil & Renshaw, 2018; Roeser et al., 2013; Tsang et al., 2021). Additionally, self-compassion in teachers fosters secure attachments and better relationships through increased perspective-taking, forgiveness, and empathy (Lathren et al., 2021; Neff, 2023; Neff & Beretvas, 2012; Sotiropoulou et al., 2023). Training in mindfulness and self-compassion in teachers improved mindfulness, focused attention and self-compassion while reducing rumination, stress and burnout, both at post-training and follow-up (O'Hara-Gregan, 2023; Tarrasch et al., 2020).

Mindful Self-Compassion (MSC) is a fairly recent mindfulness-based training program that brings together the practices of mindfulness and self-compassion. It aims to promote the capacity for self-compassion and mindfulness, where mindful attention to the present moment provides the necessary awareness of the suffering experience to bring self-kindness and understanding (Neff & Germer, 2013; Germer & Neff, 2019). Neff & Germer (2013) found that MSC trainees significantly increased self-compassion, mindfulness and life satisfaction, while decreasing anxiety, stress and depression, compared to controls. Interestingly, these effects were maintained up to 1 year later. Despite the reported benefits of this meditative approach (Neff, 2023), only one recent study was found in the scientific literature that examined the impact of an in-person MSC training on teachers, from a qualitative approach (O'Hara-Gregan, 2023). Authors report that teachers improve well-being by supporting their self-awareness of emotions, recognising their common humanity and being more kind to themselves in challenging moments. Berkovich-Ohana et al. (2019) highlight the importance of incorporating contemplative neuroscience practices into the field of education, particularly for teachers, as a way to cultivate heightened presence, awareness, decentering, and emotion regulation, thereby enhancing well-being and social-emotional competencies (Emerson et al., 2017; Meiklejohn et al., 2012, Schonert-Reichl & Roeser, 2016; Sleilaty, 2022). With the advent of the COVID-19 pandemic, an online version of this program was introduced, which had never been previously tested with teachers.

Problem Formulation and Hypothesis

Given the high levels of psychosocial stress experienced by teachers in Uruguay and their expressed need for tools to reduce stress, enhance well-being and provide them with competencies to build supportive relations and healthy educational environments, interventions to strengthen teachers' personal resources are clearly needed. These interventions should enable teachers to effectively regulate emotions, cope with the challenges inherent in their role, and cultivate rewarding relationships within their professional environment.

Despite the demonstrated benefits supported by accumulated evidence, contemplative and meditative practices are rarely practiced in the context of education in Uruguay, and it is not included as part of the teachers' initial and continuing education. Importantly, no previous research has explored this topic from a contemplative neuroscience perspective. Additionally, neither mindfulness nor mindful self-compassion training for teachers have ever been investigated in Uruguay.

Considering these antecedents, this study compares the outcomes of the training with a 9-week virtual adaptation of the MSC program (Neff & Germer, 2013; Germer & Neff, 2019) with those of an active control group undergoing Kundalini Yoga (KY) online training on self-perception of mindfulness, self-compassion, emotional regulation, stress, burnout, empathy, and well-being. The outcomes on the following measures are also compared between both groups: i) experimental performance of an empathy for pain task, and ii) HRV as a physiological index of autonomic response to experimentally induced social stress in primary school teachers in Uruguay. Furthermore, psychological and physiological measures will be contrasted.

The proposed hypotheses are as follows:

General Hypothesis

Uruguayan teachers who undergo a 9-week virtual MSC training would express long-lasting and more pronounced improvements of mindfulness and self-compassion skills, associated with higher emotional and social competencies and better autonomic nervous system adaptability to stressors, compared to those elicited by an active control condition (KY training), which does not explicitly focus on self-compassion.

Specific Hypotheses

Hypothesis 1

Teachers in Uruguay who undergo a 9-week virtual MSC training would report greater improvements in self-reported mindfulness, self-compassion skills, emotional regulation and well-being, as well as reduction in self-reported stress and burnout symptoms, compared to those who undergo KY training. Teachers trained in MSC would also show greater improvements in self-reported empathy and experimentally induced empathic abilities compared to those in the KY training. These improvements would be observed in both the short and middle-term.

Hypothesis 2

Teachers from Uruguay who complete a 9-week virtual MSC training would exhibit lower physiological stress and increased vagally-mediated HRV during a social stress test, accompanied by lower levels of perceived state anxiety and negative affect, compared to those trained in KY. This improved autonomic adaptability to stressors would be mediated by enhanced self-compassion and emotional regulation.

Methodological Design

Participants

Female primary school teachers in the metropolitan area of Uruguay, interested in participating in a research project involving free training in MSC or yoga, were recruited through a voluntary response sampling method (Muraiwa, 2015). It is important to consider that in Uruguay 90.8% of primary school teachers identify as female (Administración Nacional de Educación Pública, 2019). Various communication channels such as personal contacts, social media, and direct outreach to school authorities were used. A total of 298 teachers expressed their interest by completing a Google form. After completion of informed consents, self-reported data and psychological interviews including the Mini International Neuropsychiatric Interview (Sheehan et al., 1998; Ferrando et al., 2000) were used to select the sample. Inclusion criteria were: i) female gender, ii) current employment as a primary school teacher, and iii) right-handedness. Exclusion criteria were: i) training in yoga, mindfulness, or self-compassion within the previous two years, ii) psychological disorders, and iii) use of prescribed medications that may affect the variables of interest. Sixty-five teachers met these criteria, a number that fit the maximal number of participants per group recommended by the MSC and KY trainers to ensure visual contact via the screen and to optimize the quality of the communication in training sessions. Nevertheless, this amount fell below the sample size estimated by the power analysis (50 per group, for alpha level 0.05, effect size 0.5 and power 0.8, as calculated through pwr package in R; Cohen, 1988). Between teacher selection and the beginning of the MSC and KY trainings, 17 teachers withdrew due to COVID-19-related issues. As a result, 48 teachers were randomly assigned into 2 groups (MSC, n = 25; KY, n = 23) and started the training programs.

Methods

Two different methodologies were carried out for three distinct studies. For the studies based on self-reports and the empathy for pain task, as presented in Chapter I, a quasi-experimental longitudinal pre-test/post-test and three-month follow-up design with a control group was used. The design included an intervention and an active control group, following a parallel group trial design (Echevarría, 2016; Nair, 2019). For the study based on physiological measures of stress, as presented in Chapter II, a post-test quasi-experimental design with a control group was employed. Procedures fulfilled the guidelines of Consolidated Standards of Reporting Trials (CONSORT; Cuschieri, 2019). General aspects of the methodology pertaining to these studies are presented in this section. Further details will be introduced in the corresponding chapters.

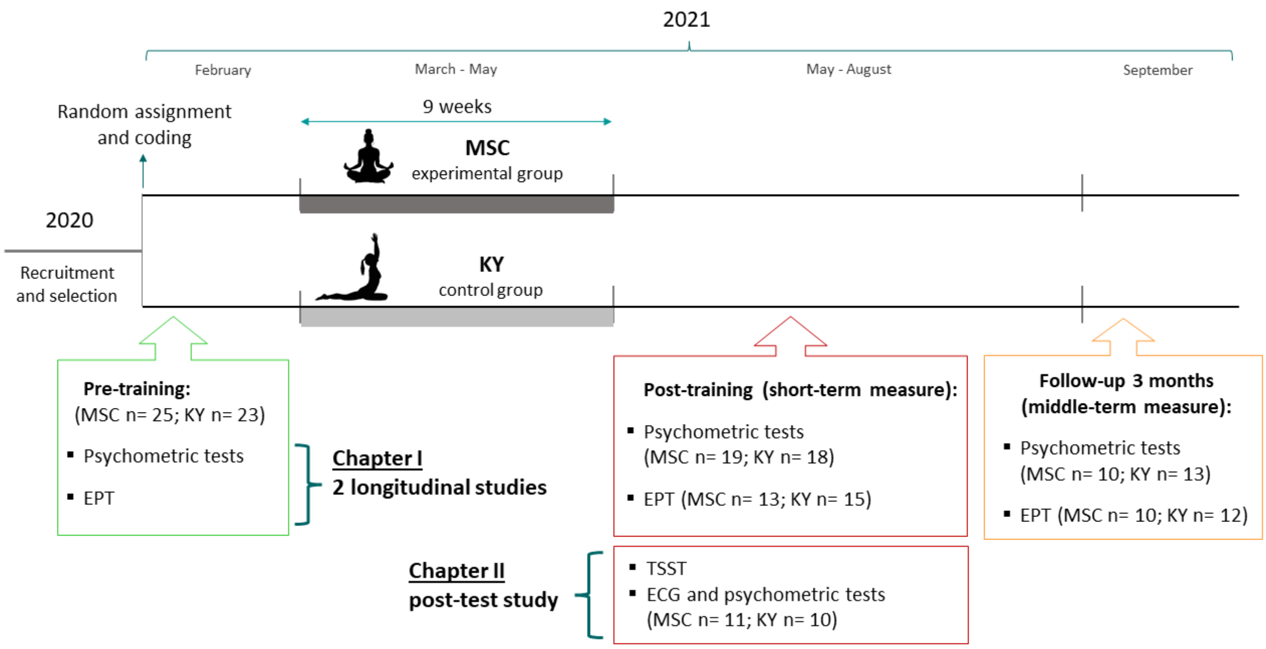
Following Davidson & Kaszniak (2015) considerations on mindfulness-based research, we selected KY as an active control condition. Kundalini Yoga is a contemplative practice not intended specifically to promote self-compassion that improves psychological outcomes and reduces stress (Streeter et al., 2010; Wang & Szabo, 2020). The KY training rigorously matched the MSC intervention on non-specific factors such as length of intervention, amount of practice, participants blinded to the experimental or control condition, examiners blinded to the participants' assigned condition, and instructors' expertise, commitment, enthusiasm, and confidence in the benefits of their interventions. The MSC instructors were certified by the Center for Mindful Self-Compassion, USA. Thus, training provided to the teachers in this study was comparable to that offered by the Center. The KY instructor was certified as a Kundalini Yoga professor by the Kundalini Research Institute, USA. In both trainings, the online training sessions were conducted via the Zoom platform, allowing for real-time interaction between participants and instructors.

Prior to the commencement of the training sessions, the 48 participants' identities were anonymized, numerically coded and assigned to the MSC or KY groups by means of a random number generator. Participants' mean ages were similar in both groups (MSC: 38 ± 6.9; KY: 41.2 ± 7,2). The MSC and KY trainings occurred over a period of 9 weeks, between March and May of 2021. During this time, the participants of both groups engaged in an equal amount of virtual synchronous formal sessions and asynchronous informal activities (Davidson & Kaszniak, 2015).

Online questionnaires were administered using the instrument Psytoolkit (Stoet, 2010; 2017) one week before the training (pre-training), one week after its completion (post-training), and at a three-month follow-up. Participants also completed an in-person modified version of an empathy for pain task (EPT; Decety et al., 2012; Baez et al., 2017) in the month prior to training, in the month following its completion, and at the three-month follow-up. The social stress test (Trier Social Stress Test; TSST; Kirschbaum et al., 1993; Gunnar et al., 2021) was conducted semi-virtually in the month following the completion of the trainings, accompanied by physiological evaluations and a series of associated psychometric assessments (see Figure 1 for timeline).

All in-person data collection sessions were conducted at the Catholic University of Uruguay. The protocol of this study was approved by the Human Research Ethics Committee of the IIBCE (#001, 2018), and participants gave their written informed consent in accordance with the Declaration of Helsinki (*).

Figure 1 *Timeline illustrating data collection timepoints in relation to the Mindful Self-Compassion (MSC) and Kundalini Yoga (KY) trainings*



Note. ECG = electrocardiographic; *EPT* = empathy for pain task; *TSST* = Trier Social Stress Test

The present thesis is structured into two chapters. Chapter one examines the effects of MSC training on psychological variables obtained by means of a longitudinal study, encompassing pre-training, post-training, and follow-up assessments. The first study focuses on the analysis of self-reported questionnaires. The second study examines empathic abilities through an experimental empathy for pain task. Chapter two focuses on the effects of training on physiological variables in relation to the social stress test. This chapter entails physiological stress and HRV analyses, accompanied by affect and anxiety assessment, and explores the relationship between physiological and the psychological variables that proved significantly different between groups in Study I.

(*) This thesis included an electrophysiological study to analyze the effects of the MSC training on empathic abilities, as measured by electrocardiography and electroencephalography during a second empathy for pain task. The characteristics of this task justified the use of right-handed participants as an inclusion criterion. Although recordings were conducted in accordance with the initial objectives, the analysis of these measures could not be completed by the time of finalizing this thesis manuscript due to numerous challenges mostly imposed by the pandemic. Among these challenges, this thesis had to be paused and adjusted while still in progress, since the originally proposed measures of stress and empathy in saliva samples (alpha-amylase and oxytocin) had to be replaced by electrophysiological measures.

The order of presentation of the chapters and the studies within them is in correspondence with the chronological order of the development of the research.

Interventions Description

The MSC (Neff & Germer, 2013; Germer & Neff, 2019) and KY trainings consisted of: i) eight 2-hour 45-minute weekly virtual group synchronous sessions, ii) one 3-hour virtual retreat, and iii) daily asynchronous individual home practices lasting 20-30 minutes. All online sessions were conducted on Wednesday evenings and required participants to have a reliable internet connection and a calm environment. Daily home practice consisted of exercises provided by the instructors beforehand and/or recorded sessions.

Aiming at cultivating mindfulness and self-compassion skills, the MSC program encompasses the following topics: discovering self-compassion, practicing mindfulness, practicing loving- kindness, discovering one's own compassionate voice, living deeply, managing difficult emotions, exploring challenging relationships, and embracing life.

To activate the Kundalini energy, the KY training addressed the following topics: meditating for a calm heart, physical strength and disease resistance, immune system booster: the inner sun, foundation for infinity, body adjustment to elevate the spirit, get the energy moving, long deep breathing, warriors tense release, and kundalini yoga for physical and mental vitality.

CHAPTER I

Effects of a Virtual Mindful Self-Compassion Training on Emotional Well-Being and Social Behavior in Primary School Teachers from Uruguay in the Short and Middle Term.

Both mindfulness and self-compassion are skills that can be cultivated through contemplative practice (Kabat-Zinn, 1994; Grossman, 2015; Neff, 2023). The Mindful Self-Compassion Program (MSC; Neff & Germer, 2013; Germer & Neff, 2019) aims to increase compassion towards oneself and others, while strengthening mindfulness as a cornerstone for self-compassion. Its effects have been shown to sustain over time (Friis et al., 2016; Shin et al., 2023) even up to a year beyond the training period (Neff & Germer, 2013).

As previously mentioned, teachers' social and emotional skills are fundamental to foster conducive learning environments (Jennings & Greenberg, 2009), while minimizing stress that can affect their health (Scheuch et al., 2015; Seibt et al., 2013) and hinder their relationships with students (Corbin et al., 2019; Spilt et al., 2011). Jennings & Greenberg (2009) proposed "the prosocial classroom model", which highlights the importance of teachers' well-being and social and emotional competencies for promoting supportive learning environments. The authors argue that socially and emotionally competent teachers respond empathically, prone to help rather than repress and setting limits effectively and respectfully. Socially and emotionally competent teachers possess prosocial skills, are self-aware of emotions, and self-regulate to promote positive outcomes even in challenging situations, without compromising their health (Jennings, 2015; Jennings & Greenberg, 2009). Jennings (2015) found that mindfulness and self-compassion may be important contributors to creating such competencies, raising the need for interventions that promote mindfulness and self-compassion with a randomized, controlled design.

Due to the significant professional demands teachers in Uruguay face, their high levels of stress and burnout and their expression of the critical need for enhanced competencies in coexistence, emotional education and interpersonal skills (INEEd, 2021a, 2021b), this thesis evaluates the effects of a virtual MSC program training (Neff & Germer, 2013) on the emotional well-being and social behavior of female primary school teachers from the Metropolitan area of Uruguay.

Hypothesis 1

Teachers from Uruguay who undergo a 9-week virtual MSC training express short and middle-term improvements in self-reported mindfulness and self-compassion skills, emotional regulation and well-being, and reduction self-reported in stress and burnout symptoms. Teachers also express improvement in self-reported empathy and experimentally induced empathic abilities.

Studies I and II address this hypothesis. Their main findings constitute the main body of evidence of a publication entitled "Effects of a virtual Mindful Self-Compassion training on mindfulness, self-compassion, empathy, well-being and stress in Uruguayan primary school teachers during Covid-19 times". This publication is included in Appendix I of this doctoral thesis.

Study I. Evaluation of Self-Perceived Mindfulness and Self-Compassion Skills, Emotional Regulation, Well-Being, Empathy, Stress and Burnout Symptoms in Response to a Virtual Mindful Self-Compassion Training in the Short and Middle-Term

When the initial objectives of this thesis were formulated, the target population we had chosen was one that particularly faced intense work-related challenges. The COVID-19 pandemic had not yet emerged, and we could not have predicted its impact by the time of fieldwork. During COVID-19 pandemic, the entire world began to implement strategies to cope with everyday life despite the social interaction restrictions imposed by the health situation. Contemplative practices were no exception; instructors in MSC began to certify as online teachers, and the online MSC program was introduced. Consequently, beyond the hypotheses we had already formulated, we were confronted with the question of the effectiveness of the online MSC program. Therefore, our primary objective was to ascertain the effectiveness of virtual MSC training in cultivating mindfulness and self-compassion, followed by a middle-term duration longitudinal study of the impact of these skills on emotional regulation, stress, burnout symptoms, well-being, and empathy, via self-reported measures. Similarly, the KY instructor needed to acquire the communication skills required for online training.

The following hypotheses for Study I were formulated:

Hypothesis 1a

Teachers from Uruguay who undergo a 9-week virtual MSC training would express greater self-perceived mindfulness and self-compassion skills, both comparing within the MSC group and to the KY training.

Hypothesis 1b

Teachers' self-perceived emotional regulation, well-being and empathy would improve, and self-perceived stress and burnout symptoms would decrease, after online MSC training, both comparing within the MSC group and to the KY training.

Hypothesis 1c: Changes in self-reported measures at post-training would persist for three months.

General Objective

The main objective of this thesis was to analyze the effects of training in MSC program on perceived emotion regulation, empathy and well-being, and stress and burnout symptoms, during the COVID-19 pandemic, compared to an active control condition (KY training).

Specific Objectives

1. To evaluate the short-term effects of a virtual MSC program on perceived mindfulness and self-compassion skills, assessed within-group and in comparison with the online KY training.

2. To evaluate the short-term effects of a virtual MSC program on self-perceived emotional regulation, well-being and empathy, and self-perceived stress and burnout symptoms, assessed within-group and in comparison with the online KY training.

3. To evaluate the middle-term effects of a virtual MSC program on perceived mindfulness and self-compassion skills, emotional regulation, well-being and empathy, and self-perceived stress and burnout symptoms, assessed within-group and in comparison with online KY training.

Method

Participants

As stated in the General Introduction, 48 of the selected teachers engaged in the project. Participants' identities were anonymized, numerically coded and assigned by means of a random number generator to the MSC or KY group (MSC n = 25, age: 38 ± 6.9; KY n = 23, age: 41.2 ± 7,2). Due to pandemic-related challenges, 11 participants dropped out as either did not complete the trainings or submit self-reports. A total of 37 participants successfully completed the training (MSC n = 19; KY n = 18) and submitted the self-reports. Hence, to evaluate whether the results stemmed from skill acquisition through the training, only these participants were included in the pre-post analyses.

By the time of the follow-up data collection, sample loss exacerbated by the pandemic upsurge, and only 23 out of the initial 37 participants completed the self-reports. Consequently, for intergroup comparisons in the follow-up and for intragroup analysis the sample sizes were MSC = 10 (mean age 37.6 ± 2.12 yr) and KY =13 (mean age 40.92 ± 8.41 yr).

Procedure

During the weeks preceding the start of the training (pre-training), after finishing the training (post-training), and three months later (follow-up), participants completed online self-reports (Stoet, 2010; 2017), as follows.

Measures

The Five Facet Mindfulness Questionnaire (FFMQ; Baer et al, 2006), is a 39-item instrument that tests the general tendency to be mindful in everyday life. The FFMQ measures five factors representing the dimensions of mindfulness: observing (noticing inner and outer experiences), describing (naming internal experiences using words), acting with awareness (attending to one's current activities rather than behaving mechanically and diverting attention), non-judging (allowing a non-evaluative experience of feelings and thoughts), non-reactivity (experiencing thoughts and feelings without getting caught up in or being carried away by them) (Baer, 2008). The five factors can be interpreted separately by their mean value on a 5-point Likert scale, or combined in a total mindfulness score (total FFMQ); higher scores depict more mindfulness. The Spanish version here used, validated in a Spanish sample, showed an internal consistency of α = 0.88 for the total FFMQ, and from α = 0.75 to α = 0.91 for the subscales (Cebolla et al., 2012).

The Self-Compassion Scale (SCS; Neff, 2003a) tests the ability to be compassionate to oneself in difficult or challenging situations. The SCS is a 26-item questionnaire that measures three interrelated components of self-compassion on separate subscales -self-kindness versus self-judgment, common humanity versus isolation, mindfulness versus over-identification- on a 5-point Likert scale (1: almost never; 5: almost always). Self-kindness involves trying to be loving towards oneself when in emotional pain while self-judgment involves being disapproving and judgmental about one's own faults and inadequacies; shared humanity involves seeing difficulties as part of life experiences, while isolation involves feeling separate from the rest of the world when confronting one's inadequacies; mindfulness involves trying to approach one's feelings with curiosity and openness while over-identification involves getting caught up in one's upsetting feelings (Neff, 2023). Self-compassion is conceptualized as a continuum from lower to higher self-compassion, the latter described by higher self-kindness, common humanity and mindfulness, and by lower self-judgment, isolation and over-identification (Neff, 2023). As a point of reference, Neff (n.d.) suggests that self-compassion scores are low between 1.0 and 2.49, moderate between 2.5 and 3.5, and high between 3.51 and 5.0. For a particular sample, the mean value can be used to determine high or low self-compassion scores. The SCS Spanish version here used, validated in a Spanish sample (García-Campayo et al., 2014), showed an internal consistency of α = 0.87, ranging from α = 0.72 to α = 0.79 for the six subscales.

The Emotional Regulation Questionnaire (ERQ; Gross & John, 2003; Larrieux, 2008) assesses the use of the emotion regulation strategies cognitive reappraisal (which involves altering the appraisal of the unpleasant emotion to reduce its impact), and expressive suppression (which involves efforts to modulate the expression of the current emotional state). This is a 10-item questionnaire on a 7-point scale (1: totally disagree; 7: totally agree) that lacks cutoff points. The Spanish version used here, validated in a sample from Uruguay, showed an internal consistency of α= 0.696, with a reliability of 0.743 for the cognitive reappraisal subscale and 0.70 for the expressive suppression subscale (Larrieux, 2008).

The World Health Organization-5 Well-Being Index (WHO-5; World Health Organization, 1998; Topp et al., 2015) assesses subjective well-being over the previous two weeks. In this 5-item measure (5: all of the time; 0: at no time), the total raw score is multiplied by 4 to obtain the final score, with 100 representing the highest level of well-being. The Spanish version used here showed an internal consistency of α= 0.903 (Lara-Cabrera et al., 2022).

The Interpersonal Reactivity Index (IRI; Davis, 1980, 1983) assesses cognitive and affective dispositional empathy. This is a 28-item index on a 5-point Likert scale (1: does not describe me well; 5: describes me very well) that consists of four 7-item subscales separately measuring empathy dimensions: perspective-taking (reflecting the tendency to adopt other people's perspectives and viewpoints), fantasy (involving the tendency to identify with fictional characters), empathic concern (entailing feelings of warmth, compassion and concern for others), and personal distress (involving anxiety and discomfort when confronting someone else's negative experience). As distinct constructs, although related, these subscales (scores ranging from 7 to 35) are interpreted separately (Davis, 1980; 1983). The Spanish version used here, validated in a Chilean sample, showed internal consistencies ranging from α = 0,67 to α = 0,89 for the four subscales (Fernández et al., 2011).

The Perceived Stress Scale (PSS; Cohen et al., 1983) tests the degree to which one’s life events in the previous month were perceived as stressful. This is a 14-item scale, rated on a 5-point Likert scale (0: never; 4: very often), with total scores ranging from 0 to 56. Higher scores indicate greater perceived stress (She et al., 2021). The Spanish version here used, validated in a Chilean sample, showed an internal consistency of α =0.79 (Tapia et al., 2007).

The Maslach Burnout Inventory Educators Survey (MBI-ED; Maslach et al., 1996; Seisdedos, 1997) assesses the level of burnout among teachers, based on the three burnout dimensions conceptualized by Maslach & Jackson (1981; 1986): emotional exhaustion (which involves feeling emotionally drained due to work demands), depersonalization (referring to the extent of recognizing attitudes of coldness and detachment); and personal accomplishment (encompassing feelings of self-efficacy and achievement in the workplace). This is a 22-item measure on a 7-point Likert scale (0: never; 6: every day). No clinical cutoff scores determine the presence or absence of burnout. However, high scores on emotional exhaustion and depersonalization, along with low scores on personal accomplishment, define the syndrome. The Spanish version used in this study, validated in a Spanish sample, demonstrated reliability as measured by Cronbach's alpha: 0.90 for emotional exhaustion, 0.79 for depersonalization, and 0.71 for personal accomplishment (Seisdedos, 1997).

Data Analysis

The statistical analysis was conducted using the SPSS 26.0 software package. Non-parametric tests were employed because of the small sample size and lack of normal distribution of some variables.

To ensure the comparability of the groups as a function of differences in terms of age, data between groups were compared with a Mann-Whitney U test prior to analysis.

To compare scores between MSC and KY at pre-, post-training and follow-up, the Mann-Whitney U test was used. For intragroup analysis of pre-post training comparison (short-term effects), the Wilcoxon signed-rank test was used. For intragroup analysis of pre-, post-training and follow-up (middle-term effects) comparisons, the Friedman ANOVA and the Wilcoxon signed-rank test post hoc were used. Alpha level was set at 0.05.

Effect sizes (ES) were calculated using $r = Z/\sqrt{N}$ (Tomczak & Tomczak, 2014). Values of 0.1, 0.3 and 0.5 correspond to small, medium and large effects sizes, respectively (Coolican, 2017, p. 484).

Results

Participants of the MSC and KY groups did not differ in age (Table 1).

Table 1 *Age Comparisons Between Mindful Self-Compassion and Kundalini Yoga Participants who completed Psychometric Tests at Post-training and Follow-up*

Time	MSC				KY					
	n	Q-25	Median	Q-75	n	Q-25	Median	Q-75	*p**	*ES*
Post-training	19	32.00	39.00	44.00	18	37.00	40.50	46.25	0.235	0.195
Follow-up	10	29.75	39.00	44.50	13	35.50	38.00	47.50	0.419	0.168

Note. ES = standard deviation; *KY* = Kundalini Yoga; *MSC* = Mindful Self-Compassion; *n* = number of participants; *p* = p-value; *Q-25* = quartile 25; *Q-75* = quartile 75
ES were calculated using $r = Z/\sqrt{N}$
*Based on the Mann-Whitney test

Comparison of MSC and KY on Psychometric Tests at Pre- and Post-Training

Thirty-seven female primary school teachers completed online self-report tests before and after training. Self-reported psychometric test data for all of the studied variables were similar in MSC and KY groups at pre-training (Table 2).

Table 2 *Summary of Results of Psychometric Tests Comparing Mindful Self-Compassion vs Kundalini Yoga Groups at Pre-training*

Test	Factor	MSC			KY			*p**	*ES*
		Q-25 pre	Median pre	Q-75 pre	Q-25 pre	Median pre	Q-75 pre		
FFMQ	Observing (1-5)	2.63	3.25	3.75	2.94	3.25	3.53	0.772	0.05
	Describing (1-5)	3.38	3.88	4.00	2.97	3.63	4.13	0.474	0.12
	Acting with Awareness (1-5)	3.25	3.63	4.13	3.06	3.50	3.78	0.377	0.15
	Non-judging (1-5)	3.25	3.75	4.25	3.00	3.69	4.06	0.784	0.05
	Non-reactivity (1-5)	2.86	3.14	3.43	2.96	3.29	3.61	0.436	0.13
	Total (1-5)	3.10	3.41	3.97	3.08	3.41	3.64	0.659	0.07
SCS	Self-kindness (1-5)	2.60	3.00	3.80	2.15	3.10	4.00	0.855	0.03
	Common Humanity (1-5)	2.50	3.25	3.50	2.81	3.25	3.81	0.501	0.11
	Mindfulness (1-5)	3.00	3.50	4.50	2.75	3.38	4.31	0.927	0.02
	Self-Judgment (1-5)	2.40	3.40	4.00	2.35	3.40	4.50	0.703	0.06
	Isolation (1-5)	2.75	3.25	3.75	2.44	3.38	4.00	0.951	0.01
	Over-Identification (1-5)	2.75	3.75	4.00	2.50	3.50	4.00	0.562	0.10
IRI	Perspective-taking (7 - 35)	21.00	24.00	28.00	22.75	26.50	31.00	0.279	0.18
	Fantasy (7 - 35)	18.00	21.00	23.00	20.50	22.50	28.00	0.126	0.25
	Empathic Concern (7 - 35)	25.00	31.00	33.00	27.00	30.50	34.25	0.551	0.10
	Personal Distress (7 - 35)	17.00	18.00	22.00	18.00	20.50	23.00	0.222	0.20
MBI	Emotional Exhaustion (0-54)	17.00	22.00	32.00	12.50	22.00	28.25	0.386	0.15
	Personal Accomplishment (0-48)	33.00	38.00	43.00	34.00	40.50	42.00	0.726	0.06
	Depersonalization (0-30)	0.00	0.00	5.00	0.00	2.00	5.25	0.597	0.09
ERQ	Cognitive Reappraisal (6-42)	27.00	34.00	37.00	26.75	33.00	34.50	0.385	0.14
	Expressive Suppression (4-28)	7.00	10.00	15.00	5.75	11.00	16.25	1.000	0.00
PSS	Total (0-56)	15.00	21.00	25.00	18.75	25.00	29.50	0.162	0.23
WHO-5	Total (0 - 100)	44.00	60.00	72.00	40.00	50.00	77.00	0.865	0.03

Note. ES = effect size; *FFMQ* = Five Facet Mindfulness Questionnaire; *IRI* = Interpersonal Reactivity Index; *KY* = Kundalini Yoga; *MSC* = Mindful Self-Compassion; *p* = *p*-value; *PSS* = Perceived Stress Scale; *SCS* = Self-Compassion Scale; *Q-25* = quartile 25; *Q-75* = quartile 75; *WHO-5* = World Health Organization-Five Well-Being Index.

ES were calculated using $r = Z/\sqrt{N}$.

* Based on the Mann-Whitney test.

When comparing data of the groups at post-training, significant differences were observed in emotion regulation and empathy, as the levels of expressive suppression on the ERQ (p = 0.037, ES = 0.34) (Figure 2; Table 3) and personal distress on the IRI (p = 0.036, ES = 0.34) were lower in the MSC group (Figure 3; Table 3).

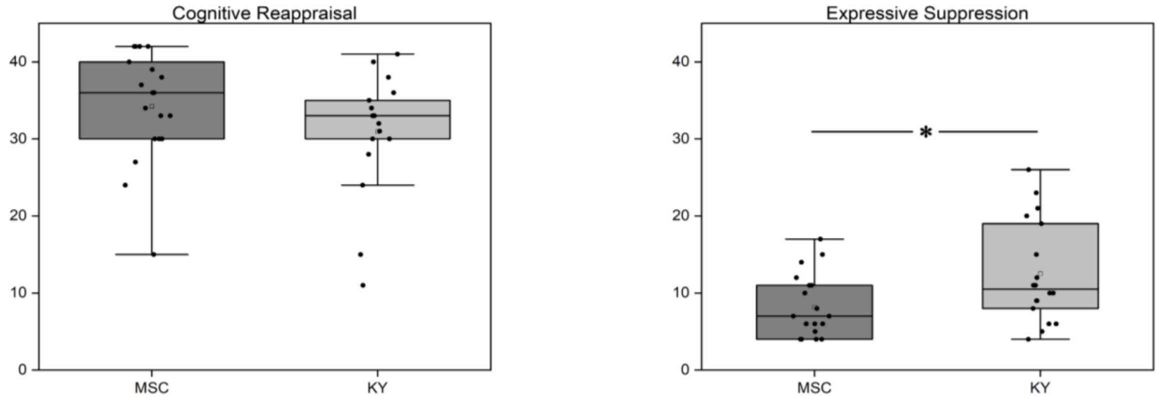


Figure 2. Comparison of Emotional Regulation Questionnaire (ERQ) scores between Mindful Self-Compassion (n = 19) and Kundalini Yoga (n = 18) trainings at post-training. Boxplots represent the ERQ components in which differences were statistically significant. *KY* = Kundalini Yoga; *MSC* = Mindful Self-Compassion. The Y axis represents ERQ scores. Asterisks indicate significant differences (p < 0.05). Error bars indicate the interquartile range.

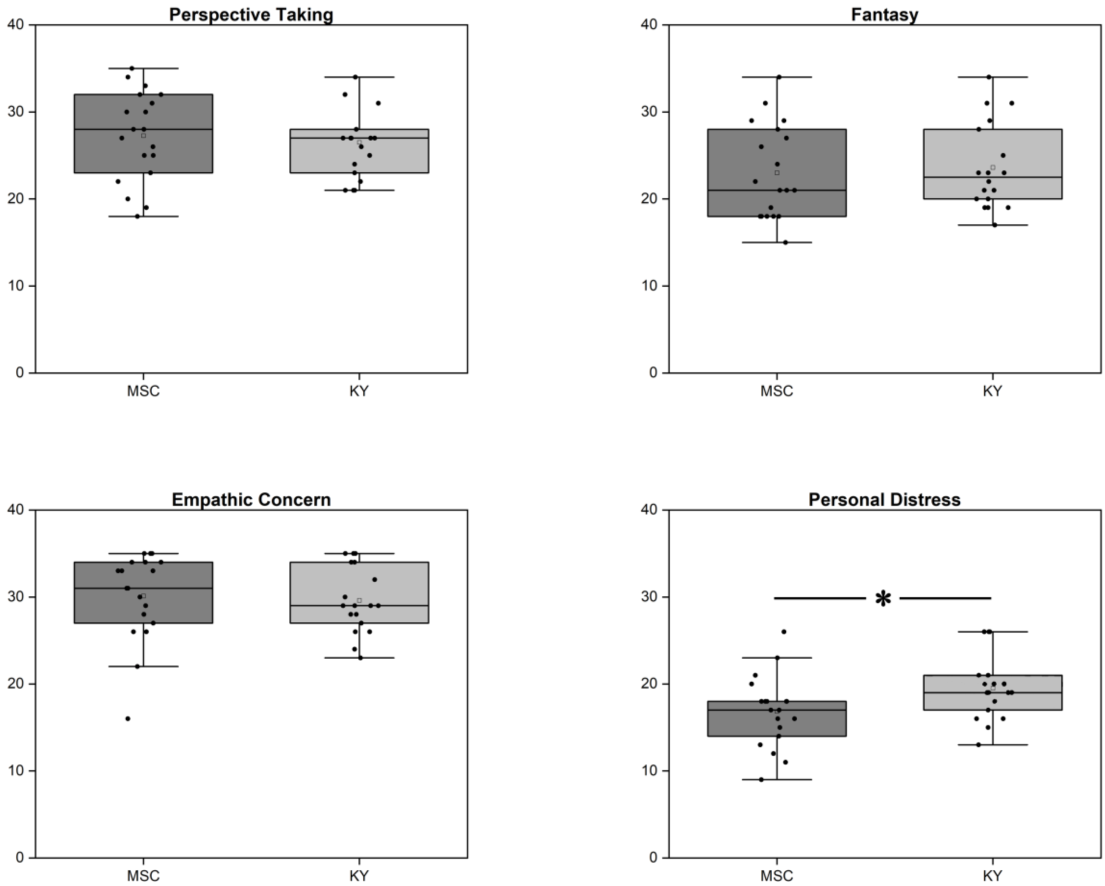


Figure 3. Comparison of Interpersonal Reactivity Index (IRI) scores between Mindful Self-Compassion (n = 19) and Kundalini Yoga (n = 18) trainings at post-training. Boxplots represent the IRI dimensions in which differences were statistically significant. *KY* = Kundalini Yoga; *MSC* = Mindful Self-Compassion. The Y axis represents IRI scores. Asterisks indicate significant differences (p < 0.05). Error bars indicate the interquartile range.

Table 3 *Summary of Results of Psychometric Tests Comparing Mindful Self-Compassion (n = 19) vs Kundalini Yoga (n = 18) at Post-training*

Test	Factor	MSC			KY			*p**	*ES*
		Q-25 post	Median post	Q-75 post	Q-25 post	Median post	Q-75 post		
FFMQ	Observing (1-5)	3.38	3.75	4.25	3.34	3.63	3.91	0.329	0.16
	Describing (1-5)	3.38	3.88	4.75	3.34	3.88	4.16	0.352	0.15
	Acting with Awareness (1-5)	3.38	3.75	4.38	3.47	3.75	4.34	0.988	0.00
	Non-judging (1-5)	3.38	3.88	4.50	3.28	4.00	4.50	0.831	0.04
	Non-reactivity (1-5)	3.00	3.43	3.71	2.54	3.29	3.75	0.344	0.16
	Total (1-5)	3.46	3.80	4.05	3.47	3.56	3.86	0.218	0.20
SCS	Self-kindness (1-5)	3.60	4.20	4.80	3.25	3.60	4.45	0.210	0.21
	Common Humanity (1-5)	3.25	3.50	4.25	2.50	3.25	4.00	0.227	0.20
	Mindfulness (1-5)	3.50	4.00	4.75	3.00	3.75	4.56	0.434	0.13
	Self-Judgment (1-5)	3.40	4.00	4.20	3.20	3.70	4.70	0.927	0.02
	Isolation (1-5)	3.25	3.75	4.00	2.94	3.38	4.00	0.536	0.10
	Over-Identification (1-5)	3.50	3.75	4.50	3.25	3.88	4.31	0.866	0.03
IRI	Perspective-taking (7-35)	23.00	28.00	32.00	22.75	27.00	28.75	0.552	0.10
	Fantasy (7-35)	18.00	21.00	28.00	19.75	22.50	28.25	0.542	0.10
	Empathic Concern (7-35)	27.00	31.00	34.00	26.75	29.00	34.00	0.531	0.10
	Personal Distress (7-35)	14.00	17.00	18.00	16.75	19.00	21.00	0.036	0.34
MBI	Emotional Exhaustion (0 - 54)	14.00	19.00	25.00	8.75	17.50	30.00	0.761	0.05
	Personal Accomplishment (0-48)	35.00	41.00	45.00	36.75	40.50	45.25	0.726	0.06
	Depersonalization (0 - 30)	0.00	0.00	2.00	0.00	1.00	2.75	0.285	0.18
ERQ	Cognitive Reappraisal (6 - 42)	30.00	36.00	40.00	29.50	33.00	35.25	0.147	0.24
	Expressive Suppression (4-28)	4.00	7.00	11.00	7.50	10.50	19.25	0.037	0.34
PSS	Total (0-56)	11.00	16.00	20.00	12.50	19.50	23.25	0.315	0.17
WHO-5	Total (0-100)	60.00	68.00	80.00	52.00	68.00	80.00	0.915	0.02

Note. ERQ = Emotional Regulation Questionnaire*; ES* = effect size; *FFMQ* = Five Facet Mindfulness Questionnaire; *IRI* = Interpersonal Reactivity Index; *p* = *p*-value; *MBI* = Maslach Burnout Inventory; *PSS* = Perceived Stress Scale; *SCS* = Self-Compassion Scale; Q-25 = quartile 25; Q-75 = quartile 75; *WHO-5* = World Health Organization-Five Well-Being Index. Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$.
*Based on the Mann-Whitney test.

Comparison of MSC and KY on Psychometric Tests at Follow-Up

Twenty-three out of the 37 participants who completed the training sessions also completed the online self-report tests administered at follow-up, three months later. When comparing groups at follow-up (MSC, n = 10; KY, n = 13), the scores of the MSC group were higher in the observing factor of the FFMQ (p = 0.029, ES = 0.45) and the total FFMQ (p = 0.046, ES = 0.41) (Figure 4; Table 4), and in the cognitive reappraisal on the ERQ (p = 0.047, ES = 0.41) (Figure 5; Table 4).

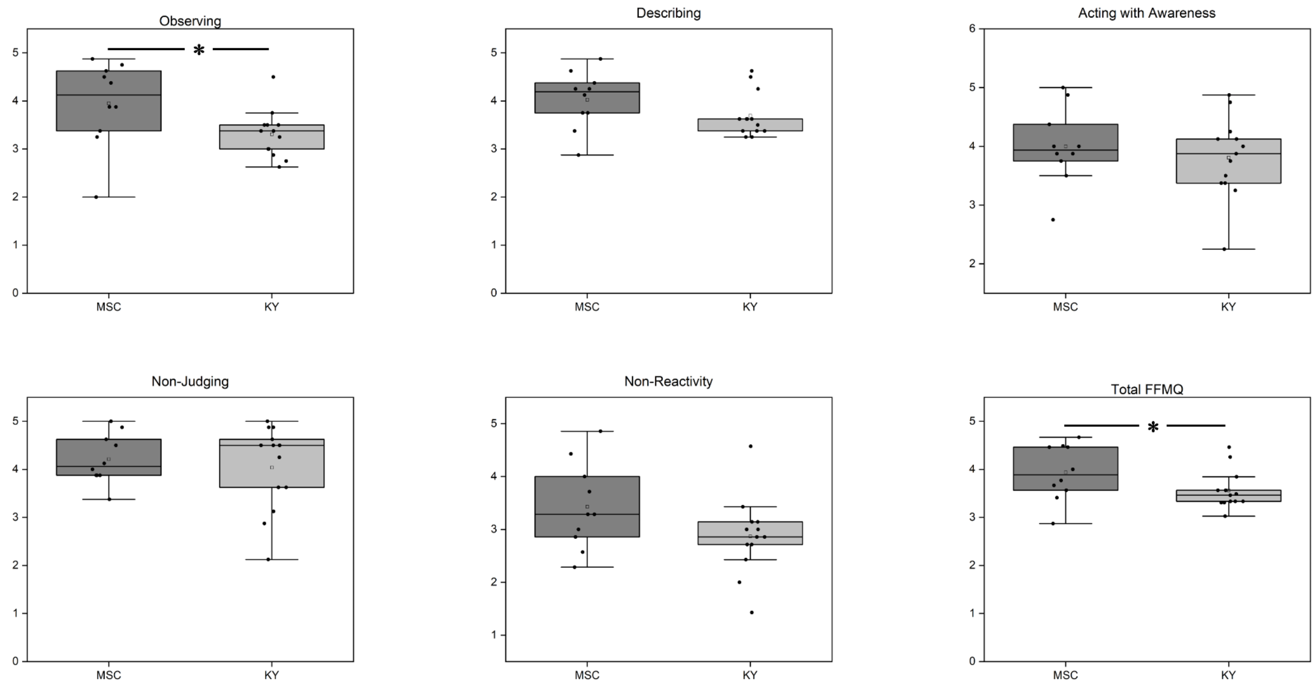


Figure 4. Five Facet Mindfulness Questionnaire (FFMQ) scores comparing Mindful Self-compassion (*n* = 10) vs Kundalini Yoga (*n* = 13) trainings at follow-up. Boxplots represent the FFMQ facets and total FFMQ scores in which differences were statistically significant. *KY* = Kundalini yoga. *MSC* = Mindful Self-compassion. The Y axis represents FFMQ scores. Asterisks indicate significant differences (p < 0.05; Mann-Whitney U-test). Error bars indicate the interquartile range.

Table 4 *Summary of Results of Psychometric Tests Comparing Mindful Self-Compassion (n = 10) vs Kundalini Yoga at Follow-up (n = 13)*

Test	Factor	MSC			KY			*p**	*ES*
		Q-25 follow-up	Median follow-up	Q-75 follow-up	Q-25 follow-up	Median follow-up	Q-75 follow-up		
FFMQ	Observing (1-5)	3.34	4.13	4.66	2.94	3.38	3.50	0.029	0.45
	Describing (1-5)	3.66	4.19	4.44	3.38	3.63	3.94	0.105	0.34
	Acting with Awareness (1-5)	3.69	3.94	4.50	3.38	3.88	4.19	0.514	0.14
	Non-judging (1-5)	3.88	4.06	4.69	3.38	4.50	4.75	0.827	0.05
	Non-reactivity (1-5)	2.79	3.29	4.11	2.57	2.86	3.14	0.120	0.32
	Total (1-5)	3.53	3.89	4.47	3.32	3.46	3.71	0.046	0.42
SCS	Self-kindness (1-5)	3.30	4.50	4.85	2.80	4.00	4.60	0.275	0.23
	Common Humanity (1-5)	3.19	3.75	4.81	2.88	3.50	4.13	0.223	0.25
	Mindfulness (1-5)	3.13	3.75	4.56	3.00	3.50	4.00	0.452	0.16
	Self-Judgment (1-5)	3.35	4.40	4.85	3.40	4.20	4.90	0.851	0.04
	Isolation (1-5)	3.00	3.75	4.00	3.38	3.50	4.00	0.798	0.05
	Over-Identification (1-5)	3.50	4.13	4.50	3.50	4.00	4.38	0.573	0.12
IRI	Perspective-taking (7-35)	24.50	28.50	29.50	21.50	28.00	29.50	0.596	0.11
	Fantasy (7-35)	19.00	22.00	27.25	18.50	23.00	27.50	0.901	0.03

Table 4 *Summary of Results of Psychometric Tests Comparing Mindful Self-Compassion (n = 10) vs Kundalini Yoga at Follow-up (n = 13)*

Test	Factor	MSC			KY			*p**	*ES*
		Q-25 follow-up	Median follow-up	Q-75 follow -up	Q-25 follow-up	Median follow-up	Q-75 follow-up		
MBI	Empathic Concern (7-35)	26.75	30.00	35.00	27.50	30.00	33.00	0.683	0.09
	Personal Distress (7-35)	12.50	15.50	22.00	15.00	18.00	21.00	0.366	0.19
	Emotional Exhaustion (0-54)	14.00	18.50	42.25	11.00	21.00	39.50	0.950	0.01
	Personal Accomplishment (0-48)	30.00	39.00	45.75	31.00	42.00	45.50	0.732	0.07
	Depersonalization (0 - 30)	0.00	5.00	6.00	0.00	1.00	4.50	0.633	0.10
ERQ	Cognitive Reappraisal (6 - 42)	32.50	34.50	36.75	22.00	29.00	34.50	0.162	0.42
	Expressive Suppression (4-28)	5.750	9.00	11.50	5.50	10.00	12.50	0.047	0.01
PSS	Total (0-56)	10.25	20.50	24.00	13.00	25.00	33.50	0.162	0.29
WHO-5	Total (0-100)	52.00	66.00	77.00	36.00	52.00	78.00	0.453	0.16

Note. ERQ = Emotional Regulation Questionnaire*; ES* = effect size; *FFMQ* = Five Facet Mindfulness Questionnaire; *IRI* = Interpersonal Reactivity Index; *MBI* = Maslach Burnout Inventory; *MSC* = Mindful Self-Compassion; *KY* = Kundalini Yoga; *p* = *p*-value; *PSS* = Perceived Stress Scale; *Q-25* = quartile 25; *Q-75* = quartile 75; *SCS* = Self-Compassion Scale; *WHO-5* = World Health Organization-Five Well-Being Index.
Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
* Based on the Mann-Whitney test

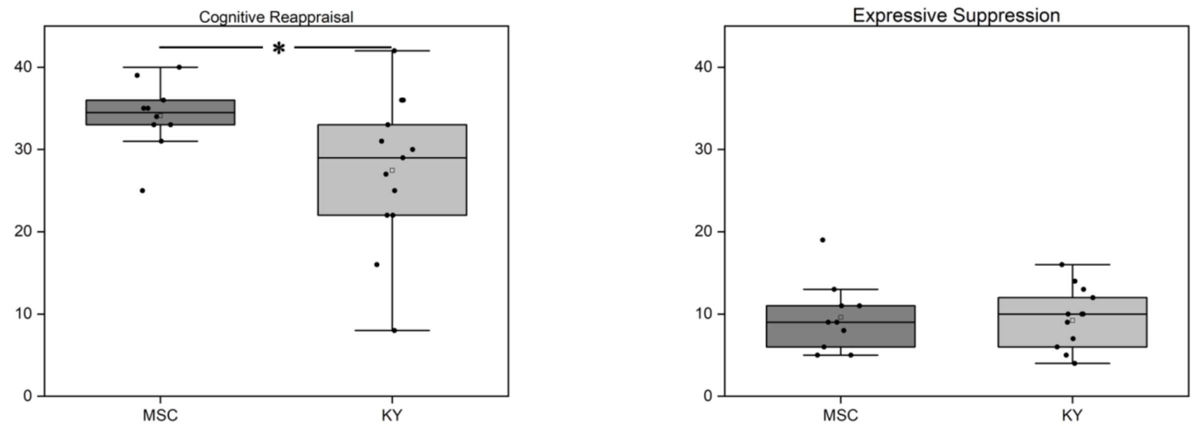


Figure 5. Emotional Regulation Questionnaire (ERQ) scores comparing Mindful Self-compassion (*n* = 10) vs Kundalini Yoga (*n* = 13) trainings at follow-up. Boxplots represent the ERQ components in which differences were statistically significant. *KY* = Kundalini yoga; *MSC* = Mindful Self-compassion. The Y axis represents ERQ scores. Asterisks indicate significant differences ($p < 0.05$; Mann-Whitney U-test). Error bars indicate the interquartile range.

Psychometric Tests Results of Short-Term Comparison (Pre-Post) Within Groups

Given the novelty of the online training format at the time this study was conducted, our initial focus was on determining if the online MSC modality would foster mindfulness and self-compassion, and subsequently impact on the other variables of interest. Therefore, apart from comparisons between groups, we evaluated intragroup changes. Short-term outcomes were analyzed by comparing pre- and post-training self-reported questionnaires.

In the MSC group, changes post-training were observed in all the psychometric tests, as follows. Regarding mindfulness, the FFMQ factors observing (p = 0.000, ES = 0.84) and non-reactivity (p = 0.038, ES = 0.48), as well as the total FFMQ score (p = 0.004, ES = 0.66) increased. As for self-compassion, the SCS components self-kindness (p = 0.001, ES = 0.75), common humanity (p = 0.010, ES = 0.59) and mindfulness (p = 0.034, ES = 0.49) increased, as well as the self-judgment (p = 0.044, ES = 0.463). The expressive suppression, an emotion regulation factor of the ERQ, diminished (p = 0.039, ES = 0.473). The well-being perception increased (p = 0.008, ES = 0.61). Regarding empathy, the IRI dimension perspective-taking increased (p = 0.028, ES = 0.505), while the personal distress dimension decreased (p = 0.011, ES = 0.59). Perception of stress post-training decreased (p = 0.050, ES = 0.45), along with a decrease in the MBI subscale emotional exhaustion, a symptom of burnout (p = 0.033, ES = 0.49) (Table 5, Appendix 1).

In the KY group, regarding mindfulness, the FFMQ factors observing (p = 0.010, ES = 0.61) and acting with awareness (p = 0.014, ES = 0.58), as well as the total FFMQ (p = 0.029, ES = 0.51) increased after training. The self-kindness component of the SCS (p = 0.015, ES = 0.57), as well as self-judgment (p = 0.012, ES = 0.59) and over-identification (p = 0.002, ES = 0.72) increased. The stress perception decreased (pp = 0.003, ES = 0.70), while well-being increased at post-training (p = 0.022, ES = 0.54) (Table 6, Appendix 1). No changes were observed in emotion regulation, empathy and burnout.

Psychometric Tests Results of Middle-Term Comparison (Pre-, Post-, Follow-up) Within Groups

Longitudinal middle-term analysis within groups considered the sample of participants who completed all three instances of self-report responses. Scores were compared between pre- and post-training, pre-training to follow-up, and post-training to follow-up.

Within the MSC group, changes were observed in dimensions of mindfulness, self-compassion, empathy and burnout. Concerning mindfulness, the observing factor of the FFMQ increased both at post-training (p = 0.015, ES = 0.77) and at follow-up (p = 0.033, ES = 0.68) with respect to pre-training. Furthermore, the non-judging factor increased at follow-up with respect to both pre- training (p = 0.035, ES = 0.67) and post-training (p = 0.036, ES = 0.66), and the total FFMQ increased at follow-up with respect to pre-training (p = 0.017, ES = 0.76. Regarding self-compassion, common humanity increased at post-training (p = 0.011, ES = 0.80) and follow-up (p = 0.014, ES = 0.78) with respect to pre-training. Concerning empathy, the personal distress decreased at post-training (p = 0.049, ES = 0.62) and follow-up (p = 0.007, ES = 0.86) with respect to pre-training. With regard to burnout, the depersonalization increased at follow-up with respect to pre-training (p =0.043, ES = 0.64) and to post-training (p = 0.026, ES = 0.71) (Tables 7 to 9, Appendix 1).

Within the KY group, changes were observed in mindfulness, self-compassion and stress. Concerning mindfulness, the factor acting with awareness of the FFMQ increased at post-training (p = 0.033, ES = 0.59) and at follow-up (p = 0.016, ES = 0.67) with respect to pre-training, and the non-judging factor increased at follow-up with respect to pre-training (p = 0.027, ES = 0.61) and post-training (p = 0.028, ES = 0.61). Regarding self-compassion, the self-kindness component increased at post-training (p = 0.037, ES = 0.59) and follow-up (p = 0.028, ES = 0.61) with respect to pre-training. The self-reported stress decreased at post-training with respect to pre-training (p = 0.001, ES = 0.88), and increased at follow-up with respect to post-training ($p = 0.015$, ES = 0.67) (Tables 10 to 12, Appendix 1).

Discussion

The present study evaluates the effects of a 9-week online MSC training (Neff & Germer, 2013; Germer & Neff, 2019) on psychological variables in female primary school teachers within the context of the COVID-19 pandemic, compared to an active control condition (KY). Mindfulness and self-compassion skills, emotional regulation, well-being, empathy, stress and burnout were assessed in the short- and middle-term. Given that this program was being tested for the first time among teachers in Uruguay, and in a novel online format, we were interested not only in comparing it against a control condition but also in observing changes within the MSC group over time. We hypothesized that this MSC training would improve teachers' mindfulness and self-compassion skills, increase their self-perception of emotion regulation, well-being and empathy, and reduce their perceived stress and burnout, with greater improvements in the MSC group than in an active control group. Finally, we hypothesized that the effects would still be present in the middle-term, three months after MSC training. Because of participant drop-out, short-term and middle-term data were analyzed separately. Importantly, prior to the training period, the comparison between the MSC and the control group yielded no significant differences in any of the variables studied.

Comparison Between MSC and KY in the Short and Middle Term

At post-training, MSC and KY only differed in emotion regulation and empathy. Despite evidencing fewer findings than anticipated, the MSC group derived the most benefit in both variables. The MSC group exhibited lower levels of expressive suppression than the control group, after training. This variable also diminished within the MSC group from pre- to post-training. Expressive suppression is regarded as a maladaptive emotion regulation strategy, involving the inhibition of outwardly expressing current emotions, which is associated with reduced positive emotions and well-being, as well as increased levels of stress, anxiety, and symptoms of depression (Lopez & Denny, 2019; Gross & John, 2003; Gross, 2015). The MSC group exhibited lower scores in personal distress than the control group after training. This variable also decreased from pre- to post-training in the MSC group assessment. Personal distress represents an affective dimension of empathy, characterized by experiencing anxiety and discomfort when confronted with another person's negative experience. It manifests as an unpleasant response, arising when the suffering experienced by others becomes indistinguishable from one's own, often leading to self-protective avoidance behaviors that are detrimental to altruistic attitudes (Preston & Hofelich, 2012; Decety, 2010). Interestingly, when analyzing the results within the MSC group at post-training, personal distress decreased while common humanity and mindfulness increased. According to Fuochi et al. (2018), improving the mindfulness dimension of self-compassion, rather than over-identification, is crucial in avoiding personal distress when confronted with the suffering of others.

When comparing effects of the interventions at follow-up, the mindfulness skill and emotion regulation differed between groups. Similar to the short-term findings, the MSC group derived the most benefit in both variables. The scores of the MSC group in the observing skill and total mindfulness were higher than those of the control group. This could be explained by the fact that MSC specifically trains mindfulness skills, as a central aspect of self-compassion (Neff, 2023). Mindfulness skills developed in mindfulness interventions lead to a mindful state lasting beyond the end of the intervention (Karing & Beelmann, 2021; Kiken et al., 2015). Meanwhile, Gaiswinkler & Unterrainer (2016) explain that most yoga benefits emerge with continued and sustained practice, and high involvement also in everyday life. This could explain the higher mindfulness levels in the MSC than the control group in the long term. Interestingly, while the MSC group in the short term exhibited reduced expressive suppression, in the long term showed increased cognitive reappraisal. Collectively, these findings substantiate improvements in both facets of the emotion regulation questionnaire. Cognitive reappraisal involves taking a different perspective towards the challenge to reduce its impact. This adaptive strategy for regulating emotions is also valuable in teaching. Teachers who use this approach tend to experience lower levels of emotional exhaustion (Donker et al., 2020). As self-compassion increases with training, it is expected that enhanced adaptive emotion regulation abilities emerge, such as reappraisal. Self-compassion functions as a versatile strategy for navigating stressors, enabling individuals to prioritize soothing cues over threat cues, thereby reducing emotional arousal (Neff, 2023; Svendsen et al., 2016). In the same line, as discussed by Shoham et al. (2017), mindfulness meditation practice influences emotional arousal by enhancing levels of decentering, leading individuals to feel more calm and less nervous. Decentering refers to the capacity to shift one's perspective, allowing one to step back and observe one's own thoughts and experiences rather than becoming fully absorbed in them (Sedlmeier et al., 2012). Hence, it is unsurprising that the observing capacity of mindfulness increased in MSC participants over the long term compared to the KY group.

Contrary to our expectations, no differences in self-compassion were found between groups in the short or long term. This is intriguing, considering the MSC program intentionally focuses on developing self-compassion skills. Two possible reasons may explain this result. Firstly, when assessing the groups separately, self-compassion improved in both MSC and KY groups. This raises the question whether KY, despite not being specifically aimed at training self-compassion, was a suitable active control training for MSC. In a previous study, comparing a mindfulness and self-compassion intervention with hatha yoga and a passive control group, both intervention groups increased mindfulness and decreased stress at follow-up, although self-compassion only increased in the mindfulness-based intervention (Falsafi, 2016). Secondly, the context of the pandemic cannot be ignored, considering self-compassion may vary depending on contextual circumstances (Dupasquier et al., 2017).

According to Weißenfels et al. (2022), teacher burnout increased after the COVID-19 pandemic, which negatively correlated with self-efficacy. Self-efficacy, in turn, negatively relates to self-evaluation (Iskender, 2009) and thus could be a counterbalancing factor to achieve better self-compassion development. It is therefore worth inquiring whether the MSC group's self-compassion improvements would have been higher in a non-pandemic context, distinguishing them from the control group. When comparing psychometric tests between groups at follow-up, the MSC training showed higher scores in the observing skill and total mindfulness than the control group. This could be explained by the fact that MSC specifically trains mindfulness skills, as central aspects of self-compassion (Neff, 2023), while KY involves some mindfulness skills but not as the focus of the practice. Mindfulness skills developed in mindfulness interventions lead to a mindful state lasting beyond the end of the intervention (Karing & Beelmann, 2021; Kiken et al., 2015). Meanwhile, Gaiswinkler & Unterrainer (2016) explain most yoga benefits emerge with continued practice and high involvement in everyday life. This could explain the higher mindfulness levels reached by the MSC group, compared with the control group in the long term.

Within-Group Comparisons in the Short-Term: From Pre to Post-Training

Regarding the question of whether the practices in an online format would be effective in the context of the pandemic, the analysis of within-group results showed effects in the short and long term. Interestingly, the MSC group participants exhibited improvements in all tests performed post-training. Meanwhile, participants of the KY group showed changes in mindfulness, self-compassion, stress and well-being.

In the MSC group, the mindfulness factors observing, non-reactivity and total mindfulness increased from pre- to post-training. The increase in non-reactivity is consistent with the improved ability to become aware of personal thoughts and feelings without reacting or trying to change them. In the control group, observing and total mindfulness also increased, as well as acting with awareness. These findings can be explained as both MSC and KY trainings cultivate directing attention to one's own body and breathing, and in the case of MSC also to the present experience.

All three positive facets of self-compassion -self-kindness, common humanity, and mindfulness- increased post-training in the MSC group. Although a decrease in self-judgment was expected, since self-kindness and mindfulness increased (Neff, 2003a), the opposite occurred, and over-identification and isolation did not decrease. It is possible that, since the observation skill improved, teachers of the MSC group may have become more aware of their own self-judgment, which had not previously been self-recorded. Given that self-kindness and self-judgment are two ends of a continuum, and that improvements in self-kindness are associated with a decrease in negative emotional experiences (Neff, 2003a), it might be expected that further MSC training would lead to a reduction in self-judgment. The increase in all three positive self-compassionate dimensions, with only self-judgment as a self-uncompassionate factor increasing (and not the over-identification), may reflect a gradual process of improvement. A middle-term increase in non-judging —as reported below–, which involves adopting a non-evaluative attitude towards one's own thoughts and feelings (Baer, 2008), supports this idea. The process of acquiring compassion skills through mindfulness training would involve detaching from self-evaluative thoughts, shifting from narrative-self processing to embodied awareness and decentering (Berkovich-Ohana et al., 2019). Concerning self-compassion findings post-training in the control group, while self-kindness increased, there was also an increase in self-judgment and over-identification. The increase in self-judgment observed both in the MSC and KY groups prompts consideration of the impact of pandemic-related stress and burnout experienced by teachers, which is negatively correlated with self-efficacy (Weißenfels et al., 2022). According to De Ocampo (2023), self-evaluations at the time of this project revealed teachers' doubts about their abilities and worth.

Thus, these results also support the effectiveness of the online MSC program implemented in this project in improving mindfulness and self-compassion skills.

This measure only changed in the MSC group, with the expressive suppression strategy decreasing post-training. Particularly for teachers, suppressing emotions and expressions may serve a functional role within the classroom environment (Frenzel, 2014), although this could lead to emotional exhaustion (Jiang et al., 2016). As discussed below, the MSC participants also reported decreased emotional exhaustion post-training. Interestingly, the decrease in this facet of emotional regulation was observed alongside increases in self-kindness, common humanity, and mindfulness, which promote individuals' capacity to approach negative thoughts, feelings, or sensations with acceptance and understanding, recognizing challenging events as part of the human experience and responding with self-compassion and reassurance (Neff & Germer, 2013). As posited by Neff (2003b, 2023), these three positive facets of self-compassion collectively contribute to a psychologically healthy self-relationship. Individuals are therefore likely to experience diminished negative affect and are less inclined to employ emotion suppression strategies, as emotions are perceived as less menacing (Allen & Leary, 2010).

Concerning self-perception of empathy, the MSC group increased perspective-taking and decreased personal distress post-training, consistent with previous research (Birnie et al, 2010; Neff & Pommier, 2013). Such outcomes were expected since cultivating self-compassion contributes to compassionately approaching others and connecting with their needs, balancing compassion to others with compassion for oneself (Gilbert, 2009; Neff, 2003b; Neff & Germer, 2013; Solomon et al., 2021; Wiklund & Wagner, 2013). In accordance with Fuochi et al. (2018), among self-compassion dimensions, common humanity would play a central role in promoting connection with others. Perspective-taking is a central dimension of cognitive empathy that involves putting oneself in another person's shoes (Preston & Hofelich, 2012), but if this entails exhaustion and discomfort, the motivation will be self-oriented, seeking to alleviate one's own discomfort rather than that of others (Eisenberg & Eggum, 2009). Personal distress is an unpleasant response that emerges when the other's experience of suffering cannot be separated from the personal one, thus promoting self-protective avoidance behaviors to the detriment of altruistic attitudes (Preston & Hofelich, 2012; Decety, 2010). In line with Fuochi et al. (2018), we sustain that here found reduction in personal distress is consistent with an increase in mindfulness skills, particularly as opposed to over-identification, which allows keeping difficulties in perspective and avoiding over-reaction. As proposed by Neff (Neff, 2023), by increasing perspective-taking and reducing personal distress, self-compassion enables reducing the separation between individuals.

After MSC training perceived stress decreased and well-being increased, consistent with previous findings (Klingbeil & Renshaw, 2018; Berkovich-Ohana et al., 2019). This is in line with the increase in mindfulness and self-compassion skills, which foster a self-supportive approach to stressful situations, recognising them as part of life while reducing rumination and perceived threat (Neff et al., 2007; Kirby et al., 2017b; Tarrasch et al., 2020). Self-kindness, connectedness and presence allow better coping with negative emotions, leading to a mental positive status even when suffering (Zessin et al., 2015; Neff, 2023).

Burnout. With regard to the level of burnout among teachers, the emotional exhaustion, which involves feeling emotionally drained due to work demands, decreased in the MSC group post-training. This finding is observed concurrently with a decrease in expressive suppression and an increase in well-being. In this regard, Ma & Liu (2024) discuss that emotion regulation and well-being are pivotal factors in fostering teachers' greater resilience amidst challenges and thus promoting capacity to tackle burnout, reducing the risk of its development.

Within-Group Comparisons in the Middle-Term: Pre-, Post-Training and Follow-Up

In the long term, the MSC groups exhibited changes in mindfulness, self-compassion, empathy, and burnout, but no effects were observed in emotion regulation, well-being, and stress. Meanwhile, the KY group showed changes in mindfulness, self-compassion and stress.

The mindfulness factors observing increased post-training and remained high at follow-up, total FFMQ increased from pre-training to follow-up, and non-judging increased from post-training to follow-up. Regarding self-compassion, common humanity increased post-training and remained high three months later. In the control group, acting with awareness and non-judging increased post-training and remained high at follow-up, and so did the self-kindness dimension of self-compassion.

Such improvements sustained in time are consistent with those reported in other studies conducting the MSC training in person (Bluth et al., 2023; Møller et al., 2019). Thus, these results suggest the effectiveness of the online MSC program implemented in this project in improving mindfulness and self-compassion skills.

Concerning perceived empathy in the MSC group in the middle-term, personal distress diminished post-training and remained low at follow-up, suggesting long-lasting effects of self-compassion as a coping resource for negative emotions (Allen & Leary, 2010). However, no change was observed concerning perspective-taking in the middle-term analysis. The discussion on empathy will be revisited in the subsequent study, where perceived empathy will be correlated with empathic ability, as measured using an empathy for pain task.

In the MSC group in the middle-term, and unlike previous research, the improvements in stress and well-being were not sustained over time (Neff & Germer, 2013; Tarrasch et al., 2020). This is not surprising given teachers had to become frontline workers during the pandemic, increasing stress and burnout (Pressley et al., 2021; Pellerone, 2021). New challenges arose, including having to adapt their pedagogical and technological approaches to innovative classroom environments, coping with emerging students' and parents' difficulties, and managing the fear of contagion (Marshall et al., 2020; Pressley et al., 2021; OECD, 2020). Work-related well-being declined at that time, with special concern about the professional future (Alves et al., 2020). Teachers, particularly women, accounted for the negative impact of the pandemic on their mental health (Allen et al., 2020). Interestingly, a report on the reopening of schools in Uruguay in 2020 noted that, among a series of measures specifically created to mitigate teachers' concerns, an emotional containment plan was the least concrete point at that time (Alarcón & Mendez, 2020). Middle-term analyses in the control group also showed a stress reduction and well-being increase post-training, but stress increased from post-training to follow-up, suggesting that benefits from the KY practice were not consolidated.

Concerning changes in the level of burnout in the MSC group in the middle-term, unlike the improvement post training, the depersonalization increased three months later. Depersonalization refers to the degree of recognizing attitudes of coldness and detachment. Interestingly, this finding was evident when comparing pre- and follow-up as well as post- and follow-up measures, indicating a gradual increase over time in depersonalization after training completion. Such results cannot be fully understood without considering the progression of the pandemic and its repercussions on increased challenges in schools at the time (Obada, 2022). This raises the question of whether this detachment might reflect the implementation of self-care and taking distance for self-preservation in times of extreme challenges.

In summary, while both trainings showed within-group improvements, only the MSC training positively impacted all of the studied variables post-training, either as a whole or in specific dimensions. Furthermore, it positively impacted more of the studied variables than the KY training in the middle term. Regarding between-group comparisons, all significant differences favored the MSC group, with improvements in emotional regulation, affective empathy, and mindfulness. Specifically, the MSC group exhibited reduced expressive suppression and personal distress post-training, and increased observing, overall mindfulness, and cognitive reappraisal at follow-up compared to the KY group. Although self-compassion did not differ significantly between groups, only the MSC group improved all positive aspects of self-compassion components in the short term. Contextual factors were discussed when interpreting these results. Together, these findings suggest a beneficial effect of both practices in the studied group of teachers, with a more advantageous impact gained from MSC training.

Study II. Examining Empathy Levels in Response to Virtual Mindful Self-Compassion Training: Experimentally Measured Empathic Abilities in the Short and Long Term

Empathy is an innate ability that entails feeling and understanding another's internal states, and it is conceptualized by consisting of an affective and a cognitive dimension. The affective dimension involves being able to feel what the other person feels, while the cognitive dimension involves understanding the other person's internal state, so it encompasses perspective taking (Decety & Jackson, 2004). Furthermore, regulatory mechanisms permit distinguishing self from others' feelings (Ickes, 2009). Promoting self-compassion among teachers can lead to secure attachments and improved relationships through increased forgiveness, perspective-taking, and empathy (Lathren et al., 2021; Neff, 2023; Neff & Beretvas, 2012; Sotiropoulou et al., 2023). Furthermore, engaging in prosocial and altruistic behavior is linked to improved health, well-being, and longevity for the benefactor (Brown & Brown, 2015). Increased mindfulness and self-compassion, coupled with reduced stress levels, have been significantly correlated with increased empathy (Wallmark et al., 2013). Although self-reports, as those used in Study I, can be effective in measuring how empathic the participants regard themselves, experimental tasks are more precise at measuring how they infer other's thoughts and feelings, which is essential for successful social interaction (Baez et al., 2014; Decety & Jackson, 2004; Ickes, 2009). Exposure to images depicting pain elicits empathetic responses in observers (Martínez-Pernía et al., 2023), and activation of brain regions associated with emotional and motivational functions similar to those experienced by individuals undergoing pain themselves (Baez et al., 2014, 2016, 2017; Bernhardt & Singer, 2012; Decety et al., 2012). In this study, an empathy for pain task (EPT) was implemented to assess empathic abilities in the context of intentional or accidental harm (Baez et al., 2014, 2016, 2017).

Hypothesis 1d: Teachers from Uruguay who undergo a 9-week virtual MSC training exhibit superior experimentally elicited empathic abilities compared to participants trained in KY.

Hypothesis 1e: Teachers from Uruguay who undergo a 9-week virtual MSC training exhibit sustained middle-term improvements in empathic abilities.

Hypothesis 1f: The results obtained from measuring empathy through the EPT task and self-reports will be consistent with each other.

General objective

To evaluate the effectiveness of the online MSC program, compared to an active control condition (KY training), in improving empathic abilities as measured through an EPT task in person, administered at pre-and post-training, and at follow-up three months later.

Specific objectives

1. To evaluate if the self-compassion skills cultivated by the MSC training improve empathic abilities as demonstrated by affective and cognitive dimensions of empathy –namely personal distress and empathic concern, and recognition of intentional harm, respectively–, leading to greater empathic abilities compared to KY participants.

2. To evaluate whether the empathic abilities improvements are sustained in the middle-term.

3. To analyze the consistency in results between perceived empathy and empathic abilities.

Method

Participants

As mentioned before, the difficulties posed by the pandemic exacerbated the expected loss of participants. Hence, from the 37 participants who completed the training sessions, 28 submitted the self-reports and completed the EPT post-training, and 22 did at follow-up. Hence, for pre- and post-training analysis 28 participants were considered (MSC: n =13, mean age 37.08 ± 7.93 yr; KY: n =15, mean age 41.13 ± 7.92 yr), and 22 was the sample at follow-up (MSC: n =10, mean age 37.6 ± 7.92 yr ; KY: n =12, mean age 41.5 ± 8.51 yr).

Procedure and Measures

After completion of the online psychometric tests, the participants attended the Catholic University venues at pre-, post-training and 3 months later. Each time, they completed an in-person modified version of an empathy for pain task (EPT; Decety et al., 2012; Baez et al., 2017) for assessing the effects of the interventions on the experimentally induced empathic response. Upon arrival, participants were interviewed about the use of stimulants or tranquilizers, smoking, alcohol, and drugs in the previous 24 hours. Additionally, they reported the stage of their menstrual cycle, as well as their emotional and fatigue state at the time of the study. Most of this information was collected regarding EEG and ECG recordings to be made during another empathy task at the same times, and ECG recordings during a social stress test, at post-test. The latter will be explained in Chapter II.

Concerning the EPT, it is a task that reliably elicits empathic responses and assesses empathy through the ability to recognize intentional harm in interpersonal contexts (Baez et. al., 2014, 2016; Decety et al., 2012). Each EPT session was individual and consisted of sitting in front of a computer screen while performing a task that lasted around 10 minutes. In each EPT session, 13 randomly selected sets of images, out of 57 possible scenarios, were presented on a computer screen, one for training and 12 for testing. Each set consisted of three images -500, 200 and 1000 ms duration from first to third- presented sequentially to imply a situation in motion. Eight situations were interactions between two persons (no faces visible) in which harm was inflicted either intentionally (n = 4) or accidentally (n = 4); four other situations were neutral, showing no harm. We used 4 neutral situations, instead of 3 as used by Baez et al. (2017; see Figure 6). After each situation, participants answered 5 questions to assess the cognitive and affective components of empathy as well as elements of moral evaluation. For the cognitive component, the yes or no question “Was the action done on purpose?” (yes = -1; no = 1) assessed comprehension of intentionality. For the affective components, the question “How sad do you feel for the victim?” assessed empathic concern and the question “How upset do you feel for what happened in the situation?” assessed personal distress. Responses were provided by sliding an analogical bar ranging from -9 to +9, allowing participants to express the intensity of their feelings on an 18-point continuum (i.e., from not sad or upset to much sadness upset). Participants were only presented with the bar; no numerical values were displayed. Questions assessing moral evaluations (“How bad was the agent’s intention?” and “How much penalty does this action deserve?”) were not analyzed as we focused on the cognitive and affective components of empathy. This task was conducted following a safety protocol for COVID-19 issued by the Uruguayan Ministry of Health.

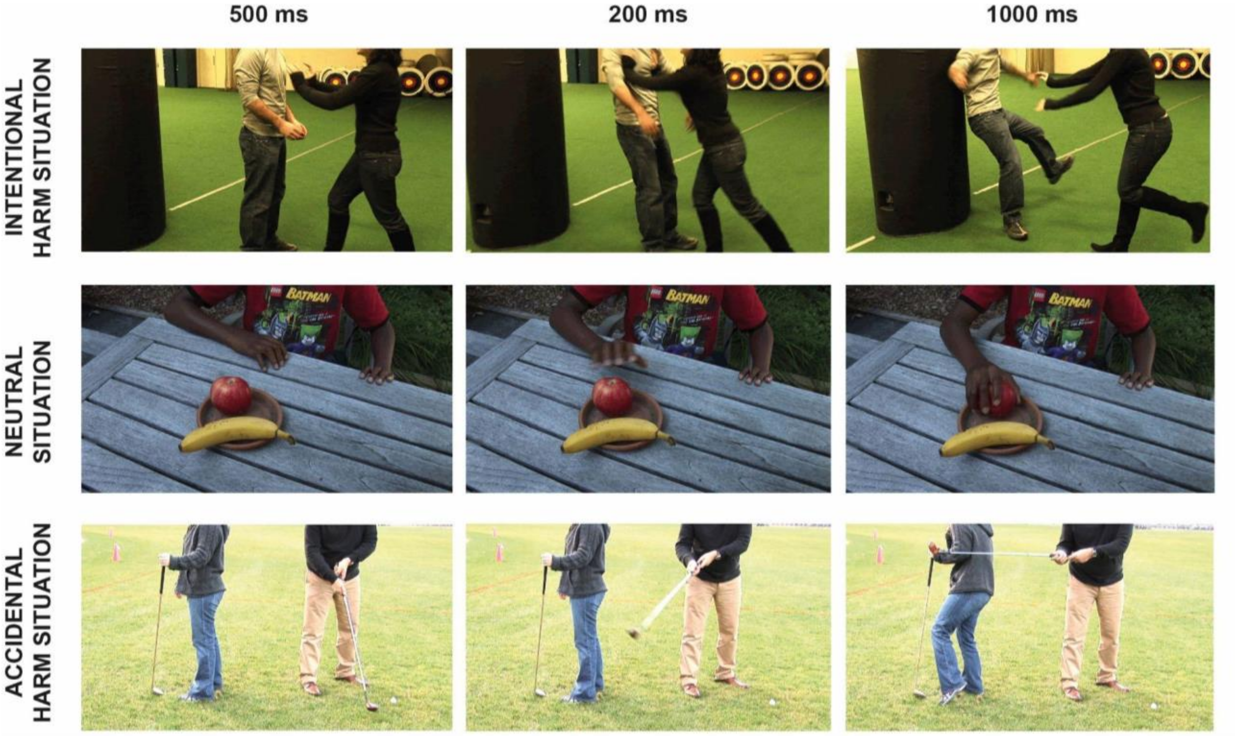


Figure 6 Empathy for pain task (EPT). Modified version of the task developed by Baez et al. (2017). Examples of the three situations of the EPT -intentional harm, neutral, and accidental harm- are shown in the rows. Column headers show the durations of the presentations of the pictures.

Data analysis

Experimental data were statistically analyzed using the SPSS 26.0 statistics software package. As for the analysis of self-reports, due to participant dropout, we conducted separate comparisons between pre- and post-training, and between pre-, post-training and follow-up. Non-parametric tests were employed because of small sample size.

To ensure the comparability of the groups, participant ages in the MSC and KY groups were compared with a Mann-Whitney U test prior to analysis.

Comparisons between MSC and KY at pre-training, post-training, and follow-up were conducted using the Mann-Whitney U test. Intra-group analysis for short-term effects (pre-post) was performed using the Wilcoxon signed-rank test, while Friedman ANOVA and Wilcoxon signed-rank test post hoc were used for middle-term comparisons (pre-, post-, and follow-up).

The comprehension of intentionality was measured by response accuracy. Correctly identifying all four intentional situations as intentional and all four non-intentional situations as accidental corresponded to 100% accuracy, whereas misidentifying all intentional as accidental and all non-intentional as intentional resulted in 0% accuracy. The significance level (alpha) was set at 0.05.

Effect sizes (ES) were calculated using the formula $r = Z/\sqrt{N}$ (Tomczak & Tomczak, 2014). Values of 0.1, 0.3 and 0.5 correspond to small, medium and large effects sizes, respectively (Coolican, 2017, p. 484).

Results

Participants of the MSC and KY groups did not differ in age (Table 13).

Table 13 *Age Comparisons Between Mindful Self-Compassion and Kundalini Yoga Participants who completed the Empathy for Pain Task at Post-training and Follow-up*

Time	MSC				KY					
	n	Q-25	Median	Q-75	n	Q-25	Median	Q-75	*p**	*ES*
Post-training	13	29.50	38.00	45.00	15	37.00	39.00	47.00	0.230	0.226
Follow-up	10	29.75	39.00	44.50	12	37.00	41.50	47.75	0.322	0.211

Note. ES = standard deviation; *KY* = Kundalini Yoga; *MSC* = Mindful Self-Compassion; *n* = number of participants; *p* = p-value; *Q-25* = quartile 25; *Q-75* = quartile 75.
ES were calculated using $r = Z/\sqrt{N}$
*Based on the Mann-Whitney test

Comparison of MSC and KY on the Empathy for Pain Task

No differences between MSC and KY groups were found on the EPT either at pre-training, post-training, or follow-up (Tables 14-16).

Table 14 *Summary of Results of the Empathy for Pain Task Comparing Mindful Self-Compassion (n = 13) vs Kundalini Yoga (n = 15) at Pre-training*

	MSC			KY				
	Q-25 post	Median post	Q-75 post	Q-25 post	Median post	Q-75 post	*p**	*ES*
Empathic Concern for Intentional Harm	-1.13	3.50	6.38	2.30	4.80	7. 25	0.345	0.20
Empathic Concern for Accidental Harm	-4.40	-3.25	2.35	-5. 75	0. 80	2. 90	0.628	0.10
Personal Distress for Intentional Harm	-0.25	3.30	5.38	2.50	4.80	7.80	0.117	0.33
Personal Distress for Accidental Harm	-5.03	-1.80	-0.15	-7.25	-3.30	0.30	0.764	0.06
Accuracy for Intentional Harm	75	100	100	100	100	100	0.127	0.29
Accuracy for Accidental Harm	50	75	100	75	100	100	0.234	0.22

Note. MSC = Mindful Self-Compassion*; KY* = Kundalini Yoga; *Q-25* = quartile 25; *Q-75* = quartile 75.
Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
*Based on the Mann-Whitney test

Table 15 *Summary of Results of the Empathy for Pain Task Comparing Mindful Self-Compassion (n = 13) vs Kundalini Yoga (n = 15) at Post-training*

	MSC			KY				
	Q-25 post	Median post	Q-75 post	Q-25 post	Median post	Q-75 post	*p**	*ES*
Empathic Concern for Intentional Harm	0.28	3.80	6.75	2.00	4.00	6.00	0.836	0.04
Empathic Concern for Accidental Harm	-6.75	-3.50	1.15	-5.80	-1.80	3.30	0.712	0.08
Personal Distress for Intentional Harm	0.90	4.00	5.90	-0.20	4.00	6.00	0.890	0.03
Personal Distress for Accidental Harm	-7.63	-6.00	-0.13	-7.80	-2.50	-0.25	0.596	0.11
Accuracy for Intentional Harm	100	100	100	75	100	100	0.051	0.37
Accuracy for Accidental Harm	75	100	100	75	75	100	0.125	0.29

Note. MSC = Mindful Self-Compassion; *KY* = Kundalini Yoga; *Q-25* = quartile 25; *Q-75* = quartile 75.
Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
*Based on the Mann-Whitney test

Table 16 *Summary of Results of the Empathy for Pain Task Comparing Mindful Self-Compassion (n = 10) vs Kundalini Yoga (n = 12) at Follow-up*

	MSC			KY				
	Q-25 follow-up	Median follow-up	Q-75 follow-up	Q-25 follow-up	Median follow-up	Q-75 follow-up	*p**	*ES*
Empathic Concern for Intentional Harm	- 0.88	2.38	6.06	0.06	2.63	4.812	0.692	0.08
Empathic Concern for Accidental Harm	-4.31	0.63	2.89	-3.38	-1.88	0.187	0.338	0.20
Personal Distress for Intentional Harm	-0.71	3.25	6.31	1.31	3.38	6.187	0.921	0.02
Personal Distress for Accidental Harm	-4.01	-1.63	0.73	-5.56	-2.38	-0.750	0.306	0.26
Accuracy for Intentional Harm	100	100	100	100	100	100	0.619	0.11
Accuracy for Accidental Harm	75	75	100	75	75	100	0.912	0.02

Note. MSC = Mindful Self-Compassion; *KY* = Kundalini Yoga; *Q-25* = quartile 25; *Q-75* = quartile 75.
Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$.
*Based on the Mann-Whitney test.

Within Groups Empathy for Pain Task Results

In the MSC group, the accuracy of intentionality comprehension for intentional harm improved at post-training (p = 0.034, ES = 0.59), while empathic concern or personal distress showed no change from pre- to post-training (Table 17, Appendix 2). Analysis of the task three months later yielded no significant differences either in affective or cognitive empathy in the MSC group (Tables 18-20, Appendix 2).

For the KY group, personal distress for intentional harm decreased post-training ($p = 0.038$, ES = 0.54), while no significant differences were found in the intentionality comprehension accuracy between pre- and post-training (Table 21, Appendix 2). The comparison between pre-training, post-training and follow-up showed the personal distress for intentional harm decreased both at post-training ($p = 0.004$, ES = 0.72) and follow-up ($p = 0.021$, ES = 0.67) compared to pre-training. No significant differences were found in the middle-term concerning accuracy of intentionality comprehension (Tables 22-24, Appendix 2).

Discussion

This thesis pays particular attention to empathy, recognizing that providing emotional support to students is a fundamental part of a teacher's role (Jennings & Greenberg, 2009), which became especially relevant during pandemic times. However, without the necessary skills to cope with the challenges that may arise, concern for the student's difficult experiences could lead to personal distress, emotional exhaustion and, ultimately, to burnout. As explained by Jennings & Min (2023), while empathy is crucial for teachers to recognize and understand students' emotions, over-empathizing can lead to high levels of stress and compassion fatigue, which can be harmful to both teachers and students. Socio-emotionally competent teachers possess compassionate skills that allow them to respond to students' needs while protecting themselves from the distress that can result from empathic responses, thus feeling motivated to help without becoming overwhelmed.

Empathic abilities were evaluated in the context of intentional or accidental harm (Baez et al., 2014, 2016, 2017), including cognitive empathy (the intentionality comprehension of the inflicted harm, measured through response accuracy), and affective empathy (empathic concern and personal distress). As occurred with the variables in Study I, prior to the training period, the comparison between MSC and KY groups yielded no significant differences in any of the EPT variables. Furthermore, contrary to expectations, no differences were observed between groups post-training or at follow-up.

Concerning within-group analysis, in the MSC group the cognitive empathy improved from pre- to post-training when assessed by the EPT, since the accuracy in the intentionality comprehension increased post-training, reflecting the capacity to take the other's perspective by understanding others intentions, motivations and emotional state (Decety & Jackson, 2004). This could be reflecting the ability to recognize other's suffering while protecting themselves from empathic distress, as argued by Jennings & Min (2023) concerning socio-emotional competent teachers who cultivated compassion for self and others. This finding in the EPT is consistent with results obtained from self-report at post-training, which showed an increase in perspective-taking accompanied by a decrease in personal distress. Interestingly, this increase in the intentionality comprehension was observed only for intentional harm, as commonly found in previous studies (Baez et al., 2014, 2016, 2017; Decety et al., 2012). Baez et al. (2014) argue that accidental harm is not as conspicuous as intentional, thus leading to greater ambiguity and hindering the process of attributing intentionality. Furthermore, moral transgressions are interpreted as more serious when they are intentional than accidental, while higher arousal has been reported when harm is intentional (Decety et al., 2012). This improvement in cognitive empathy was no longer observed at follow-up.

In the MSC group, affective empathy showed no change in the short- and middle-term as measured by the EPT. It is clear that, in this group, the self-report measure produced more conspicuous results than the EPT, as perceived empathy improved both between groups and within the group, and both in the short and long term. In this regard, self-reports could be reflecting responses influenced by social desirability, since it would be difficult to disagree on altruistic purposes when being asked, especially when altruistic reasons prevail among teachers' motivations (Baez et al, 2017; Erten, 2015). Aldrup et al. (2022) posit that teachers' implicit caring role may lead to the assumption of possessing higher empathy levels than real. An EPT paradigm approaches empathy less explicitly than self-evaluation and may elicit more automatic responses, eluding the influence of social desirability (Baez et al., 2017).

Meanwhile, in the KY group, personal distress for intentional harm decreased both at short and middle-term. This is a surprising finding since there were no changes observed in self-reported empathy across any subscale of the test. Within-group changes both in MSC and KY exhibited high effect sizes.

The question of whether the MSC group was able to increase their empathy as measured by the EPT is not easy to answer. The cognitive dimension that was improved in this group shows an increased ability to understand and take the perspective of the other, which represents a positive aspect of empathy as it serves the empathic process. If this is accompanied by empathic concern - a dimension of empathy that tends to help, with altruistic motivation - but without personal distress - being negatively affected by the other's suffering - positive empathy is achieved, driven by compassion (Vieten et al., 2024). In our results, understanding of suffering improves, but it is not accompanied by empathic concern, which would be expected since the cultivation of compassion is a driver of increased other-centered empathy with motivation to help (Vieten et al., 2024). However, it is also not accompanied by an increase in personal distress, which is a positive finding since personal distress is a self-centered empathic response that involves feeling the urge to avoid or escape from the stressful situation, driven by egoistic motivations (Fabi et al., 2019). In conclusion, it could be said that the regulatory mechanisms that allow distinguishing one's own feelings from those of others (Ickes, 2009), which are trained during the cultivation of self-compassion, operated properly. However, the affective improvement expected from the cultivation of self-compassion was not evident when assessed by the EPT.

Considering that differences in self-reported affective empathy emerged in both within-group and between-group comparisons in Study I, it is relevant to discuss the possible influence of the type of instrument used. While the IRI may allow participants to select responses they consider desirable, the EPT, as a performance-based task, may lack the sensitivity needed to detect subtle changes in empathy. In this regard, a larger sample size could help reduce variability and make subtle effects more detectable. Furthermore, while this task has proven effective in eliciting empathic responses (Baez et al., 2014, 2016, 2017; Bernhardt & Singer, 2012; Decety et al., 2012), two limitations might negatively affect its efficacy: first, the use of images designed specifically for laboratory settings rather than naturalistic stimuli; and second, the restriction to visual-only stimuli, which may reduce its ecological validity. Both aspects could limit the task's ability to elicit an emotional experience of empathy that the participant can perceive, potentially impacting results. Consequently, the EPT may be more effective for evaluating cognitive empathy, as it assesses the ability to put oneself in another's position, but may be less suitable for assessing affective empathy. Interestingly, the studies cited above show detectable impacts in neuroimaging, though these changes may not always translate into perceptible differences for the individual.

CHAPTER II

Effect of Virtual Mindful Self-Compassion Training on the Physiological Stress Response: Analysis of Autonomic Nervous System Control on the Heart During Experimentally Induced Social Stress in Teachers and Its Relation to Self-Compassion and Emotion Regulation

Different meditative approaches produce changes in the way the mind and body respond to stressful events, further affecting peripheral biology (Brandmeyer et al., 2019). Mindfulness-based interventions that encompass self-compassion as a core component are efficacious in enhancing stress management at both the psychological and physiological levels (Biber, 2022; Mysuria et al., 2020). Acting as a protective factor against the development of negative self-feeling, self-compassion moderates emotions in challenging social contexts, reducing individuals' reactions to adverse circumstances (Leary et al., 2007) and enhancing emotion regulation (Dietrich et al., 2014; Diedrich et al., 2016). Studies investigating the role of dispositional (trait) self-compassion on the physiological stress response to social-evaluative stressors conclude on the association between increased self-compassion and decreased stress levels, as measured by cortisol levels (Bluth et al., 2016; Maeda, 2022), systolic blood pressure (Bluth et al., 2016), inflammation (Breines et al., 2014, 2015) and HRV (Luo et al., 2018; Svendsen et al, 2016).

Self-compassion effects on the autonomic nervous system can be measured. Investigations involving self-compassion training show increases in HRV when self-compassion increases (Petrocchi et al., 2016; Rockliff et al., 2008; Matos et al., 2017). Within the interplay between the parasympathetic and sympathetic nervous systems, reflected in HRV, the myelinated vagal branch plays a fundamental role in eliciting calming responses (Porges, 2009). This parasympathetic response fosters feelings of safety, with higher HRV indicating enhanced self-soothing abilities (Porges, 2009; Kirby et al., 2017a). Practices that promote self-compassion, such as mindful breathing and positive self-talk, elicit feelings of safety, calmness, and affection, thereby facilitating emotional regulation and boosting the vagal regulatory activity and increasing HRV (Shaw & Kelly, 2024). The HRV thus emerges as a physiological marker of the mind-body interconnectedness (Shaffer et al., 2014), compassion (Kirby et al., 2017a; Petrocchi et al., 2016), and adaptive emotion regulation (Thayer et al., 2012). According to Goldberg & Davidson (2024), it is advantageous to utilize objective metrics in the assessment of processes believed to be affected by self-compassion, including emotion regulation.

It is noteworthy that a bidirectional relationship is demonstrated, whereby compassion training can enhance HRV, and conversely, intentionally enhanced HRV by biofeedback can increase levels of compassion (Kirby et al., 2017a). In biofeedback HRV, breathing occurs at a frequency that maximizes HRV and stimulates respiratory sinus arrhythmia and the baroreflex, thus contributing to the regulation of psychophysiological states and well-being (Bornemann et al., 2019; Lalanza et al., 2023). Interestingly, utilizing biofeedback to raise HRV promotes the sense of self-care and security associated with self-compassion, leading to a reduction in stress. Therefore, HRV functions as one of the mechanisms that supports self-compassion's ability to regulate challenging emotions (Bornemann et al., 2019; Ehrenreich, 2020; Ernst, 2017).

The rhythm of a healthy heart is not stationary but rather oscillates constantly over time as an adaptive response to environmental, biological, and psychological demands (McCraty & Shaffer, 2015). This reflects the interplay between the sympathetic and parasympathetic divisions of the ANS (Shaffer & Ginsberg, 2014), along with the modulatory function of intracardiac and extracardiac networks composing the cardiac nervous system, which establishes connections with the brain. Thus, HRV represents a measure of autonomic and neurocardiac function, reflecting the intricate interplay between the heart and brain (Shaffer et al., 2014).

In this chapter, a semi-virtual adaptation of the Trier Social Stress Test (TSST) was used to measure the physiological response to acute social stress in teachers trained in MSC, compared to those trained in KY. For this purpose, the HRV was assessed using time-domain, frequency-domain, and nonlinear methods. To ascertain participants' subjective state in response to the TSST, self-report questionnaires of anxiety, as well as positive and negative affect, were administered pre- and post-test. Furthermore, the relation between HRV and self-compassion and emotional regulation was studied.

Hypothesis 2: Teachers from Uruguay who complete a 9-week virtual MSC training exhibit lower physiological stress and increased vagally-mediated HRV during a social stress test, accompanied by lower levels of perceived state anxiety and negative affect, compared to those trained in KY. This improved autonomic adaptability to stressors is anticipated to be mediated by enhanced self-compassion and emotional regulation.

Hypothesis 2a: Teachers virtually-trained in MSC undergoing a social stress test exhibit lower levels of physiological stress and higher cardiac vagal tone, as measured by HR, time- and frequency-domain indices, and nonlinear measures of HRV, compared to teachers virtually trained in KY.

Hypothesis 2b: Teachers virtually-trained in MSC exhibit lower levels of perceived state anxiety and negative affect associated with a social stress test, compared to teachers virtually-trained in KY.

Hypothesis 2c: The physiological outcomes in the MSC group significantly different from those in the KY group would be explained by improved psychological outcomes resulting from the MSC training.

General objective

To evaluate the impact of self-compassion skills cultivated through MSC training on physiological stress, anxiety and affect in primary school teachers from Uruguay who undergo a social stress test, compared to an active control condition (KY training).

Specific objectives

1. To compare the physiological stress response to the TSST between the MSC and the control group

2. To compare pre- and post-test levels of perceived anxiety, positive affect, and negative affect between and within groups

3. To evaluate the impact of significantly different psychological outcomes resulting from MSC training on the significantly different physiological outcomes observed during the TSST when comparing the MSC and KY groups.

Methods

Participants

Participants who completed the MSC and KY trainings and the post-training online psychometric tests were invited to complete the in-person TSST while being ECG-recorded (n = 37). Due to a dropout of 10 participants, the impossibility to acquire the ECG recording in 1 participant and the exclusion of 4 due to poor ECG data quality verified offline. The sample for the TSST consisted of 21 participants (MSC, n = 11, mean age = 36.37 ± 8.46; KY = 10, mean age = 42 ± 9.42). These participants also completed the pre-test and post-test self-reported questionnaires on anxiety and affect.

Materials and Procedure

Trier Social Stress Test Description

In order to induce psychosocial stress, the Trier Social Stress Test (TSST; Kirschbaum et al., 1993) was employed as it is a gold standard stress evaluative tool for psychobiological research (Goodman et al., 2017; Kudielka et al., 2007; Seddon et al., 2020). The TSST is a standardized test conducted in a laboratory setting with the objective of eliciting moderate psychological stress and assessing its effects on physiological responses. This test represents a social-evaluative threat, as the participant has to make a performance that is observed by others who can make a negative evaluation. It reliably induces psychological, cardiac, and neuroendocrine stress responses (Dickerson & Kemeny, 2004).

The protocol used in this study incorporates the guidelines suggested by Narvaez Linares et al., (2020) in their systematic review of TSST methodology. Accordingly, it adheres to the proposed timeline for collecting physiological measures and administering background questionnaires. The protocol consists of five stages, through which the participant is guided by a researcher who provides instructions but does not remain with the participant. These stages are described as follows.

1. Resting (30 minutes). The participant remains seated quietly and alone in a room to record baseline state.

2. Preparation (5 minutes). The researcher guides the participant to the test room and instructs them to prepare a brief speech intended for presentation in front of a virtual evaluation panel of evaluators, to convince them of being the best applicant for an ideal vacant job position. The researcher also provides paper and pen for the participant to outline the speech, although annotations will not be permitted during the presentation.

The guiding researcher explains to the participant that the evaluation panel consists of judges specially trained to assess non-verbal behavior, and that the entire session will be video recorded for subsequent performance and voice frequency analysis of nonverbal behavior. The panel consists of two members from the research team, unknown to the participants, who connect via videoconference displayed on a TV monitor in front of the participants. They are instructed offstage to maintain neutral facial expressions and adhere strictly to a predefined script, minimizing any additional communication.

3. Speech (5 minutes): The researcher guides the participant to the monitor displaying the virtual meeting with the evaluative panel and then leaves the room. The panel welcomes and

prompts them to deliver the speech. The panel maintains strict timekeeping, signaling remaining time if the participant concludes in less than 5 minutes, and observes a silent period of up to 20 seconds if the participant finishes early, followed by asking prepared questions.

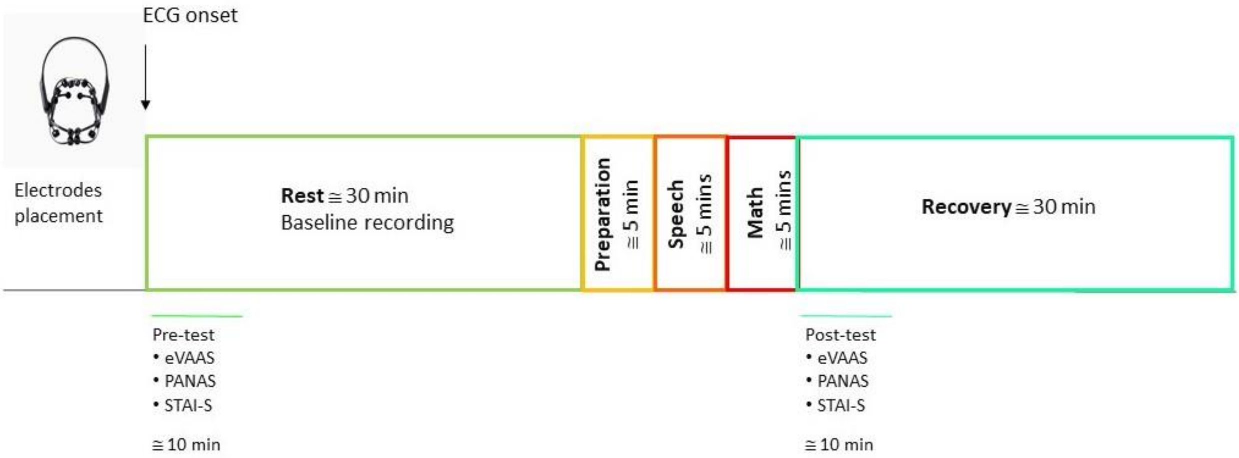
4. Mental arithmetic task (5 minutes): The participant is instructed by the panel to perform a mental arithmetic task (from now on, Math), counting backwards from 2023 by subtracting 17 each time, as quickly and accurately as possible. In the event of an error, the process is to be restarted upon the panel's voice saying: “Mistake. 2023”.5. Recovery (30 minutes): the participant is escorted back to the initial room to sit and recover.

5. Recovery (30 minutes). The participant is directed back to the initial room to take a sit and rest.

After the recovery stage, the participant receives a debriefing on the purpose of the test, with clarification provided that no recordings were made and none of the previously mentioned analyses have been or will be performed.

Due to the sanitary restrictions imposed by the pandemic, an adapted version of the original protocol was implemented, following the TSST-online methodology outlined by Gunnar et al. (2021). While our protocol was not conducted entirely online due to the need for electrocardiographic recordings, modifications were made to accommodate a semi-virtual format, with the participant and researcher meeting in person. These adaptations included replacing the in-person evaluative panel with a couple of evaluators connected online via a Zoom video conference (ZOOM™) and projected onto a television screen. Additionally, the use of a video recorder was substituted with an online simulated recording session.

Figure 7 *Timeline illustrating the TSST stages progression with ECG recording and self-report evaluation*



Note. ECG = electrocardiogram; eVAAS = electronic Visual Analogue Scale of Anxiety; *PANAS* = Positive and Negative Affect Schedule; *STAI-S* = State scale of the State-Trait Anxiety Inventory.

Procedure Protocol Description

Physiological and self-perceived responses to the TSST were assessed according to a structured protocol that took place after the EPT test at the Catholic University venue. Importantly, participants were not allowed to access their mobile phones at any stage of the TSST. Upon arrival, researchers confirmed that participants had not used stimulants or tranquilizers, medicines, smoking, alcohol, and recreational drugs (with the exception of necessary medication for an acute episode or as part of a prescribed treatment) within the previous 24 hours as instructed. Additionally, they reported the stage of their menstrual cycle, as well as their emotional and fatigue state at the time of the study. After completion of the EPT, the participants had 10-15 min. free time to relax.

Before TSST, a researcher guided the participant to a room (Experimental room) and fitted them with a wireless recording device (EMOTIV EPOC X 14 Channel Mobile Brainwear EEG headset) adapted with a cable extended from the AF4 lead to a suction electrode. Then the researcher placed the suction electrode at the precordium over the upper third of the participants' sternum. This equipment was also used for recording ECG and EEG signals during an EPT not included in this thesis.

Then, the researcher guided the participant to another room (Rest and Recovery room), and invited them to remain sitting on a comfortable sofa for 30 minutes. Within the first minutes the participant filled pre-test self-reports on anxiety and affect already uploaded on a computer screen. After confirming the proper functioning of the recording system and continuous signal acquisition, the researcher inserted a mark in the software to indicate the beginning of the Rest stage, an action that was repeated throughout the TSST session to denote the start and end of consecutive stages. Once the Rest stage was accomplished, the researcher guided the participant to the Experimental room and introduced them to the panel who was already visible on a screen. The researcher informed the participant about the aim of the Preparation stage. For the Speech and Maths stages, the participant stood behind a line marked on the floor, which ensured an optimal distance for the panel to have a complete view of the participant' body movements, which were supposed to be recorded. The guiding researcher remained outside, out of sight but attentive, ready to enter and escort the participants out once they had completed these two stress-eliciting stages. Then, the researcher guided the participant back to the Rest and Recovery room, and invited them to remain seated and complete the post-test self-reports on anxiety and affect within the first few minutes of the Resting stage. After half an hour, the guiding researcher entered the room to indicate the test was over and to proceed with the debriefing.

Due to the pandemic, all stages but Speech and Maths were performed while wearing face masks. The researchers were required to utilize N95 masks in accordance with the guidelines provided by the Uruguayan Ministry of Health for this research.

Data Acquisition

The recording device was connected via Bluetooth to a laptop containing the Emotiv Pro software to allow signal acquisition at 256 samples per second, and data transmission in real time. Data was continuously saved continuously along the TSST stages for offline analysis. Throughout the recording period, participants were required to stay near the laptop to ensure that the Bluetooth connection was maintained. To ensure this and check for uninterrupted display of the QRS complex and continuous recording, the participants were always escorted by a guiding researcher holding the laptop when transitioning between the two rooms used for the test. However, during the TSST stages, they stayed alone.

Measures

Physiological Measures

The HRV can be measured with different metrics, being the usual ones time-domain, frequency-domain and nonlinear methods (Task Force, 1996).

Time-domain methods. According to Cohen (1989) these metrics measure instantaneous HR as well as HRV by detecting the R wave of the QRS complex and ascertaining normal-to-normal sinus beats intervals (NN), i.e. RRs intervals resulting from actual sinus node depolarization and not ectopic or artifacts. These methods can be simple, like mean HR and mean NN interval, or more complex, as resulting from statistical analysis. Among the latter, there are deviation-based indices, like the standard deviation of the NN intervals (SDNN), and difference-based indices, like the root mean square of successive differences of the NN intervals (RMSSD) (Pham et al., 2021). In particular, the RMSSD is a measure of choice when analyzing vmHRV, as it encompasses successive interval differences and therefore reflects the parasympathetic tone (Shaffer et al., 2014).

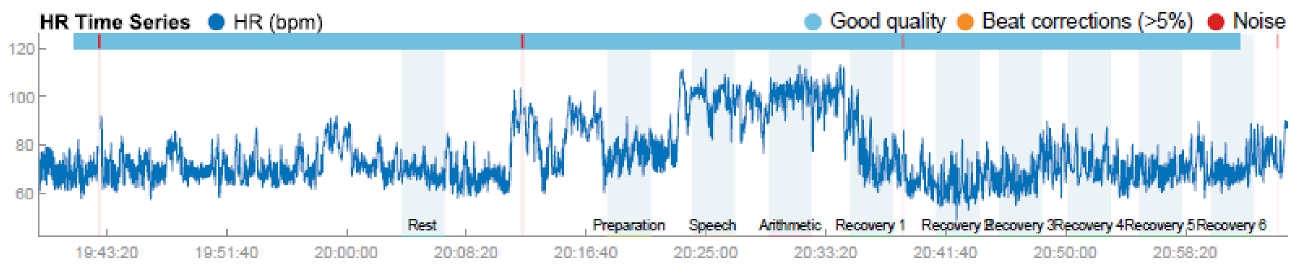
Frequency-domain methods. According to Akselrod et al. (1981) frequency-domain methods are spectral analyses of a tachogram, which is a plot depicting the duration of IBIs as a function of consecutive heartbeats or the number of intervals. This plot describes waves that reveal different rhythms within the HRV. By means of a spectral analysis, such as the fast Fourier transform, the power of the bands and corresponding peak frequency values are calculated. In short-term recordings (≤5 minutes), three types of spectral components are distinguished: very low frequency (VLF; 0.0033–0.04 Hz), low frequency (LF; 0.04–0.15 Hz), and high-frequency (HF; 0.15–0.40 Hz). Among these, LF and HF, whose power and peak frequency vary with the ANS modulation on the heart, are related to HRV. Parasympathetic effect on the heart is faster (less than a second) than sympathetic effect (over 5 seconds) (Nunan et al., 2010), due to differences in their mechanisms of action. While both branches of the ANS influence sinoatrial node cell via G-protein-coupled receptors and adenylyl cyclase-cAMP-Protein kinase A (AC-cAMP-PKA) signaling, the parasympathetic nervous system (PNS) also operates via another mechanism involving K^+ ionotropic receptors, allowing for a quicker response and giving rise to the HF wave components (Behar et al., 2016). Given its shorter response latency, the PNS exerts a dominant influence in the case of rapid modifications of HRV, such as those induced by respiration (Migliaro et al, 2004). High frequency waves are synchronized with the cyclic breathing changes; HR increases with inspiration and decreases with expiration, a phenomenon known as respiratory sinus arrhythmia (Behar et al., 2016; Fisher et al., 2022; Pham et al., 2021). While the HF measure is widely accepted to reflect parasympathetic modulation, LF is proposed to reflect both sympathetic and parasympathetic activations, as well as the baroreceptor influence (Brennan et al., 2002; Goldstein et al., 2011; Kleiger, 2005). LF and HF are usually measured in absolute values, i.e., milliseconds squared, or relative values, i.e., normalized units (the power component relative to the total spectral power minus the VLF). By normalization, the variability in raw HRV spectral power within and across subjects is reduced, and results are more comparable between studies since the problem of variation that may arise from using different spectral analysis algorithms is mitigated (Burr, 2007; Pham et al., 2021; Task Force, 1996). However, it should be noted that LFnu and HFnu are algebraically redundant, as they are expressed on a 0-1 proportion and are predictable from each other (LFnu = 1 – HFnu, and viceversa). Hence, interpretations regarding sympathetic or parasympathetic dominance based on these measures may not reflect actual physiological events, as any change in one measure automatically impacts the other (Burr, 2007). This interpretation fails to consider that SNS and PNS may change reciprocally or in parallel, and their relationship is nonlinear (Billman et al., 2013; Goodman et al., 2017; Seddon et al., 2020). Taking this into account, LF and HF absolute values should accompany normalized unit reports to fully describe the power distribution across spectral components and clarify the physiological events reflected in the results (Burr, 2007; Task Force, 1996). Concerning the LF/HF ratio, while some authors pose it as a measure of sympatho-vagal balance (Pham et al., 2021), others argue such assumption oversimplifies the cardiac autonomic function (Kleiger et al., 2005). Hence, some authors advocate against drawing definitive conclusions from this parameter (Billman et al., 2013), argumenting that, while a decreased ratio may indicate a predominant vagal influence -either by HF increase or LF decrease-, an increased ratio could be influenced by a number of factors. Importantly, challenges to physiology—such as those imposed by a social stress test—may affect ANS divisions, either leading to reciprocal or parallel changes (Billman et al., 2013; Goodman et al., 2017; Seddon et al., 2020). Furthermore, considering the LF/HF ratio is also algebraically redundant with respect to LFnu and HFnu, and these are predictable from the LF/HF ratio, only 1 parameter results from these interdependent variables that does not reflect the actual differential modulation of the SNS and PNS (Burr, 2007). Regarding the LF/HF ratio, some authors view it as a measure of sympatho-vagal balance (Pham et al., 2021) while others argue that this assumption oversimplifies the cardiac autonomic function (Kleiger et al., 2005). A decreased ratio may suggest predominant vagal influence—either through an increase in HF or a decrease in LF— but an increased ratio could be influenced by various factors, as mentioned before. Importantly, physiological challenges, such as those from a social stress test, may affect ANS divisions, leading to either reciprocal or parallel changes (Billman et al., 2013; Goodman et al., 2017; Seddon et al., 2020). Hence, caution is advised against drawing definitive conclusions from the LF/HF ratio (Billman et al., 2013). Additionally, since this ratio is algebraically redundant with LFnu and HFnu, and these are predictable from the ratio, it is argued that the 3 variables represent only one parameter that reflects the overall HRV (Burr, 2007).

Nonlinear methods. These methods take into account that HR oscillations are not regular and periodic but rather complex and unpredictable, and vary depending on the circumstances from moment to moment. Such variations result from the interacting actions of autonomic and central nervous system regulation, as well as electrophysiological, hemodynamic, and humoral determinants (Huikuri et al., 2003; Goldberger & West, 1987; Signorini et al., 1994; Task Force, 1996). Among the most commonly used nonlinear methods is the Poincaré plot, where each NN interval is plotted against the preceding interval, describing an ellipse shape (Brennan et al., 2001). When NN intervals are longer than preceding ones, indicating HR deceleration, points lie above the identity line; when those intervals are shorter than preceding ones, indicating HR acceleration, points lie below the identity line (Tayer & AlSaba, 2015). The level of variability of the Poincaré plot corresponds to the dispersion of points related to the identity line. The standard deviation of the points perpendicular to the identity line (SD1; width of the ellipse) represents the short-term variability. This measure is equivalent to the time-domain measure RMSSD, reflecting the vagal influence on the heart (Ciccone et al., 2017). The standard deviation of points along the identity line (SD2; length of the ellipse) describes long-term variability. This measure is equivalent to time-domain measure SDNN (Brennan et al., 2002). While some authors report SD2 reflects a predominance of sympathetic modulation (Pham et al., 2021), others argue it mostly reflects the total ANS influence on HRV, or even a predominance of parasympathetic action (Rahman et al., 2018). Following this, the SD2/SD1 ratio, as for the LF/HF ratio, should not be interpreted as an indicator of sympathetic or parasympathetic dominance, but viewed instead as a measure of total HRV (Kleiger et al., 2005). In this study, considering the short duration of the TSST stages, particularly Preparation, Speech and Math, and the need to select shorter windows to allow for stabilization of the signal, we decided to focus on the most reliable physiological measures for ultra-short-term recordings (UST; less than 3 minutes duration). To make this decision, a thorough research of the existing literature on UST was conducted in advance to HRV analysis (Baek et al., 2015; Burma et al., 2021; Castaldo et al., 2019; Lee et al., 2022; Liu et al., 2023; McNames & Aboy, 2006; Munoz et al., 2015; Pereira et al., 2017; Shaffer et al., 2020; Wu et al., 2020). According to this, the MeanNN, SDNN, RMSSD and Mean HR (time-domain), HF and LF in ms^2 and normalized units (nu), and LF/HF (frequency-domain), and SD1, SD2 and SD2/SD1 (nonlinear) parameters were used for analysis of the HRV.

Once acquired, the ECG data were imported into the Kubios HRV Premium Scientific (4.0.3) software (Tarvainen et al., 2021) for capturing the R waves of the QRS complex and further offline analysis of the HRV. Based on the Pan–Tompkins algorithm (Pan & Tompkins, 1985) the R-wave time instants were detected, and a pre-processing, i.e., beat correction and noise handling, was carried out by the software.

For ECG analysis, 9 time-windows were manually selected as follows: 4 for Rest, Preparation, Speech and, Math analysis, and 5 for the Recovery stage progression analysis. Within those periods, segments exhibiting a stable signal and devoid of any markings indicative of noise or artifacts were visually checked and manually selected, which forced us to reduce the time windows to 3 minutes in order to prevent affecting the accuracy of the HRV analysis (Figure 8). Originally, to select the Recovery time-windows, the total Recovery period was divided into six segments, and six windows were chosen from these segments. However, due to the amount of noise only 5 time-windows were analyzed (from now on referred to as: Recovery1 to Recovery5). Figure 8 illustrates a HR time series example from one participant, highlighting the ultra-short-term windows selected for analysis.

Figure 8 *Heart Rate Time Series Example Highlighting Ultra-Short-Term Windows for Analysis*



Note. Heart Rate time series example from one participant across the entire Trier Social Stress Test, highlighting the ultra-short-term windows selected for analysis. Graph of participant #7, created by Kubios HRV Premium Scientific (4.0.3)

Anxiety and Affect Measures

Subjective feelings accompanying the physiological outcomes of the TSST were measured following the guidelines outlined by Narvaez Linares et al. (2020) in their systematic review of the TSST methodology. As suggested by the authors, two different anxiety questionnaires to assess and ensure the subjective state of participants' anxiety experiences were administered before and after the stress-eliciting stages (Preparation, Speech and Math) to capture changes. Accordingly, the three questionnaires recommended by Narvaez Linares et al. (2020) were presented consecutively as follows.

The electronic Visual Analogue Scale of Anxiety (eVAAS; van Duinen et al., 2008). This is a computerized adaptation of a valid method for the measurement of subjective anxiety levels

(DeLoach et al., 1998; Gift, 1989; Hornblow & Kidson, 1976), which demonstrates high performance in laboratory environments for measuring state anxiety. Participants provide responses by sliding an analog 10-cm line and selecting a point to indicate their current level of anxiety. The extreme left represents no anxiety at all, while the extreme right represents the highest level of anxiety possible. A mark in the center of this line indicates moderate anxiety. There is no Spanish version available due to its simple implementation. Thus, the instructions were translated into Spanish. A report on the correlation between electronic (e) and original paper (p) VAAS values showed the eVAAS correlated well with the pVAAS across groups and circumstances (r = 0.98, Spearman's rho; p <0.001) (van Duinen et al., 2008), and increased sensitivity to changes in state anxiety was demonstrated from pre- to during-stress ($F(1,48) = 25.13$, $p < .001$) (Abend et al., 2014).

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). This is a reliable and widely used scale that measures mood or emotion through the two factors of emotional experience: positive affect, which represents the dimension of pleasant emotionality, and negative affect, which represents the dimension of unpleasant emotionality, such as general distress. This scale consists of 20 items, divided into a 10-item positive affect scale and a 10-item negative affect scale. Participants rate each item on a 5-point Likert scale (1 = very slightly or not at all; 5 = extremely), indicating the degree to which they have experienced each affect within a specified time interval and/or in response to emotional events. The Spanish version used here, validated in a Uruguayan sample (Saiz et al., 2013), proved to be reliable. The internal consistency (Cronbach's alpha) for negative affect was 0.77 for the trait-general mode and 0.76 for the state-last week mode. For the positive affect, the values were 0.79 for the trait-general mode and 0.86 for the state-last week mode.

The State-Trait Anxiety Inventory (Spielberger et al., 1983). This is a widely used instrument designed to obtain reliable self-reported measures of both trait and state anxiety. In line with our goals, participants responded based on their current feelings, measuring their state anxiety (STAI-S). This is characterized by subjective, consciously perceived feelings of tension and anxiety at the moment, experienced with a specific intensity, and accompanied by ANS hyperactivity (Buela-Casal et al., 2011). The STAI-S scale consists of 20 items rated on a 4-point Likert-type scale (0 = Not at all; 3 = Very much so). The Spanish version used here (Buela-Casal et al., 2011), validated in a Spanish sample, showed Cronbach's alpha reliability of 0.89 for trait anxiety.

Analytic Strategy

As mentioned before, data were statistically analyzed using the SPSS 26.0 statistics software package. Non-parametric tests were employed because of small sample size and non-normal distribution of some of the variables.

Treatment of Missing Data

Due to poor ECG data quality on some occasions, including noise and artifacts, physiological data corresponding to specific stages for certain participants were missing, necessitating the completion of data imputations. Before proceeding with imputation, following Tabachnick and Fidell (2007), an MCAR analysis (missing completely at random) was conducted using the expectation-maximization method, which confirmed data missing at random ($p > 0.05$). Furthermore, in accordance with Hair et al. (2010) regarding the acceptable threshold for missing data per variable (less than 10%), one participant and one of the Recovery stages for all participants (originally intended to be six Recovery stages) were removed to validate the data collection and ensure a reliable database. Once accomplished this, the multiple imputation method was employed, as it is robust against violations of normality assumptions and produces reliable results even with a small sample size or a high amount of missing data. This method effectively restores the natural variability of missing data and accounts for uncertainties, leading to valid statistical inferences by reflecting the estimation uncertainty of the missing data (Woods et al., 2024). For imputations procedures, please see: https://drive.google.com/drive/folders/1dh6zQD-bCKOrJ3VS9Klf28AR3PmC7_bp?usp =drive_link

Analysis of Physiological and Self-Report Data

Regarding physiological data, a within-group examination was initially conducted to track progression across stages and confirm that the hybrid version of the TSST effectively elicited a physiological stress response. Nine UST windows of three minutes each during the TSST stages (encompassing Rest, Preparation, Speech, Math, and Recovery windows 1 to 5) were compared using the Friedman ANOVA and the Wilcoxon signed-rank test post hoc. To compare physiological data between the MSC and KY groups, the Mann-Whitney U test was conducted for each of the 9 time-windows.

Regarding self-reports to ascertain effectiveness of the TSST (eVAAS, PANAS, STAI), pre-post test comparisons within-groups were conducted via the Wilcoxon signed-rank test. Comparisons between MSC and KY self-reports were conducted at pre- and post-TSST by using the Mann-Whitney U test.

Effect sizes (ES) for physiological and self-report outcomes were calculated using $r = Z/\sqrt{N}$ (Tomczak & Tomczak, 2014), with values of 0.1, 0.3 and 0.5 corresponding to small, medium and large effects sizes, respectively (Coolican, 2017, p. 484). For all analyses, the α level was set at 0.05.

Analysis of Physiological-Psychological Relationship

To analyze the impact of psychological outcomes post-training on physiological responses derived from the TSST, we selected variables that showed significant differences between MSC and KY groups. Regarding the psychological variables, expressive suppression –emotion regulation strategy as measured through the ERQ – and personal distress –empathy dimension– exhibited lower scores in MSC than KY groups. Regarding the latter, since an alternative approach would have been necessary to measure empathy in relation to the physiological stress response as assessed by the TSST, this variable was not considered for this analysis. Concerning expressive suppression, for a comprehensive understanding of the potential impact of emotion regulation on physiological variables, both strategies assessed by the ERQ — expressive suppression and cognitive reappraisal— were considered as predictors. Additionally, mindfulness and self-compassion, which are variables of primary interest and showed post-training improvements within the MSC group, were also included as predictors. To avoid overloading the regression model, the total SCS score was preferred over its subscales. Before further analysis, self-reported psychological variables were compared again between groups only with the participants who underwent the TSST (n = 21).

With regard to physiological variables, between-group differences were found in HFnu, LFnu, and LF/HF during Recovery stages 3 and 5, as well as in SD2/SD1 during Recovery 5. Burr (2023) discussed the algebraic redundancy of LFnu, HFnu, and LF/HF, noting that they are mutually predictable. Additionally, Billman et al. (2013) and Kleiger et al. (2005) advised that LFnu, LF/HF, and SD2/SD1 should not be reliably interpreted as indicators of sympathetic or parasympathetic dominance. Therefore, HFnu was selected for analysis because it reflects vagal cardiac activity and provides valuable insights into vmHRV, a variable of particular interest during the recovery period.

A Spearman bivariate correlation analysis was conducted to assess the correlation between dependent (HFnu) and independent variables (total FFMQ, total SCS, ERQ_CR and ERQ_ES), and to identify potential strong linear correlations between the latter. A very high correlation between the total FFMQ and the total SCS presented a redundancy issue. To address this and improve the model, the total FFMQ was excluded on the assumption that self-compassion encompasses mindfulness, which could explain the redundancy.

Next, multicollinearity was assessed. For this purpose, a dummy variable for groups (with MSC = 0 as the reference group, and KY = 1 as the comparison group), centered variables and interaction variables were created. Interaction variables were created by combining the centered variables of the independent ones with the dummy variable of group. As a result, the predictor variables included total SCS, ERQ_CR, ERQ_ES, the dummy variable, and the interaction variables. Focusing on HFnu as dependent variable, predictor variables exhibiting significant multicollinearity issues, identified by a Variance Inflation Factor (VIF) over 10 or a Tolerance below 0.1, were removed from the model. This process excluded two interaction variables -total SCS*Group and ERQ_CR*Group-, resulting in a final model that demonstrated no multicollinearity issues.

Finally, quantile regressions (Koenker et al., 2005; Tang et al., 2022) were performed separately for the 50^{th} quantile (median) for the HFnu Recovery 3 and HFnu Recovery 5 dependent variables. The predictors included total SCS, ERQ_CR, ERQ_ES, ERQ_SE*Group, and the dummy variable for group. Subsequent quantile regressions were conducted separately to test other models, one using total SCS and ERQ_CR as predictors, and other using ERQ_ES and the interaction variable ERQ_ES*Group as predictors, both including the dummy variable for group. Pseudo R-squared for each of the models was used to interpret effect size, with values of 0.02, 0.13 and 0.26 corresponding to small, medium and large effects sizes, respectively (Cohen, 1988; Konker, 2005).

To ensure the comparability of the groups, participant ages in the MSC and KY groups were compared with a Mann-Whitney U test prior to analysis.

Results

After completion of the trainings, twenty-one participants (MSC, n = 11; KY, n = 10) completed all TSST stages while being ECG recorded, as well as pre- and post-test self-report questionnaires on anxiety and affect.

Participants of the MSC and KY groups did not differ in age (Table 25).

Table 25 *Age Comparisons Between Mindful Self-Compassion and Kundalini Yoga Participants who completed the Trier Social Stress Test*

MSC				KY					
n	Q-25	Median	Q-75	n	Q-25	Median	Q-75	*p**	*ES*
11	28.00	35.00	46.00	10	32.75	45.00	49.25	0.158	0.308

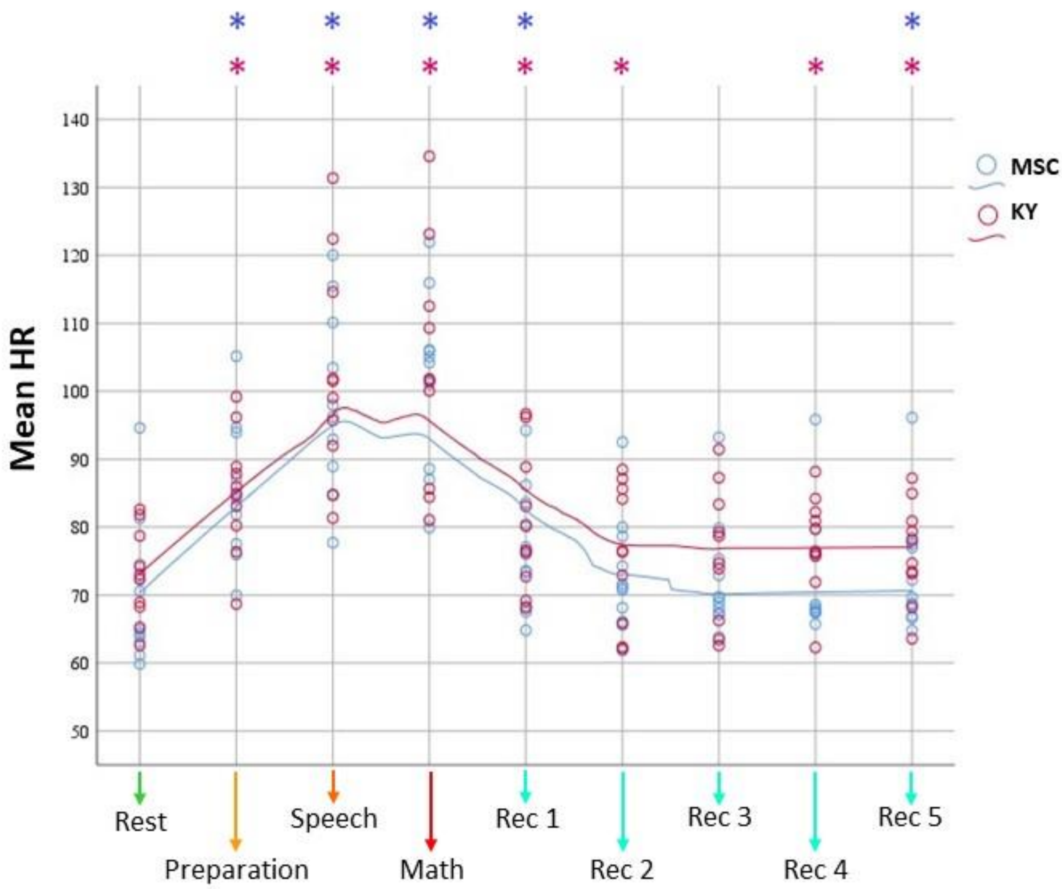
Note. ES = standard deviation; *KY* = Kundalini Yoga; *MSC* = Mindful Self-Compassion; *n* = number of participants; *p* = p-value; *Q-25* = quartile 25; *Q-75* = quartile 75.
ES were calculated using $r = Z/\sqrt{N}$
*Based on the Mann-Whitney test

Physiological Measures

To evaluate the influence of the ANS on the heart in response to the TSST and assess the HRV, the following parameters were analyzed: MeanNN, SDNN, Mean HR, RMSSD, HFms^2, LFms^2, HFnu, LFnu, LF/HF ratio, SD1, SD2 and SD2/SD1. Physiological data at the Rest stage revealed no differences between the MSC and KY groups for any studied variables.

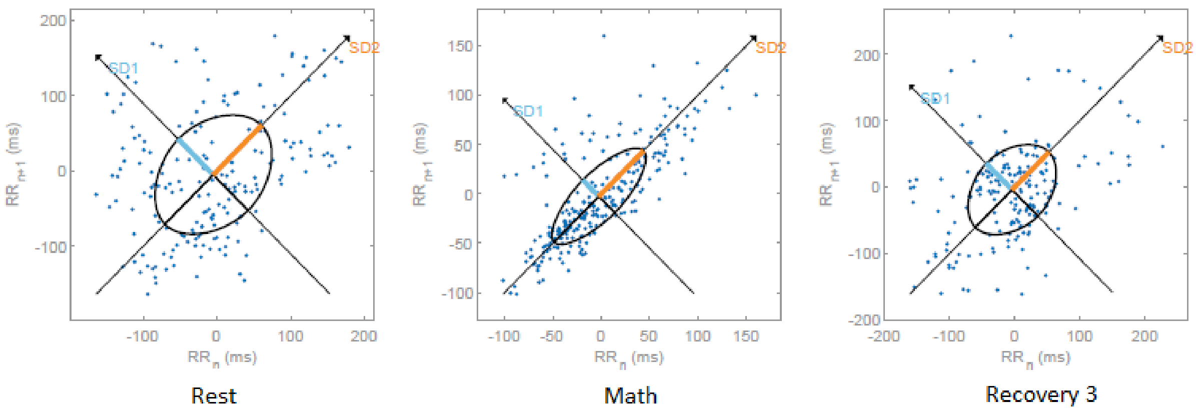
Within-group physiological response was ascertained by comparing all TSST stages to the Rest stage. For the MSC group, significant changes ($p < 0.05$) with regard to the Rest stage were observed for the different parameters as follows: i) the Mean HR increased (Figure 9) and the Mean NN decreased at Preparation, Speech, Math, and the Recovery time-windows 1 and 5; ii) the RMSSD decreased at Preparation, Speech and Math; iii) the HFms^2 and HFnu decreased at Preparation, Speech and Math; iv) the LFnu increased at Preparation, Speech and Math; v) the LF/HF ratio increased at Speech and Math; vi) SD1 decreased at Preparation, Speech and Math; vii) the SD2/SD1 ratio increased at Preparation, Speech, Math and Recovery time-window 1, as exemplified in Figure 10. This figure illustrates three Poincaré plots corresponding to different stages of the TSST (Rest, Math, and Recovery 3). The ellipse fitting technique quantifies this variability using SD1 (short-term variability) and SD2 (long-term variability). During the high social stress stage (Math), the points align along the line of identity (RRn = RRn+1), indicating reduced variability, and the ellipse becomes elongated. In the Recovery 3 stage, the points become more dispersed, forming a rounder ellipse, similar to that observed in the Rest stage. No significant changes were observed in SDNN, LFms^2 and SD2 (Table 26, Appendix 3).

Figure 9 *Mean Heart Rate Changes Across the TSST Stages for the MSC (n = 11) and KY Groups (n = 10)*



Note. Locally estimated scatterplot smoothing (LOESS) curve depicts changes in HR across TSST stages. On the x-axis, time points correspond to the consecutive stages of the TSST. The Rest Stage serves as a baseline measure. *HR* = heart rate; *KY* = Kundalini Yoga; *MSC* = Mindful Self-Compassion; *TSST* = Trier Social Stress Test. Lines represent the curves of the media for each group. Significant differences of TSST stages with respect to the Rest stage are indicated by asterisks, where blue correspond to MSC and magenta correspond to KY group.

Figure 10 *Example of Poincaré Plots Across Three Different Stages of the TSST*



Note. Poincaré plots are presented, corresponding to different stages of the Trier Social Stress Test (Rest, Math, and Recovery 3). Each RR interval is plotted against the preceding one, forming an ellipse shape. Blue dots represent the correlation between successive RR intervals. The nonlinear values SD1 (light blue) and SD2 (orange) describe short-term and long-term variability, respectively, and are obtained from the ellipse fitting technique. *SD1:* standard deviation of points perpendicular to the identity line; *SD2:* standard deviation of points along the identity line Plotted data correspond to *Participant #59.* Graphs created by Kubios HRV Premium Scientific (4.0.3)

For the KY group, significant changes ($p < 0.05$) with regard to the Rest stage were observed for the different parameters as follows: i) the Mean HR increased for all the TSST stages but Recovery time-window 3 (Figure 9); ii) the Mean NN decreased for all the TSST stages but Recovery time-window 2 and 3; iii) the RMSSD decreased at Speech and Math; iv) the $HFms^2$ decreased at Math; v) the HFnu decreased at Speech and Math; vi) the LFnu increased at Speech and Math; vii) the LF/HF ratio increased at Speech; viii) SD1 decreased at Speech and Math; ix) the SD2/SD1 ratio increased at Speech, Math and Recovery time-window 5. No significant changes were observed in SDNN, $LFms^2$ and SD2 (Table 27, Appendix 3).

Comparisons of physiological measures between MSC and KY groups for the different TSST stages showed a difference in the frequency-domain parameters for the time-windows 3 and 5 of the Recovery stage. For both time-windows, HFnu was higher and LFnu was lower in the MSC group as compared to KY, and the LF/HF ratio was lower (for Recovery 3: $p = 0.014$, ES = 0.54; same value for the three measures; for Recovery 5: LFnu, $p = 0.041$, ES = 0.45; HFnu, $p = 0.035$, ES = 0.46; LF/HF, $p = 0.029$, ES = 0.48). Furthermore, for Recovery 5 the SD2/SD1 ratio nonlinear parameter was lower in the MSC group ($p = 0.049$; ES = 0.43). Table 28 summarizes these results. For the frequency-domain parameters, only HFnu is graphically illustrated considering their mutual predictability (Figure 11).

Table 28 *Physiological Results Comparing Mindful Self-Compassion (n = 11) vs Kundalini Yoga (n = 10) Across Stages of the Trier Social Stress Test*

Parameters	MSC			KY			*p**	*ES*
	Q-25	Median	Q-75	Q-25	Median	Q-75		
MeanNN_Rest	810.17	924.32	951.32	755.10	825.27	889.07	0.181	0.29
SDNN_Rest	26.04	35.26	38.19	22.76	32.36	42.80	0.622	0.11
MeanHR_Rest	63.07	64.91	74.06	67.51	72.70	79.48	0.181	0.29
RMSSD_Rest	19.34	32.27	54.22	18.10	28.36	37.88	0.439	0.17
$LF\_ms^2\_Rest$	154.54	392.03	736.98	145.02	532.46	1384.33	0.725	0.08
$HF\_ms^2\_Rest$	163.27	477.51	1117.56	124.48	408.21	557.62	0.398	0.18
LFnu_Rest	29.61	44.07	69.72	39.98	54.90	72.55	0.360	0.20
HFnu_Rest	30.28	55.92	70.38	27.44	45.08	59.94	0.360	0.20
LF/HF_Rest	0.42	0.79	2.30	0.67	1.24	2.65	0.360	0.20
SD1_Rest	13.71	22.88	38.45	12.83	20.10	26.84	0.439	0.17
SD2_Rest	31.09	38.09	49.19	27.87	39.50	53.62	0.778	0.06
SD2/SD1_Rest	1.19	1.54	2.65	1.38	1.88	2.47	0.481	0.15
MeanNN_Preparation	638.63	706.97	774.00	662.23	703.11	757.43	0.888	0.03
SDNN_Preparation	26.92	32.13	53.83	24.87	27.60	35.58	0.231	0.26
MeanHR_Preparation	77.52	84.87	93.95	79.25	85.34	90.71	0.888	0.03
RMSSD_Preparation	17.03	28.66	48.92	16.93	23.93	31.95	0.622	0.11
$LF\_ms^2\_Preparation$	248.68	574.94	1186.40	270.08	457.84	607.03	0.231	0.26
$HF\_ms^2\_Preparation$	123.22	449.47	570.18	145.69	389.25	637.59	0.888	0.03

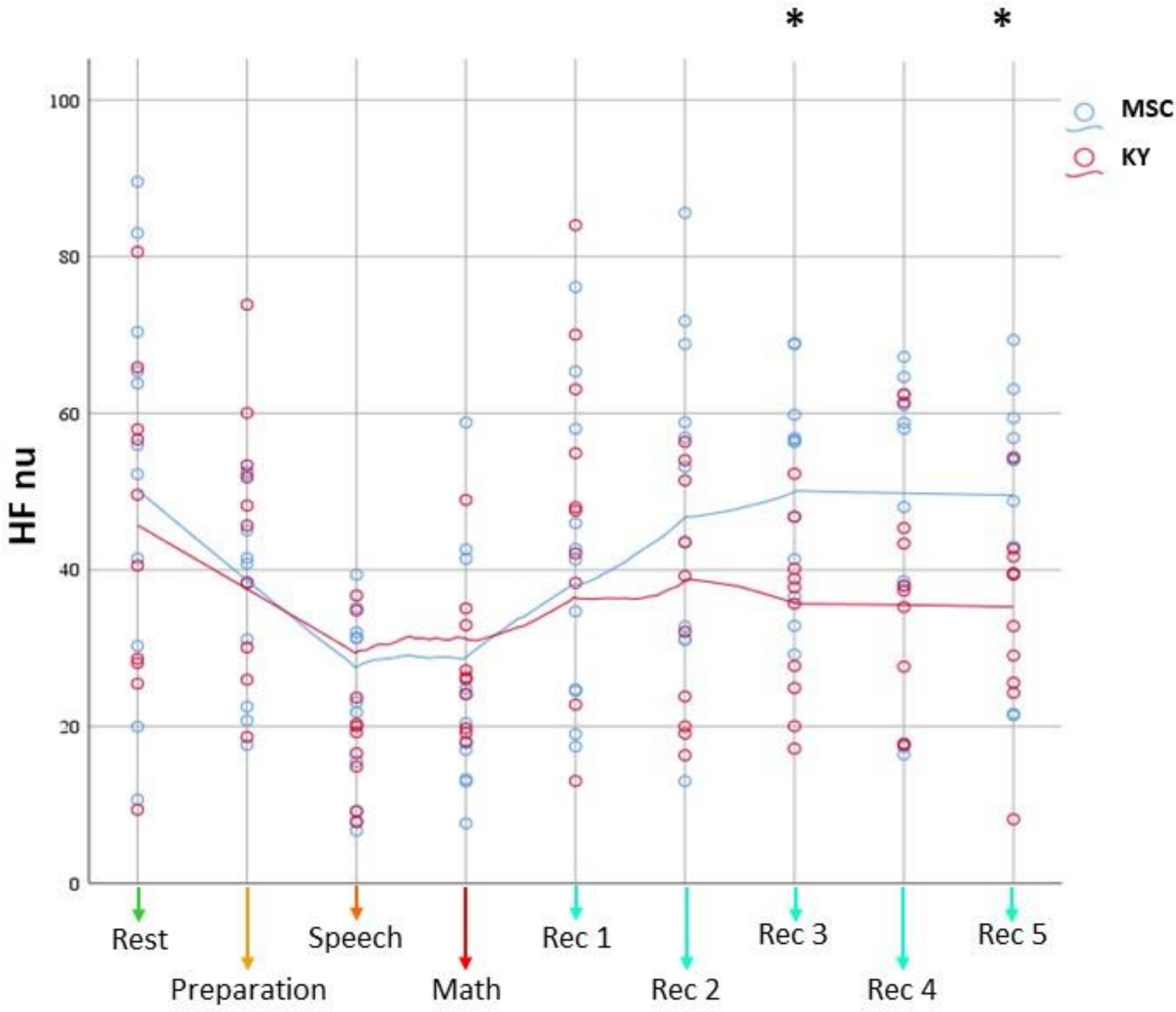
LFnu_Preparation	54.94	61.71	77.43	44.94	53.04	70.91	0.205	0.28
HFnu_Preparation	22.54	38.28	45.05	29.07	46.94	55.02	0.205	0.28
LFHFratio_Preparation	1.22	1.62	3.44	0.82	1.13	2.45	0.181	0.29
SD1_Preparation	12.07	21.19	34.67	11.99	16.96	22.64	0.573	0.12
SD2_Preparation	34.74	44.23	64.14	28.82	35.34	46.46	0.181	0.29
SD2/SD1_Preparation	1.82	2.31	3.05	1.65	2.44	2.59	0.833	0.05
MeanNN_Speech	544.92	623.32	708.44	515.15	609.66	666.15	0.526	0.14
SDNN_Speech	15.56	38.79	52.35	15.89	33.85	43.83	0.725	0.08
MeanHR_Speech	84.69	96.26	110.11	90.18	100.28	116.57	0.481	0.15
RMSSD_Speech	10.95	20.08	33.66	8.97	21.70	25.48	0.573	0.12
LF_ms^2_Speech	165.74	1084.72	1931.39	231.15	653.61	1968.26	0.888	0.03
HF_ms^2_Speech	67.38	220.78	510.54	70.43	205.55	393.73	0.725	0.08
LFnu_Speech	67.96	76.87	90.76	73.05	80.32	86.53	0.673	0.09
HFnu_Speech	9.24	23.13	32.02	13.45	19.62	26.48	0.573	0.12
LF/HF_Speech	2.12	3.32	9.83	2.88	4.45	6.77	0.573	0.12
SD1_Speech	7.76	14.22	23.84	6.35	14.65	18.05	0.573	0.12
SD2_Speech	21.37	53.05	62.19	21.56	44.14	59.85	0.778	0.06
SD2/SD1_Speech	2.42	3.37	3.74	3.14	3.37	3.55	0.888	0.03
MeanNN_Math	565.68	575.79	677.39	521.71	592.78	703.18	0.944	0.02
SDNN_Math	12.76	32.43	51.22	17.13	25.34	31.40	0.181	0.29
MeanHR_Math	88.58	104.20	106.07	85.33	101.72	115.18	0.944	0.02
RMSSD_Math	10.71	16.83	31.30	8.64	14.46	19.40	0.360	0.20
LF_ms^2_Math	85.66	1145.04	1632.34	167.90	447.42	816.36	0.205	0.28
HF_ms^2_Math	67.95	217.60	442.58	40.61	197.69	339.14	0.622	0.11
LFnu_Math	58.58	79.54	86.72	66.47	74.77	80.35	0.291	0.23
HFnu_Math	13.27	20.45	41.42	19.64	26.14	33.47	0.231	0.26
LF/HF_Math	1.41	3.89	6.53	1.99	2.97	4.22	0.324	0.22
SD1_Math	7.59	11.92	22.18	6.12	10.68	15.28	0.398	0.18
SD2_Math	17.28	44.19	65.44	23.27	34.08	42.08	0.159	0.31
SD2/SD1_Math	2.61	3.62	3.89	2.81	3.16	3.71	0.573	0.12
MeanNN_Recovery_1	717.91	789.34	877.71	662.43	766.17	835.53	0.398	0.18
SDNN_Recovery_1	32.35	37.87	64.13	21.49	33.54	43.23	0.181	0.29
MeanHR_Recovery_1	68.36	76.01	83.58	71.85	78.35	90.68	0.398	0.18
RMSSD_Recovery_1	21.26	44.44	51.13	15.38	26.60	44.44	0.159	0.31
LF_ms^2_Recovery_1	294.44	974.06	1717.56	196.74	327.18	853.24	0.159	0.31
HF_ms^2_Recovery_1	159.99	366.80	1306.36	111.61	212.17	802.44	0.231	0.26

LFnu_Recovery_1	41.96	58.62	75.26	35.11	52.22	65.54	0.398	0.18
HFnu_Recovery_1	24.55	41.30	58.01	34.45	47.77	64.80	0.398	0.18
LF/HF_Recovery_1	0.72	1.42	3.06	0.37	0.95	1.43	0.105	0.35
SD1_Recovery_1	15.06	31.51	36.23	10.90	18.86	31.49	0.159	0.31
SD2_Recovery_1	33.85	49.94	79.51	28.11	38.19	54.98	0.260	0.25
SD2/SD1_Recovery_1	1.54	1.90	2.61	1.50	2.39	2.93	0.944	0.02
MeanNN_Recovery_2	762.73	843.76	907.93	697.75	785.06	924.28	0.398	0.18
SDNN_Recovery_2	22.95	42.41	58.40	18.86	34.60	46.49	0.526	0.14
MeanHR_Recovery_2	66.08	71.11	78.67	64.95	76.43	86.00	0.398	0.18
RMSSD_Recovery_2	17.66	34.45	61.00	17.25	25.07	49.84	0.725	0.08
LF_ms^2_Recovery_2	172.90	426.39	1130.28	161.48	671.20	923.57	0.725	0.08
HF_ms^2_Recovery_2	192.75	336.80	1615.32	101.83	255.83	742.75	0.439	0.17
LFnu_Recovery_2	31.15	46.83	68.86	47.89	64.34	80.20	0.121	0.34
HFnu_Recovery_2	31.13	53.16	68.82	19.79	35.65	52.07	0.121	0.34
LF/HF_Recovery_2	0.45	0.88	2.21	0.92	1.83	4.06	0.121	0.34
SD1_Recovery_2	12.51	24.42	43.24	12.22	17.77	35.33	0.725	0.08
SD2_Recovery_2	30.24	42.09	72.72	23.76	45.85	54.89	0.833	0.05
SD2/SD1_Recovery_2	1.30	1.86	2.54	1.61	2.05	2.69	0.622	0.11
MeanNN_Recovery_3	796.75	861.47	891.27	711.79	783.10	915.83	0.481	0.15
SDNN_Recovery_3	23.95	36.33	59.71	21.57	38.63	46.39	0.944	0.02
MeanHR_Recovery_3	67.32	69.65	75.31	65.54	76.67	84.33	0.481	0.15
RMSSD_Recovery_3	18.64	38.02	59.34	17.59	26.36	46.86	0.439	0.17
LF_ms^2_Recovery_3	254.24	328.17	1434.88	264.48	702.10	1622.05	0.573	0.12
HF_ms^2_Recovery_3	146.71	604.99	1270.38	141.27	357.52	896.72	0.526	0.14
LFnu_Recovery_3	40.19	43.67	63.40	58.17	63.26	76.31	0.014	0.54
HFnu_Recovery_3	36.59	56.31	59.81	23.69	36.72	41.79	0.014	0.54
LF/HF_Recovery_3	0.67	0.78	1.73	1.40	1.73	3.26	0.014	0.54
SD1_Recovery_3	13.21	26.95	42.06	12.47	18.68	33.22	0.439	0.17
SD2_Recovery_3	31.64	38.01	70.61	27.89	45.98	60.01	1.000	0.00
SD2/SD1_Recovery_3	1.34	1.76	2.27	1.45	2.23	2.65	0.181	0.29
MeanNN_Recovery_4	784.22	880.46	889.63	725.52	769.56	811.15	0.091	0.37
SDNN_Recovery_4	25.73	38.65	58.24	14.83	31.23	43.26	0.324	0.22
MeanHR_Recovery_4	67.44	68.15	76.51	74.78	78.01	82.71	0.078	0.38
RMSSD_Recovery_4	17.07	51.55	69.81	13.57	27.76	36.07	0.260	0.25
LF_ms^2_Recovery_4	312.99	493.87	938.13	59.73	557.63	890.97	0.622	0.11
HF_ms^2_Recovery_4	113.48	588.89	1703.15	75.81	347.51	539.01	0.205	0.28

LFnu_Recovery_4	37.65	41.98	62.03	50.60	62.31	74.79	0.231	0.26
HFnu_Recovery_4	37.97	58.01	62.34	25.19	37.65	49.35	0.205	0.28
LF/HF_Recovery_4	0.60	0.72	1.63	1.06	1.66	3.12	0.231	0.26
SD1_Recovery_4	12.10	36.54	49.48	9.62	19.67	25.50	0.260	0.25
SD2_Recovery_4	34.19	40.19	65.09	18.56	40.73	54.88	0.398	0.18
SD2/SD1_Recovery_4	1.21	1.78	2.26	1.73	2.04	2.69	0.275	0.24
MeanNN_Recovery_5	774.10	861.52	896.93	732.92	786.61	835.17	0.205	0.28
SDNN_Recovery_5	22.54	37.41	58.09	14.66	36.54	41.97	0.398	0.18
MeanHR_Recovery_5	66.90	69.64	77.51	71.91	76.38	81.90	0.205	0.28
RMSSD_Recovery_5	19.46	44.62	64.96	12.70	30.25	39.16	0.260	0.25
LF_ms^2_Recovery_5	245.03	594.63	1367.79	130.00	791.30	1126.01	1.000	0.00
HF_ms^2_Recovery_5	164.09	397.53	1613.85	75.91	386.57	729.67	0.439	0.17
LFnu_Recovery_5	40.62	45.98	59.76	57.11	63.90	74.71	0.041	0.45
HFnu_Recovery_5	39.60	53.99	59.38	25.26	36.09	41.93	0.035	0.46
LF/HF_Recovery_5	0.68	0.85	1.51	1.49	2.31	2.96	0.029	0.48
SD1_Recovery_5	13.79	31.64	46.05	9.00	21.43	27.75	0.260	0.25
SD2_Recovery_5	28.72	45.52	68.85	18.68	45.91	52.55	0.439	0.17
SD2/SD1_Recovery_5	1.36	2.07	2.27	1.78	2.61	3.93	0.049	0.43

Note. ES = effect size*; HF = high-frequency power; HR* = heart rate*; KY* = Kundalini Yoga*; LF = low-frequency power; MSC* = Mindful Self-Compassion*; NN* = normal-to-normal interval*; p = p-value; Q-25 = quartile 25; Q-75 = quartile 75; RMSSD* = root mean square of successive differences between normal-to-normal intervals; *SDNN* = standard deviation of normal-to-normal intervals
ES were calculated using $r = Z/\sqrt{N}$
*Based on the Mann-Whitney U-test

Figure 11 *High-Frequency Heart Rate Variability in Normalized Units Across the TSST stages for the MSC (n = 11) and KY groups (n = 10)*



Note. LOESS (locally estimated scatterplot smoothing) curve depicts the contribution of the high-frequency (HF) component to the overall HRV across the TSST stages. On the x-axis, time points correspond to the consecutive stages of the TSST. The Rest Stage serves as a baseline measure. *HFnu* = High-frequency power in normalized units; *KY* = Kundalini Yoga; *MSC* = Mindful Self-Compassion; *TSST* = Trier Social Stress Test. Significant differences between MSC and KY groups across TSST stages are indicated by asterisks.

Anxiety and Affect Measures

To analyze the subjective feelings accompanying the physiological outcomes of the TSST and compare within groups, state anxiety and positive and negative affect were measured at pre- and post- stress-eliciting stages. Self-reported data at Rest revealed no differences between the MSC and KY groups for any studied variables.

Comparison of anxiety and affect between MSC and KY groups yielded no differences either at pre- or post-TSST (Tables 29 and 30).

Table 29 *Anxiety And Affect Measures Comparing Mindful Self-Compassion (n = 11) vs Kundalini Yoga (n = 10) pre-Stress*

Measure	MSC			KY			*p**	*ES*
	Q-25 pre	Median pre	Q-75 pre	Q-25 pre	Median pre	Q-75 pre		
VAAS	10.00	25.00	35.00	15.00	30.00	52.50	0.570	0.12
Positive Affect	28.00	30.00	35.00	28.75	32.00	35.00	0.697	0.09
Negative Affect	15.00	16.00	20.00	15.25	20.00	24.50	0.322	0.22
STAI-S	5.00	12.00	19.00	7.00	12.50	19.50	0.888	0.03

Note. ES = effect size; *KY* = Kundalini Yoga; *MSC* = Mindful Self-Compassion; *p* = *p*-value; *Q-25* = quartile 25; *Q-75* = quartile 75; *STAI-S* = State-Trait Anxiety Inventory – State; *VAAS* = Visual Analogue Scale of Anxiety
Effect sizes were calculated using $r = Z/\sqrt{N}$
*Based on the Mann-Whitney U-test

Table 30 *Anxiety and Affect Measures Comparing Mindful Self-Compassion (n = 11) vs Kundalini Yoga (n = 10) post-Stress*

Measure	MSC			KY			*p**	*ES*
	Q-25 post	Median post	Q-75 post	Q-25 post	Median post	Q-75 post		
VAAS	45.00	50.00	80.00	47.50	57.50	82.50	0.499	0.15
Positive Affect	26.00	30.00	37.00	25.25	29.00	33.25	0.646	0.10
Negative Affect	15.00	16.00	25.00	13.75	17.50	26.50	1.000	0.00
STAI-S	18.00	24.00	29.00	16.00	25.00	31.75	0.724	0.08

Note. ES = effect size; *KY* = Kundalini Yoga; *MSC* = Mindful Self-Compassion; *p* = *p*-value; *Q-25 = quartile 25; Q-75 = quartile 75; STAI-S* = State-Trait Anxiety Inventory – State; *VAAS* = Visual Analogue Scale of Anxiety
Effect sizes were calculated using $r = Z/\sqrt{N}$
*Based on the Mann-Whitney U-test

Within-group assessment showed anxiety levels in the MSC group post-test increased as measured by both the VAAS ($p = 0.003$, $ES = 0.89$) and the STAI-S ($p = 0.012$, $ES = 0.75$), while no changes emerged in affect (Table 31, Appendix 3). Similarly, in the KY group, anxiety levels also increased post-test as measured through the VAAS ($p = 0.011$, $ES = 0.81$) and the STAI-S ($p = 0.022$, $ES = 0.73$), accompanied by a decrease in positive affect ($p = 0.016$, $ES = 0.76$) (Table 32, Appendix 3).

Impact of perceived self-compassion and emotion regulation on vmHRV

To analyze the impact of psychological outcomes on vmHRV, self-reported data collected post-training was used. The analysis was limited to participants who performed the TSST. Re-assessment of self-reported questionnaires with only the TSST participants revealed no differences between the MSC and KY groups (Table 33).

Table 33 *Psychometric Tests Results Comparing Mindful Self-Compassion (n = 11) vs Kundalini Yoga (n = 10) at Post-training*

Test	Factor	MSC			KY			*p**	*ES*
		Q-25 post	Median post	Q-75 post	Q-25 post	Median post	Q-75 post		
FFMQ	Observing (1-5)	3.38	3.75	4.50	3.44	3.56	3.78	0.320	0.22
	Describing (1-5)	3.50	3.88	4.50	3.34	3.88	4.16	0.458	0.16
	Acting with Awareness (1-5)	3.50	3.75	4.13	3.38	3.63	4.66	0.696	0.09
	Non-judging (1-5)	3.38	3.63	4.50	3.28	3.63	4.31	0.645	0.10
	Non-reactivity (1-5)	3.00	3.14	3.57	2.54	3.14	3.75	0.804	0.05
	Total FFMQ (1-5)	3.46	3.79	4.05	3.40	3.54	3.87	0.307	0.22
SCS	Self-kindness (1-5)	3.60	4.00	4.80	3.25	3.60	4.15	0.136	0.32
	Common Humanity (1-5)	3.00	3.50	4.25	2.38	3.25	4.00	0.322	0.22
	Mindfulness (1-5)	3.00	3.75	4.25	3.38	3.75	4.00	0.886	0.03
	Self-Judgment (1-5)	3.00	4.00	4.80	3.20	3.80	5.00	0.832	0.05
	Isolation (1-5)	3.00	3.75	4.75	3.25	4.00	4.81	0.644	0.10
	Over-Identification (1-5)	3.25	3.75	4.25	3.25	4.00	4.63	0.645	0.10
	Total SCS (1-5)	3.36	3.92	4.15	3.26	3.70	4.16	0.672	0.09
MBI	Emotional Exhaustion (0-54)	11.00	20.00	28.00	7.75	14.50	25.00	0.29	0.23
	Personal Accomplishment (0-48)	39.00	41.00	46.00	36.75	40.00	45.25	0.86	0.04
	Depersonalization (0-30)	0.00	0.00	1.00	0.00	1.00	3.00	0.221	0.27
ERQ	Cognitive Reappraisal (1-42)	30.00	36.00	39.00	29.50	32.50	34.25	0.23	0.26
	Expressive Suppression (1-28)	4.00	6.00	11.00	7.25	9.50	11.25	0.167	0.30
PSS	Total (0-56)	10.00	19.00	20.00	9.50	15.50	24.25	0.698	0.08
WHO-5	Total (0-100)	60.00	68.00	80.00	51.00	70.00	80.00	0.887	0.03

Note. This table presents self-reported questionnaires only of participants who performed the TSST. *ES* = effect size*; FFMQ* = Five Facet Mindfulness Questionnaire*; IRI* = Interpersonal Reactivity Index*; KY* = Kundalini Yoga*; MSC* = Mindful Self-Compassion*; p = p-value; PSS = Perceived* Stress Scale*; Q-25 = quartile 25; Q-75 = quartile 75; SCS = Self-*Compassion Scale*; WHO-5* = World Health Organization-Five Well-Being Index
ES were calculated using $r = Z/\sqrt{N}$
*Based on the Mann-Whitney U-test

Spearman bivariate correlation revealed no significant correlation between the dependent variables (HFnu of Recovery 3 and 5) and the independent ones (total FFMQ, total SCS, ERQ_CR and ERQ_ES). A strong positive correlation was found between total FFMQ and total SCS ($rho_{(19)} = 0.74$, $p = 0.000$), as well as a moderate negative correlation between the ERQ_ES and both total FFMQ ($rho_{(19)} = 0.70$, $p = 0.000$) and total SCS ($rho_{(19)} = 0.46$, $p = 0.034$). Due to the high redundancy between total FFMQ and total SCS, total FFMQ was excluded from further analysis. Correlation results are presented in Table 34.

Table 34 *Spearman Bivariate Correlations Among Predictor and Dependent Variables*

Predictors		Total FFMQ	Total SCS	ERQ-CR	ERQ-ES	HFnu Recovery 3	HFnu Recovery 5
Total FFMQ	*ρ (rho)*	1.000	0.739**	-0.026	-0.696**	0.097	0.158
	p	.	0.000	0.912	0.000	0.676	0.494
Total SCS	*ρ (rho)*	0.739**	1.000	0.014	-0.464*	-0.019	0.077
	p	0.000	.	0.952	0.034	0.935	0.739
ERQ-CR	*ρ (rho)*	-0.026	0.014	1.000	0.002	0.212	0.236
	p	0.912	0.952	.	0.993	0.357	0.302
ERQ-ES	*ρ (rho)*	-0.696**	-0.464*	0.002	1.000	-0.242	-0.301
	p	0.000	0.034	0.993	.	0.291	0.186
HFnu Recovery 3	*ρ (rho)*	0.097	-0.019	0.212	-0.242	1.000	.0525*
	p	0.676	0.935	0.357	0.291	.	0.015
HFnu Recovery 5	*ρ (rho)*	0.158	0.077	0.236	-0.301	0.525*	1.000
	p	0.494	0.739	0.302	0.186	0.015	.

Note. n = 21. *ERQ-CR* =Emotional Regulation Questionnaire-Cognitive Reappraisal; *ERQ-ES* = Emotional Regulation Questionnaire-Expressive Suppression; *FFMQ* = Five Facet Mindfulness Questionnaire*; HFnu* = High Frequency in normalized units; *SCS* = Self-Compassion Scale; *p* = *p*-value; *ρ (rho)* = Correlation Coefficient
**p<.05*
***p<.01*

Multicollinearity issues were detected in the interaction variables total SCS*group, and ERQ_ES*group (VIF > 10, Tolerance < 0.1). After excluding these variables to ensure the reliability of the estimated coefficients, the re-tested model demonstrated no multicollinearity issues. Multicollinearity results are presented in Tables 35 and 36.

Table 35 *Multicollinearity Analysis for Predictors of High Frequency in Normalized Units (HFnu) Recovery 3*

Model	Predictors	B	SE B	ß	t	*p*	Tolerance	VIF
1	(Constant)	120.95	62.50		1.94	0.075		
	Total SCS	-11.63	12.31	-0.43	-0.95	0.362	0.22	4.61
	ERQ-CR	-0.32	0.58	-0.14	-0.55	0.589	0.76	1.32
	ERQ-ES	-2.00	1.54	-0.56	-1.31	0.214	0.24	4.10
	Total SCS_Group	6.77	14.52	0.89	0.47	0.649	0.01	80.16
	ERQ-CR_Group	0.24	1.33	0.27	0.18	0.858	0.02	48.67
	ERQ-ES_Group	1.98	1.98	0.76	1.01	0.333	0.08	12.63
	Dummy_Group	-65.80	76.73	-2.25	-0.86	0.407	0.01	151.95
2	(Constant)	95.84	33.85		2.83	0.013		
	Total SCS	-6.67	6.13	-0.25	-1.09	0.294	0.77	1.29
	ERQ-CR	-0.24	0.49	-0.10	-0.49	0.629	0.96	1.05
	ERQ-ES	-1.57	1.16	-0.44	-1.36	0.195	0.38	2.63
	ERQ-ES_Group	1.61	1.60	0.62	1.01	0.329	0.11	9.34
	Dummy_Group	-29.40	15.30	-1.01	-1.92	0.074	0.15	6.84

Note. n = 21. Dependent variable HFnu Recovery 3. VIF factor and Tolerance indicate degree of multicollinearity. A VIF value over 10 and a tolerance under 0.1 show high collinearity between the variables. Model 2 shows multicollinearity problems were mitigated by excluding the interaction variables Total SCS_Group and ERQ-CR_Group. *B* = unstandardized regression coefficients; *ß* = standardized regression coefficients; *ERQ-CR* = Emotional Regulation Questionnaire-Cognitive Reappraisal; *ERQ-ES* = Emotional Regulation Questionnaire-Expressive Suppression; *p* = p-values; *SCS* = Self-Compassion Scale; *SE B* = Standard Error of B; *t* = t-values; *VIF* = Variance Inflation Factor.

Table 36 *Multicollinearity Analysis for Predictors of High Frequency in Normalized Units (HFnu) Recovery 5*

Model	Predictors	B	SE B	ß	t	*p*	Tolerance	VIF
1	(Constant)	86.70	62.75		1.38	0.190		
	Total SCS	-5.74	12.36	-0.20	-0.46	0.650	0.22	4.61
	ERQ-CR	-0.25	0.59	-0.10	-0.43	0.676	0.76	1.32
	ERQ-ES	-1.07	1.55	-0.28	-0.69	0.502	0.24	4.10
	Total SCS_Group	2.20	14.61	0.27	0.15	0.883	0.01	80.156
	ERQ-CR_Group	1.85	1.34	1.94	1.38	0.192	0.02	48.67
	ERQ-ES_Group	-1.77	1.98	-0.64	-0.89	0.388	0.08	12.63
	Dummy_Group	-62.97	77.04	-2.03	-0.82	0.428	0.01	151.95
2	(Constant)	63.49	36.05		1.76	0.099		
	Total SCS	-3.23	6.53	-0.11	-0.49	0.628	0.77	1.29
	ERQ-CR	0.11	0.52	0.04	0.22	0.833	0.96	1.05
	ERQ-ES	-0.87	1.24	-0.23	-0.70	0.495	0.38	2.63
	ERQ-ES_Group	-1.41	1.70	-0.51	-0.83	0.422	0.11	9.34
	Dummy_Group	1.02	16.30	0.03	0.06	0.951	0.15	6.84

Note. n = 21. Dependent variable HFnu Recovery 5. VIF factor and Tolerance indicate degree of multicollinearity. A VIF value over 10 and a tolerance under 0.1 show high collinearity between the variables. Model 2 shows multicollinearity problems were mitigated by excluding the interaction variables Total SCS_Group and ERQ-CR_Group. *B* = unstandardized regression coefficients; *ß* = standardized regression coefficients; *ERQ-CR* = Emotional Regulation Questionnaire-Cognitive Reappraisal; *ERQ-ES* = Emotional Regulation Questionnaire-Expressive Suppression; *p* = p-values; *SCS* = Self-Compassion Scale; *SE B* = Standard Error of B; *t* = t-values; *VIF* = Variance Inflation Factor.

The quantile regression analysis at the 50th percentile (median; n = 21; MSC = 11, KY = 10) was conducted in three stages to investigate the predictors of HFnu of Recovery 3 and Recovery 5. An initial comprehensive model was tested, followed by two additional models with different sets of predictors to further explore the relationships. The initial model included total SCS, ERQ_CR, ERQ-ES, ERQ_ES*Group, and the dummy variable for group. Other two models were tested, one including total SCS, ERQ_CR and Group, and other including ERQ-ES, ERQ_ES*Group and Group.

With regard to HFnu Recovery 3, analysis of the initial comprehensive model revealed no significant predictors. The predicted value was 57.00 for the MSC group and 29.01 for the KY group. The model's pseudo R-squared was 0.22 (Table 37). Next, a model including total SCS, ERQ_CR and Group as predictors was tested. This analysis also revealed no significant predictors, although a marginal result was observed for Group (*p* = 0.05). The predicted values for HFnu of Recovery 3 were 53.44 for the MSC group and 35.40 for the KY group. The MSC group had an average HFnu value 18.06 units higher than the KY group, after adjusting for total SCS and ERQ-CR (p = 0.05). The model's pseudo R-squared was 0.18 (Table 38). Lastly, a model including ERQ-ES, ERQ_ES*Group and Group as predictors was tested, which also revealed no significant predictors. The predicted values for HFnu of Recovery 3 were 50.12 for the MSC group and 35.96 for the KY group. The model's pseudo R-squared was 0.19 (Table 39).

Table 37 *Quantile Regression Results for High Frequency in Normalized Units (HFnu) of Recovery 3 at the 50th Percentile*

Predictors	Coefficients	Std. Error	t-value	*p*	Pseudo R-squared	Mean Absolute Error	95% Confidence Interval		Dummy_Group Prediction	
							inferior	superior	.00	1.00
(Intercept)	59.37	44.46	1.34	0.202	0.22	9.47	-35.40	154.13	57.00	29.01
Total SCS	-04.87	9.18	-0.53	0.604			-24.44	14.70		
ERQ-CR	0.064	0.73	0.09	0.931			-1.50	1.62		
ERQ-ES	-2.61	1.74	-1.50	0.153			-6.31	1.09		
ERQ-ES_Group	1.82	2.39	0.76	0.457			-3.27	6.92		
[Dummy_Group=.00]	27.99	22.91	1.22	0.241			-20.84	76.82		
[Dummy_Group=1.00]	0	.	.	.	.	.	.	.	.	.

Note. This quantile regression model includes all predictors that did not show multicollinearity issues. n = 21. Total SCS_Group and ERQ-CR_Group. *ERQ-CR* = Emotional Regulation Questionnaire-Cognitive Reappraisal; *ERQ-ES* = Emotional Regulation Questionnaire-Expressive Suppression; *p* = p-values; *R*-squared = determination coefficient; *SCS* = Self-Compassion Scale; *Std.*= Standard
*[Dummy_Group=.00] represents the MSC group (reference)
**[Dummy_Group=1.00] represents the KY group. Defined in 0 due to redundancy

Table 38 *Quantile Regression Results for High Frequency in Normalized Units (HFnu) of Recovery 3 at the 50th Percentile for Self-Compassion and Cognitive Reappraisal Predictors only (Total SCS and ERQ-CR)*

Predictors	Coefficients	Std. Error	t-value	*p*	Pseudo R-squared	Mean Absolute Error	95% Confidence Interval		Dummy_Group Prediction	
							inferior	superior	.00	1.00
(Intercept)	62.06	38.41	1.62	0.125	0.18	9.92	-18.97	143.09	53.44	35.40
Total SCS	-4.30	7.85	-0.55	0.591			-20.86	12.26		
ERQ-CR	-0.32	0.70	-0.46	0.654			-1.79	1.15		
[Dummy_Group=.00]	18.06	8.55	2.11	0.050			0.02	36.10		
[Dummy_Group=1.00]	0	.	.	.			.	.		

Note. n = 21. *ERQ-CR* = Emotional Regulation Questionnaire-Cognitive Reappraisal; *p* = p-values; *R*-squared = determination coefficient; *SCS* = Self-Compassion Scale; *Std.*= Standard
*[Dummy_Group=.00] represents the MSC group (reference)
**[Dummy_Group=1.00] represents the KY group. Defined in 0 due to redundancy.

Table 39 *Quantile Regression Results for High Frequency in Normalized Units (HFnu) of Recovery 3 at the 50th Percentile for Expressive Suppression Predictors only (ERQ-ES and ERQ-SE_Group)*

Predictors	Coefficients	Std. Error	t-value	*p*	Pseudo R-squared	Mean Absolute Error	95% Confidence Interval		Dummy_Group Prediction	
							inferior	superior	.00	1.00
(Intercept)	50.50	18.34	2.75	0.014			11.80	89.20		
ERQ-ES	-2.09	1.65	-1.27	0.223			-5.57	1.39		
ERQ-ES_Group	0.74	2.40	0.31	0.761	0.19	9.80	-4.31	5.79	50.12	35.96
[Dummy_Group=.00]	14.16	23.09	0.61	0.548			-34.56	62.88		
[Dummy_Group=1.00]	0	.	.	.			.	.		

Note. n = 21. *ERQ-CR* =Emotional Regulation Questionnaire-Cognitive Reappraisal; *p* = p-values; *R*-squared = determination coefficient; *SCS* = Self-Compassion Scale; *Std.*= Standard
*[Dummy_Group=.00] represents the MSC group (reference)
**[Dummy_Group=1.00] represents the KY group. Defined in 0 due to redundancy

With regard to HFnu Recovery 5, analysis of the initial comprehensive model revealed no significant predictors for HFnu of Recovery 5. The predicted values were 49.76 for the MSC group and 30.86 for the KY group. The model's pseudo R-squared was 0.29 (Table 40). Next, a model including total SCS, ERQ_CR and Group as predictors was tested, which also revealed no significant predictors. The predicted values for HFnu of Recovery 5 were 52.70 for the MSC group and 36.83 for the KY group. The model's pseudo R-squared was 0.16 (Table 41). Lastly, a model including ERQ-ES, ERQ_ES*Group and Group as predictors was tested, which also revealed no significant predictors. The predicted values for HFnu of Recovery 5 were 38.62 for the MSC group and 52.53 for the KY group. The model's pseudo R-squared was 0.23 (Table 42).

Table 40 *Quantile Regression Results for High Frequency in Normalized Units (HFnu) of Recovery 5 at the 50th Percentile*

Predictors	Coefficients	Std. Error	t-value	*p*	Pseudo R-squared	Mean Absolute Error	95% Confidence Interval		Dummy_Group Prediction	
							inferior	superior	.00	1.00
(Intercept)	80.65	33.28	2.42	0.03			9.71	151.59		
Total SCS	-8.06	6.87	-1.17	0.26			-22.71	6.59		
ERQ-CR	-0.05	0.55	-0.08	0.94			-1.21	1.12		
ERQ-ES	-2.29	1.30	-1.76	0.10	0.29	8.91	-5.06	0.48	49.76	30.86
ERQ-ES_Group	0.43	1.79	0.24	0.81			-3.38	4.24		
[Dummy_Group=.00]	18.90	17.15	1.10	0.29			-17.66	55.45		
[Dummy_Group=1.00]	0	.	.	.	.	.	.	.	.	.

Note. This quantile regression model includes all predictors that did not show multicollinearity issues. n = 21. Total SCS_Group and ERQ-CR_Group. *ERQ-CR* =Emotional Regulation Questionnaire-Cognitive Reappraisal; *ERQ-ES* =Emotional Regulation Questionnaire-Expressive Suppression; *p* = p-values; *R*-squared = determination coefficient; *SCS* = Self-Compassion Scale; *Std.*= Standard
*[Dummy_Group=.00] represents the MSC group (reference)
**[Dummy_Group=1.00] represents the KY group. Defined in 0 due to redundancy

Table 41 *Quantile Regression Results for High Frequency in Normalized Units (HFnu) of Recovery 5 at the 50th Percentile for Self-Compassion and Cognitive Reappraisal Predictors only (Total SCS and ERQ-CR)*

Predictors	Coefficients	Std. Error	t-value	*p*	Pseudo R-squared	Mean Absolute Error	95% Confidence Interval		Dummy_Group Prediction	
							inferior	superior	.00	1.00
(Intercept)	14.43	37.98	0.38	0.71	0.16	10.60	-65.69	94.55	52.70	36.83
Total SCS	4.99	7.76	0.64	0.53			-11.38	21.36		
ERQ-CR	0.11	0.69	0.15	0.88			-1.35	1.56		
[Dummy_Group=.00]	15.86	8.45	1.88	0.08			-1.97	33.70		
[Dummy_Group=1.00]	0	.	.	.	.	.	.	.	.	.

Note. n = 21. *ERQ-CR* =Emotional Regulation Questionnaire-Cognitive Reappraisal; *inf* = infinity; *p* = p-values; *R*-squared = determination coefficient; *SCS* = Self-Compassion Scale; *Std.*= Standard
*[Dummy_Group=.00] represents the MSC group (reference)
**[Dummy_Group=1.00] represents the KY group. Defined in 0 due to redundancy

Table 42 *Quantile Regression Results for High Frequency in Normalized Units (HFnu) of Recovery 5 at the 50th Percentile for Expressive Suppression Predictors only (ERQ-ES and ERQ-SE_Group)*

Predictors	Coefficients	Std. Error	t-value	*p*	Pseudo R-squared	Mean Absolute Error	95% Confidence Interval		Dummy_Group Prediction	
							inferior	superior	.00	1.00
(Intercept)	70.88	14.65	4.84	0.00	0.23	9.63	39.97	101.79	38.62	52.53
ERQ-ES	-0.74	1.32	-0.57	0.58			-3.52	2.03		
ERQ-ES_Group	-2.56	1.91	-1.34	0.20			-6.59	1.48		
[Dummy_Group=.00]	-13.91	18.44	-0.75	0.46			-52.82	25.01		
[Dummy_Group=1.00]	0	.	.	.	.	.	.	.	.	.

Note. n = 21. *ERQ-CR* =Emotional Regulation Questionnaire-Cognitive Reappraisal; *inf* = infinity; *p* = p-values; *R*-squared = determination coefficient; *SCS* = Self-Compassion Scale; *Std.*= Standard
*[Dummy_Group=.00] represents the MSC group (reference)
**[Dummy_Group=1.00] represents the KY group. Defined in 0 due to redundancy

Discussion

Self-compassion has been proposed to serve as a tool to moderate emotions in socially challenging situations (Leary et al., 2007; Luo et al., 2018). Evidence suggests that increased self-compassion is associated with lower stress levels as measured by vmHRV (Svendsen et al., 2016). Mindfulness and self-compassion-based interventions have been shown to foster stress management both psychologically and physiologically (Biber, 2022; Mysuria et al., 2020). Therefore, it was hypothesized that participants who received a 9-week virtual MSC training would exhibit reduced levels of physiological stress and higher levels of vmHRV compared to KY participants when performing a social stress test. Additionally, it was hypothesized that participants trained in MSC would exhibit lower levels of perceived state anxiety and negative affect associated with the stress response, compared to participants trained in KY. Finally, it was hypothesized that the physiological outcomes in the MSC group, compared to those in the KY group, would be explained by improved psychological outcomes resulting from the MSC training.

To test the first hypothesis, the present study evaluated the physiological response of female primary school teachers to the TSST after a 9-week online MSC training (Neff & Germer, 2013) during the COVID-19 pandemic, as compared to an active control condition (KY). To evaluate the second hypothesis, changes in perceived anxiety and affect pre- and post-TSST were analyzed within groups and compared between groups. To test the last hypothesis, self-compassion and emotion regulation were tested in regression to the HFnu during Recovery 3 and 5. Considering the sanitary restrictions, a semi-virtual adaptation of the Trier Social Stress Test (Gunnar et al., 2021; Kirschbaum et al., 1993) was conducted to induce psychosocial stress.

Physiological Stress Response

Time-domain, frequency-domain and nonlinear methods suitable for ultra-short-term recordings (Baek et al., 2015; Burma et al., 2021; Castaldo et al., 2019; Lee et al., 2022; Liu et al., 2023; McNames & Aboy, 2006; Munoz et al., 2015; Pereira et al., 2017; Shaffer et al., 2020; Wu et al., 2020) were analyzed for the five stages of the TSST: Rest, Preparation, Speech, Math, and Recovery. For the Recovery stage, five time-windows were considered to capture the progression of the recovery process.

Overall analysis permitted confirming that this semi-virtual TSST approach was effective in eliciting a physiological stress response both in the MSC and the KY participants. This was as expected, considering the TSST is a gold-standard psychosocial stress paradigm used to elicit physiological stress by activating the sympathetic adrenomedullary system and the hypothalamic-pituitary-adrenal axis, which leads to increased physiological responses such as increased HR, blood pressure and cortisol release (Allen et al., 2014; Bluth et al., 2015; Luo et al., 2018; Dickerson & Kemeny, 2004; Pereira et al., 2017; Shah et al., 2024). However, verifying the effectiveness of our approach was crucial, as various methods for conducting the TSST had been proposed until previously, including both in-person and fully virtual formats (Gunnar et al., 2021; Narváez et al., 2020), but never in a semi-virtual format where the panel was remotely connected via videoconference. The mean HR and mean NN metrics were utilized as appropriate measures to assess the effects of stress on physiological dimensions in UST recordings (Pereira et al., 2017). However, they may not clearly indicate whether changes in HRV are driven by predominant activation or deactivation of the SNS or PNS (von Rosenberg et al., 2017). By observing simultaneous changes across multiple levels of analysis (time-domain, frequency-domain, and nonlinear) during the TSST, a consistent perspective was obtained for categorizing stress, providing a comprehensive approach to the impact of stress on the ANS, and the autonomic subsequent response. The evolution of the curves consistently indicated an increase in stress during the stress-eliciting stages and a decrease during recovery, in line with previous studies (Bluth et al, 2016; Luo et al., 2018; Andorfer et al., 2023). Both groups exhibited a stress response where global HRV, reflecting both sympathetic and parasympathetic activity, was evident. During stress stages, short-term variability indicators, such as RMSSD, HF, and SD1, decreased, while variables like LF, LF/HF, and SD2/SD1 increased. As a point to remember, the latter are not solely indicative of sympathetic activity, as they may also reflect parasympathetic influences and, in the case of LF, also the baroreflex responses (Billman, 2013; Burr, 2007; Kleiger et al., 2005; von Rosenberg et al., 2017). Nevertheless, changes in HF relative to LF provide valuable insights into autonomic function and HRV. Frequency-domain measures are suitable for determining the contribution of each autonomic component, but considering absolute values for LF and HF is recommended to accurately assess the predominance of one branch over the other (Task Force, 1996). It is interesting to note that HR and vmHRV as measured by the HFnu mirror each other across stages.

Within-group evaluation showed that participants in the MSC group experienced a significant increase in stress from the Preparation through the Speech and Math stages, as observed through increased mean HR and decreased mean NN. As evidenced in previous studies, the preparation period constituted an anticipatory process that, in itself, presented a challenge capable of significantly increasing stress levels (Bluth et al., 2015; Luo et al., 2018). This was accompanied by a decrease in vmHRV, indicated by reductions in RMSSD, HF (ms^2 and nu), and SD1 measures, consistently with previous studies (Lackschewitz et al., 2008; Man et al., 2023). While stress levels were still high at Recovery 1, Recovery 2, 3 and 4 showed no difference compared to Rest in mean HR and mean NN, indicating a return to baseline within 5 to 10 minutes. Furthermore, vmHRV increased as soon as the stress-stages ended, that is, from Recovery 1 onward. These changes reflect an adaptive homeostatic adjustment, where the sympathetic stress response to a social-evaluative threat led to increased heart rate through adrenergic stimulation, accompanied by cholinergic vagal withdrawal. Subsequently, HRV returned to baseline levels, and resting parasympathetic dominance was regained once the threat subsided, indicating flexible SNA control over the cardiac function (Gaidica & Dantzer, 2020; Motiejunaite et al., 2021). These findings align with prior research, not involving contemplative practices, which conducted the TSST in adult populations, demonstrating similar patterns in both time-domain and frequency-domain measures (Lackschewitz et al., 2008; Klumbies et al., 2014), as well as HR and RSA measures in adolescents (Bluth et al., 2016). The MSC participants demonstrated post-stress recovery in shorter times than those reported in similar studies where baseline physiological levels were reached in approximately 15 to 20 minutes (Lackschewitz et al., 2008; Wearne et al., 2019; Bluth et al., 2016). However, a new increase in mean HR and decrease in mean NN were observed at Recovery 5. Although noteworthy, this might not be linked to the previous stress episode but could instead be a response to a new source of stress, such as the length of time spent at the site. This is plausible considering that the entire TSST protocol involved approximately one hour and thirty minutes, and participants had previously been performing the EPT task and undergoing the placement of the registration device and ECG electrode. Interestingly, increases in mean HR along the stress response were accompanied by increases in middle-term variability indicators. LFnu increased from Preparation through Speech and Math, the LF/HF ratio increased at Speech and Math, and the SD2/SD1 ratio did from Preparation through Speech, Math and Recovery 1. Although these findings could be interpreted as either increased dominance of the sympathetic branch or decreased parasympathetic cardiac tone, the evidence of decreased parasympathetic measures (RMSSD and $HFms^2$) supports sympathetic dominance across those stages.

A separate consideration is warranted for the measures of HFnu, LFnu, and the LFnu/HFnu ratio. As argued by Burr (2007), although these normalized units present advantages because they reduce variability in raw HRV spectral power and provide consistent values across studies, physiological assumptions should take into account their algebraical redundancy. Since normalized measures are calculated from the initial statistical estimation of power in the LF and HF bands rather than being directly derived from raw R-R intervals, reporting them as reflecting sympathetic and parasympathetic activities may lead to misinterpretation of the actual physiological events. LFnu and HFnu are expressed on a 0-1 proportion, making them predictable from each other (LFnu = 1 –

HFnu, and HFnu = 1 – LFnu,). Similarly, the LF/HF ratio is redundant with respect to LFnu and HFnu. Any change in LFnu or HFnu impacts the other in the opposite direction, while PNS and SNS branches may change both oppositely or similarly, and following a nonlinear relationship (Billman et al., 2013; Tomasi et al, 2024). LFnu, HFnu, and the LF/HF ratio are interdependent, hence reflecting overall HRV. As stated by the author, to fully describe power distribution across spectral components and ascertain physiological behavior, absolute values should be reported, as also recommended by the Task Force (1996; Burr, 2007). Accordingly, the decrease in HFnu from Preparation to Math, along with a significant decrease in $HFms^2$, as well as in RMSSD, supports the notion of parasympathetic withdrawal during stress stages, followed by an increase indicated by a return to baseline values.

Participants in the KY group also showed a significant increase in stress from the Preparation stage through the Speech and Math levels, as observed through the increased mean HR and decreased mean NN. The increase in Mean HR was accompanied by increased LFnu and SD2/SD1 ratio during Speech and Math, and the LF/HF ratio during Speech. With regard to mean HR, values remained significantly higher than Rest during all stages but Recovery 3. This was accompanied by decrease in mean NN in all stages but Recovery 2 and 3. Together, these findings suggest the recovery post-stress was fully achieved at Recovery 3, followed by a new increase in mean HR and decrease in mean NN starting from Recovery 4. As with the MSC group, the increase in stress by the end of the Recovery period may be attributed to the procedure's length. With regard to short-term variability indicators, decreases in RMSSD, HFnu and SD1 were observed at Speech and Math stages, and $HFms^2$ at Math. Intriguingly, no changes emerged at Preparation in this group. Hence, although an anticipatory stress response was observed as measured by the mean HR and NN, a vagal withdrawal in this stage was not evident. This is interesting considering that the KY group showed significantly higher self-reported expressive suppression than MSC when the emotional regulation was tested post-training, which might have been used as a regulatory strategy, although this finding was no longer present when re-tested including only participants who performed the TSST. Similar to the MSC group, LFnu and SD2/SD1 ratio increased accompanying mean HR during Speech and Math, and the LF/HF ratio increased at Speech. The SD2/SD1 ratio increased again at Recovery 5.

Comparisons of physiological measures between the MSC and KY groups across the different TSST stages were conducted to test the hypothesis that participants trained in MSC would exhibit lower levels of physiological stress and higher levels of HRV. Differences between groups were found in the Recovery stage, time-windows 3 and 5. Contrary to our expectations, no differences were found in the physiological stress response during the stress stages as measured by mean HR and mean NN across groups. These findings align with previous studies comparing HR in individuals with high and low self-compassion, which found no differences between groups in HR when performing the TSST (Bluth et al., 2016; Luo et al., 2018). As proposed by Bluth et al., (2016), a ceiling effect with both groups displaying a maximum increase in HR during the stress-eliciting stages could explain these results. Although lower values for the MSC group were expected in our hypothesis, the observed capability to respond with a maximal stress activation, reflecting dominance of the sympathetic branch may reveal proper, adaptive and flexible functioning of ANS regulation, enabling the activation of the fight-or-flight response when needed. As discussed by Berntson et al. (2008), both sympathetic and parasympathetic contributions enable adaptive cardiovascular responses, and overall HRV, including the sympathetic predominance in challenging situations, reflect a healthy autonomic response. An autonomic response that oscillates to adapt to a changing environment, as reflected in overall HRV, is essential for healthy functioning (Thayer & Lane, 2000, 2009). Sympathetic dominance during stressful moments is crucial; a lower response may not be adaptive in the face of a threat. However, if one process predominates excessively, the autonomic sympathetic/parasympathetic balance is disrupted, compromising flexible responsiveness. While autonomic imbalance with predominant sympathetic hyperactivity poses health risks, a stress response characterized by sympathetic dominance and parasympathetic withdrawal reflects necessary dynamic flexibility for survival (Thayer & Sternberg, 2006). Thus, a sufficient cardiovascular response that manages stress while maintaining high vmHRV may not indicate a healthy reaction. This relates to allostasis (Sterling, 2004), the physiological process by which an organism confronted to a demand or stressor achieves stability through change. Effective adaptation requires modifying parameters based on needs, allowing organisms to adjust to changing environments. Allostatic regulation describes this process, where regulated values are flexible to optimally meet demands (Sterling, 2012). Importantly, both MSC and KY exhibited the same response. Comparing with a passive control group would have enhanced our understanding of whether these responses were attributable to the capacities developed during the training. Although no statistical differences between groups were found for the stress-eliciting stages, it is interesting to note that, while both groups showed increased HR during the Preparation stage, only the MSC group showed a decrease in parasympathetic activity in this period. Considering a healthy and flexible stress response involves both the sympathetic dominance and parasympathetic withdrawal, this could be indicating an adaptive advantage in managing stress for the MSC group, showing an enhanced ability to respond to stress in a balanced and effective manner, by appropriately engaging both the sympathetic and parasympathetic branches of the ANS.

Concerning recovery post-stress and return to parasympathetic dominance, comparison between groups revealed differences in the frequency-domain parameters during Recovery 3 and 5, with the MSC group showing higher HFnu, lower LFnu, and a lower LF/HF ratio. Furthermore, during Recovery 5, the SD2/SD1 ratio was lower in the MSC group. Considering the previous discussion on the normalized variables, to interpret the physiological outcomes normalized results were compared to absolute values, (i.e., LF and HF in ms^2). With regard to Recovery 3, the absolute values elucidated the observed differences between groups, showing higher HF and lower LF in the MSC group compared to KY, both in normalized and absolute units, which was also reflected in the LF/HF ratio. Consequently, the MSC group demonstrated a parasympathetic predominance in Recovery 3, explaining the baseline values.

During Recovery 5, although HFnu was higher in MSC, this was not corroborated in absolute values, as $HFms^2$ was similar between groups. Meanwhile, a higher LF both in normalized and absolute values in the KY group explained the difference between groups in this time-window, which was consistent with higher LF/HF and SD2/SD1 ratio for KY than MSC. Essentially, while in Recovery 3 the difference between groups could be explained by an increase in short-term HRV in the MSC group, indicating parasympathetic predominance, in Recovery 5 the difference was mainly due to an increase in middle-term HRV in the KY group, presumably due to increased stress in this group. Accordingly, when measured within-group, the SD2/SD1 for KY was also higher in Recovery 5. Overall, a higher vmHRV was observed in the MSC group in Recovery 3, observed both in comparison to the KY group and when analyzed within-group with respect to Rest. Remarkably, the MSC group showed a rapid return to baseline values of HR and vmHRV, indicating an adaptive functioning system capable of healthy responding to environmental challenges (Jentsch & Wolf, 2020; Schiweck et al., 2018; Tomasi et al., 2024). The reduction observed in vmHRV, as part of the stress response, followed by a return to baseline levels as the stressors disappeared, is similar to the pattern observed by Luo et al. (2018) when comparing high versus low self-compassionate individuals, emphasizing the importance of self-compassion in flexibly regulating physiological responses to stressors. Importantly, as discussed by Flores-Kanter et al. (2021), the post-stress recovery period is crucial for returning to homeostatic states both at physiological and behavioral levels, achieved through the process of allostasis, which involves flexible adaptation to changing conditions, thereby preventing chronic stress-related problems (Gormally et al., 2019; Karatsoreos

& McEwen, 2011; Sterling, 2004). Although no significant baseline differences were observed between groups (Rest stage), it is noteworthy that absolute LF and HF values at rest showed similar trends as those observed in the recovery periods, with the MSC group exhibiting lower LF and higher HF values compared to the KY group. This raises the question of whether this trend might be more pronounced with a larger sample size.

Individuals high in self-compassion treat themselves kindly during negative events, leading to more positive coping and better handling of challenges (Allen & Leary, 2010). Self-compassion fosters loving awareness towards oneself, protecting against self-reproach, and is positively correlated with optimism and negatively correlated with neuroticism and negative affect (Neff, 2023; Heffernan et al., 2010). When comparing high versus low self-compassionate individuals, those high in self-compassion exhibited higher vmHRV at baseline (Luo et al., 2018; Svendsen et al., 2016), as well as when facing a social-evaluative threat (Luo et al., 2018), demonstrating greater autonomic flexibility during stress. High self-compassionate individuals experienced reduced negative affect and fast recovery from stress, exhibiting higher adaptive emotion regulation to stressful events, thus emphasizing self-compassion's role in modulating physiological and emotional responses (Luo et al., 2018). Self-compassion helps reframe stressful experiences, reducing perceived negativity and anxiety. It involves accepting adverse events and using positive cognitive reframing as an emotional regulation strategy (Allen & Leary, 2010). The ability to regulate emotions impacts stress response and recovery (Jentsch & Wolf, 2020). As discussed by MacIntyre et al. (2010), successful emotion regulation may be partially influenced by the ability to promptly adjust cardiac function to stressful situations. Adaptive emotion regulation enables healthy post-stress recovery by facilitating the management of negative experiences and the effective control of emotional responses (Flores-Kanter et al., 2021; Miklosi et al., 2014; Murray et al., 2021). Emotion regulation involves strategies to influence the emotional experience (Gross, 1998). While reappraisal changes the interpretation of an unpleasant emotion to reduce its impact (Gross & John, 2003; Lazarus & Alfert, 1964), emotional suppression seeks to attenuate the expression of the current emotional state (Gross, 1998; Gross & John, 2003). Reappraisal promotes regulatory flexibility and dynamic physiological adjustments to the situation (Jentsch & Wolf, 2020; Kim et al., 2018; Balzarotti et al,, 2017). It leads to phasic vagal withdrawal during stress, followed by rapid vagal tone recovery post-stress, indicating healthy adaptation (Schiweck et al., 2018). Conversely, suppression increases cortisol and sympathetic activity, raising physiological stress (Goldin et al., 2008; Lopez & Denny, 2019; Tyra et al., 2023). Slow cardiovascular recovery is linked to poor emotional regulation (Smith et al., 2020). Interestingly, Jentsch & Wolf (2020) found that participants who used reappraisal instead of suppression during the TSST experienced significantly greater reductions in HRV during stress, but also showed a more pronounced HRV recovery post-stress. The observed physiological differences between groups, showing faster and more sustained post-stress recovery with higher vmHRV in the MSC group, may be due to MSC participants facing challenges with more self-kindness and less self-reproach. This would likely facilitate more effective emotional regulation through strategies like reframing and reappraisal, leading to better post-stress recovery. To determine if these results are attributable to self-compassion and improved emotion regulation, it is essential to analyze their impact on the physiological outcomes. These findings prompt us to explore the final hypothesis, which regards the potential effect of improved psychological outcomes from MSC training on the physiological results, which could explain the differences observed between the MSC and KY groups.

In summary, our hypothesis that participants trained in MSC who performed a social stress test would exhibit reduced levels of physiological stress and higher levels of vmHRV compared to KY participants was partially confirmed. While both groups exhibited a similar stress response, the MSC group showed higher levels of vmHRV throughout the recovery stage, which increased earlier and lasted longer.

Anxiety and Affect

Questionnaires on anxiety and affect were used in addition to physiological measures to evaluate the results of the TSST on subjective stress, following the guidelines of Narvaez Linares et al. (2020) concerning systematic implementation of the TSST. Both the VAAS and STAI-S measures assess the subjective experience of anxiety in the moment, making them sensitive to changes in anxiety levels due to stressful circumstances such as social evaluative threat (Narváez Linares et al., 2020). The systematic review by Man et al. (2023) reports that TSST stress results in increased anxiety and negative affect, as well as decreased positive affect although with marginal changes.

As explained by Spielberger (1971), anxiety is a concept that encompasses both a transient state and a personality trait. Given the nature of this study, our focus was on state anxiety, which refers to an unpleasant emotional response characterized by apprehension and somatic symptoms of tension, emerging when an individual perceives a situation as dangerous or frightening (American Psychological Association, 2018; Spielberger, 1971). It involves consciously perceived feelings of tension and anxiety, with specific duration and intensity based on the subjective appraisal of the situation, and is accompanied by ANS hyperactivity (Buela-Casal et al., 2011; Spielberger, 1971). Meanwhile, the affective system, as described by Cacioppo et al. (1999), encompasses two evaluative components, one negatively valenced that processes threat-related stimuli, and the other positively valenced that processes appetitive, safety-related stimuli. Changes in affect can be described as involving reciprocal positivity and negativity activation (opposing effects), uncoupled activation (only positive or only negative), and nonreciprocal activation (increases or decreases in both positivity and negativity) (Cacioppo et al., 1999; Roemer & Medvedev, 2023).

Comparison of state anxiety and positive and negative affective states between MSC and KY groups yielded no differences, with low to moderate effect sizes, indicating that the TSST was equally efficacious for both groups and that neither group experienced better or worse anxiety outcomes.

Regarding within-group assessment of state anxiety, both VAAS and STAI-S showed a significant increase in both groups from pre- to post-stress, with high effect sizes, which confirmed the psychological impact of the social-evaluative threat accompanying the physiological outcomes, in line with previous reports (Bluth et al., 2016; Hellhammer & Schubert, 2012). With regard to affect, no changes in positive or negative affect were observed from pre- to post-stress in the MSC group, while the KY group exhibited a decrease in positive affect post-stress, with high effect size. As discussed by Allen & Leary (2010), self-compassionate individuals are more likely to reframe their experiences in a way that permits them to cope with difficult situations, approaching them from a more positive perspective. Comparisons between high and low self-compassionate individuals have shown that the former exhibit less negative affect (Bluth et al., 2016; Luo et al., 2018). In our study, although groups were not divided by self-compassion levels and the comparison of affective states between groups did not yield significant results, it is noteworthy that the KY group experienced a decrease in positive affect post-stress, whereas the MSC group did not. This may be revealing a difference in the way both groups perceived the stress experience, where the MSC group affective state was not impacted by the threatening event, while the control group decreased their safety-related feelings after the social-evaluative threat. Also, this might suggest that higher levels of self-compassion in the MSC group may have buffered them from a decrease in positive affect or an increase in negative affect.

Although these results do not support our hypothesis, as no lower levels of state anxiety or negative affect were found in the MSC group compared to KY, it is worth considering whether a larger sample size might have accentuated these findings and revealed a difference between groups.

Impact of perceived self-compassion and emotion regulation on vmHRV

The third hypothesis of this chapter posits that the physiological outcomes exhibited by the MSC group, as compared to those in the KY group, are explained by improved psychological outcomes resulting from the MSC training. As described in Study I, the variables that showed significant differences between groups were the personal distress subscale of the IRI, which measures perceived empathy, and the expressive suppression subscale of the ERQ, which measures perceived emotional regulation. In both cases, these were lower in the MSC group.

To evaluate the personal distress component of empathy as a predictor of the physiological stress response, alternative methodologies would have been required, such as assessing the stress response of a participant acting as a passive observer while another participant undergoes the TSST (Engert et al., 2014; Frisch et al., 2015). However, an approach of this nature extends beyond the scope of this study. Regarding expressive suppression, to obtain a comprehensive understanding of the potential impact of emotion regulation on the physiological outcomes, not expressive suppression but also cognitive reappraisal strategies were considered as predictors. We also included mindfulness and self-compassion as predictors, since they are the focus of interest in this thesis, particularly self-compassion, which has been described as a buffer for stress and is consistently related to vmHRV (Arch et al., 2014; Bluth et al., 2016; Luo et al., 2018; Svendsen et al., 2016). Interestingly, despite no differences being found between groups for these variables, within-group assessments showed that the MSC group significantly increased all three compassionate subscales of the SCS post-training, with large effect sizes. Additionally, a difference between groups was found for mindfulness at the follow-up, with the MSC group exhibiting higher levels of observing and total FFMQ, as well as for cognitive reappraisal, which also resulted higher for the MSC group. These findings observed during the follow-up are noteworthy because they reveal an ongoing process that was presumably occurring during the period in which the TSST was conducted. However, contrary to our expectations, when we reduced the sample to only the participants who completed the TSST and repeated the between-group comparisons of self-reports, no differences were found. These results suggest a significant influence of sample size on the findings, as only 21 teachers were finally included in the physiological variable analysis. This was due to a drop-out rate accentuated by additional absences resulting from the pandemic, which was in a resurgence period in our country during those months, in addition to data collection technical issues and poor ECG data quality verified offline.

With regard to physiological variables, HFnu, LFnu, and LF/HF exhibited significant differences between groups in Recovery 3 and 5, while SD2/SD1 also did in Recovery 5. Considering warnings against using LFnu, LF/HF, and SD2/SD1 as reliable indicators of sympathetic or parasympathetic dominance (Billman et al., 2013; Kleiger et al., 2005; Rahman et al., 2018) and against interpreting HFnu, LFnu, and LF/HF as separate variables due to their algebraic interdependency (Burr, 2007), HFnu was selected. HF is widely accepted as a reliable indicator of short-term variability (Task Force, 1996; Kleiger et al., 2005; von Rosenberg et al., 2017), offering valuable insights into the parasympathetic influence on heart rate variability (vmHRV), which is particularly relevant during the recovery period. This selection was a methodological decision aimed at ensuring the reliability of the results and subsequent interpretations.

Before conducting the regression analysis, correlations were examined to evaluate the relationships between dependent variables (HFnu for Recovery 3 and 5) and predictors, and to identify any strong linear associations among the predictors. The predictors included total mindfulness (measured by the total FFMQ score), total self-compassion (measured by the total SCS score), expressive suppression (measured by ERQ_ES), and cognitive reappraisal (measured by ERQ_CR). A very high correlation was found between mindfulness and self-compassion, which is not unexpected since mindfulness is a core component of self-compassion. As discussed by Neff (2023), self-compassion involves being mindful of one's suffering, responding with kindness, and without judgment. It requires being present and accepting discomfort rather than avoiding or resisting it. This mindful attitude helps recognize that experiences are dynamic and transient. To offer ourselves self-kindness, we need to stop resisting and change our perspective, observing ourselves from an external viewpoint, with a mindful attitude. In Neff's own words (2023), "mindfulness is the pillar on which self-compassion rests" (section 7.4). Including both variables in the regression model could lead to redundancy, capturing similar aspects of the constructs being measured. Thus, the total FFMQ was excluded from further analysis to simplify the model due to the conceptual overlap between the constructs. By excluding the mindfulness predictor, the model focuses on self-compassion as a broader construct that encompasses mindfulness, thereby reducing multicollinearity and redundancy, and providing a clearer interpretation of the results.

Regarding the relationships between the dependent variables and predictors, no significant correlations were found. This was anticipated, given that no differences in mindfulness, self-compassion, or emotion regulation were observed between the groups in the sample that performed the TSST. Nevertheless, given that correlation only provides information about the linear relationship between two variables, a regression analysis was next conducted because it integrates variables into a comprehensive model, potentially revealing more complex relationships than those suggested by individual correlations, due to its ability to control for multiple variables simultaneously and model complex interactions (Pandey, 2020).

After addressing other multicollinearity issues, the final regression model included group, self-compassion, cognitive reappraisal, expressive suppression, and the interaction between expressive suppression and group. Other interactions were excluded due to multicollinearity issues.

An initial regression analysis for HFnu Recovery 3 revealed no significant predictors. However, there was an observed trend where the MSC group had a higher predicted HFnu value compared to the KY group when considering the combined contributions of all variables in the model. This suggested that, collectively, the predictor variables might have exerted a greater impact on the MSC group. While this difference was not statistically significant, it offers insight into potential patterns that warrant further investigation. Upon observing these results, the question emerged whether some predictors might be counteracting each other, thus hindering a clear analysis of their impact on the dependent variable. Based on this consideration, and given that cognitive reappraisal and expressive suppression are strategies that can elicit opposing outcomes (Jentsch & Wolf, 2020), a new regression analysis was warranted, separating these variables.

When regression analysis was conducted excluding predictors related to expressive suppression and focusing on group, self-compassion, and cognitive reappraisal, no significant predictors were found, indicating that these variables did not impact HFnu individually. However, the group predictor showed a marginal significance, with the MSC group exhibiting a higher predicted value. This suggests that the difference between MSC and KY groups was not captured by self-compassion and cognitive reappraisal alone, but was reflected in the group predictor. Hence, combining group, self-compassion, and cognitive reappraisal showed a marginally greater impact on HFnu for Recovery 3 in the MSC group compared to the KY group. While this finding is not conclusive as it only suggests a trend, it aligns with expectations, since a higher level of vmHRV at this stage in the MSC group could be attributed to higher levels of self-compassion and a greater ability to reframe challenging situations as an emotion regulation strategy.

When regression analysis was conducted focusing on group, expressive suppression, and the interaction of expressive suppression and group, no significant predictors were found. This indicates that these variables did not impact HFnu in Recovery 3, either individually or when adjusted for the group variable. This was as expected considering expressive suppression is not positively associated with vmHRV but with increased levels of stress (Jentsch & Wolf, 2020; Gross, 2015). Effect sizes of all regression analysis for HFnu in Recovery 3 were moderate.

The same procedure was followed for the dependent variable HFnu in Recovery 5. In this case, none of the regressions showed significant predictors, with a high effect size for the first regression and moderate for the subsequent ones. Despite no statistical significance, different trends were observed in how the emotion regulation strategies interacted with the groups. While the regression with all combined predictors, as well as the one containing group, self-compassion, and cognitive reappraisal, showed a higher HFnu for the MSC group, the regression focusing on emotional suppression showed a higher HFnu for the KY group.

It is important to consider that, although HFnu for MSC was higher than for KY in Recovery 5, absolute values were similar between groups, with a decrease value for MSC as compared to Recovery 3. These inverted trends could be suggesting that emotional suppression may have interfered more with the emotion regulation strategies in the MSC group in Recovery 5, or even less in the KY group, which maintained similar absolute values of HFn in both recovery periods, even slightly higher in Recovery 5.

Based on these results, we cannot confirm that our hypothesis was supported, as it was not possible to explain the physiological outcomes by self-compassion skills or enhanced emotional regulation. However, the observed trends across the regressions suggest that, with a higher sample of participants, self-compassion and cognitive reappraisal might have predicted improved emotional regulation at least for the Recovery 3 period. A larger sample would increase statistical power, making it easier to detect subtle effects and clarifying central trends that may be obscured in smaller samples. Additionally, longer interventions should be considered, as they might yield clearer results. Given that some individuals adopt mindfulness as a lifestyle, it is likely that these individuals would show different outcomes. In this study, the objective was to test the effect on heart rate variability immediately post-training, and given the 9-week duration of the program, an alternative approach was not feasible.

General Discussion

The high levels of psychosocial stress experienced by teachers in Uruguay justify the implementation of interventions aimed at strengthening their personal resources, thus enabling them to effectively regulate emotions, cope with work-related challenges, and cultivate rewarding relationships at work. Teachers themselves have expressed the need for tools to reduce stress, enhance well-being, and provide them with competencies to build supportive relationships and healthy educational environments. Despite increasing evidence worldwide of the benefits of mindfulness and self-compassion practice for teachers (Berkovich-Ohana et al., 2019; de Carvalho et al., 2021; Hidajat et al., 2023; Hwang et al., 2017; Janssen et al., 2023; Jennings et al., 2017; Klingbeil & Renshaw, 2018; Lathren et al., 2021; Neff, 2023; Neff & Beretvas, 2012; O'Hara-Gregan, 2023; Sotiropoulou et al., 2023; Tarrasch et al., 2020; Tsang et al., 2021), these trainings are not yet considered in Uruguay as an approach to address these needs. Furthermore, this topic has not been previously explored from a contemplative neuroscience perspective. In light of this, the present thesis compares the effects of a 9-week virtual adaptation of the MSC program (Neff & Germer, 2013; Germer & Neff, 2019) to those of an active control group undergoing KY training in primary school teachers in Uruguay. This comparison focuses on: i) self-perception of mindfulness, self-compassion, emotional regulation, stress, burnout, empathy, and well-being; ii) empathic abilities in an empathy-for-pain task; and iii) physiological indices of stress and emotion regulation in response to a psychosocial stress test.

The general hypothesis proposed that primary school teachers from Uruguay who undergo a 9-week virtual MSC training would express long-lasting and more pronounced improvements of mindfulness and self-compassion skills, associated with higher emotional and social competencies and better autonomic nervous system adaptability to stressors, compared to those elicited by an active control condition (KY training), which does not explicitly focus on self-compassion.

This was partially confirmed, as explained in relation to each of the studies conducted, detailed across Chapters I and II as follows.

Chapter I, Study I

The hypothesis of Study I was that teachers from Uruguay who had completed a 9-week virtual MSC training would express greater self-perceived mindfulness and self-compassion skills, compared to a KY training. It was also hypothesized that perceived emotional regulation, well-being and empathy would improve, and perceived stress and burnout symptoms would decrease, after the online MSC training, in comparison with online KY training. Finally, it was hypothesized that the changes in self-reported measures at post-training would persist for three months.

To test this, comparisons between groups were performed at pre-, post-training and at follow up 3 months later. Due to the pandemic occurring at the time this work was conducted, adaptations to virtual formats were required for both the MSC and KY trainings. Hence, in addition to comparing between groups, we were also interested in observing changes within the MSC group over time, as the virtual format of the program was being tested for the first time worldwide. Spanish versions of the following questionnaires were used: FFMQ (Baer et al, 2006; Cebolla et al., 2012), SCS (Neff, 2003a; García-Campayo et al., 2014), ERQ (Gross & John, 2003; Larrieux, 2008), WHO-5 (World Health Organization, 1998; Topp et al., 2015; Lara-Cabrera et al., 2022), IRI, (Davis, 1980, 1983; Fernández et al., 2011), PSS (Cohen et al., 1983; Tapia et al., 2007), and MBI-ED (Maslach et al, 1996; Seisdedos, 1997).

Concerning the first hypothesis, within-group analysis post-training showed that MSC participants improved their perceived mindfulness and self-compassion skills. Interestingly, only the MSC group demonstrated improvements in all positive dimensions of self-compassion.

Comparisons between groups at pre-training showed both groups were equivalent, as no differences were observed between them in any of the studied variables. Post-training comparisons between groups revealed that the MSC group exhibited lower levels of expressive suppression of emotion regulation and personal distress of empathy compared to the KY group. Lower expressive suppression is beneficial on an individual level, as it is generally regarded as maladaptive, being associated with reduced positive emotions, well-being, and increased levels of stress, anxiety, and depression (Lopez & Denny, 2019; Gross & John, 2003; Gross, 2015). Similarly, lower personal distress is advantageous for prosocial behavior, as it refers to an unpleasant empathetic response characterized by anxiety and discomfort when confronted with another person's negative experience, often leading to self-protective avoidance (Preston & Hofelich, 2012; Decety, 2010). The within-group analysis also showed a reduction in these two variables in the MSC group post-test, while they did not change within KY.

At follow-up, the MSC group exhibited higher levels of observing and total mindfulness, as well as cognitive reappraisal in emotion regulation, when compared to the KY group. Higher mindfulness in the MSC group three months post-intervention was expected, as the mindful state has been reported to persist beyond the end of the intervention (Karing & Beelmann, 2021; Neff & Germer, 2013). Findings in emotion regulation at follow-up were in the same direction as those found post-training, indicating advantages for prosocial behavior. Cognitive reappraisal is considered an adaptive strategy for regulating emotions, as it allows individuals to reframe negative experiences and thus reduce the impact of unpleasant emotions (Gross & John, 2003; Lazarus & Alfert, 1964). This, in turn, helps minimize or avoid emotional exhaustion (Donker et al., 2020). Within-group analysis also showed an increase in observing and total mindfulness in the MSC group at follow-up, while the KY group increased acting with awareness and non-judging. Although improvements in emotion regulation were found in the MSC group as compared to KY at follow-up, no changes were found in the within-group analyses. Importantly, emotion regulation was positively impacted by MSC practice both in the short and long term, consistent with expectations since self-compassion fosters emotion regulation (Inwood & Ferrari, 2018).

A difference between groups was expected in self-compassion since MSC training specifically cultivates this skill. However, no significant differences emerged, likely due to improvements in both groups, as revealed in the within-group analyses. Notably, in these analyses, MSC improved all three positive self-compassion dimensions, while KY improved one.

Stress and well-being showed no differences between groups, as could be anticipated since both practices foster improvements in these areas (Conversano et al., 2020; Ansori, 2023). Supporting this, intra-group analysis revealed decreased stress and increased well-being in both groups. Interestingly, while burnout showed no differences between groups, within-group assessment showed only the MSC group demonstrated a reduction in emotional exhaustion post-training. Of note, both groups also showed some unexpected results, not anticipated in contemplative practices aimed at well-being, such as increased self-judgment at post-training and increased depersonalization at follow-up in the MSC group, and increased self-judgment and over-identification at post-training and increased stress at follow-up in the KY group.

In summary, both interventions provided benefits as measured through self-reports, and, although few studied variables showed significant differences between groups, those that differed indicate advantageous results for the MSC group. Furthermore, between-group and intra-group findings supported the effectiveness of the MSC program in a virtual format. Therefore, considering the results at post-training and follow-up, our hypotheses regarding differences between groups in self-perception of the studied variables were partially confirmed.

Chapter I, Study II

Study II hypothesized that teachers from Uruguay who completed a 9-week virtual MSC training would exhibit superior experimentally elicited empathic abilities compared to participants trained in KY, and that this would be found both in the short and long term, as measured by an experimental empathy for pain task (EPT; Decety et al., 2012; Baez et al., 2017). The EPT elicits empathic responses by presenting images depicting intentional harm, accidental harm, or neutral situations, and participants answer questions that assess cognitive empathy (intentionality comprehension of the inflicted harm) and affective empathy (empathic concern and personal distress) (Baez et al., 2014, 2016, 2017). It was also hypothesized that outcomes related to empathic abilities and perceived empathy would be consistent. To test this, empathic abilities were evaluated and the EPT performance compared between groups at pre-training, post-training, and follow-up, and subsequently compared to perceived empathy (see Study I).

Comparisons at pre-training confirmed that both groups were equivalent, since no significant differences emerged in any of the empathic responses to the EPT. Contrary to our expectations, comparisons at post-training and follow-up showed no differences between MSC and KY groups. Consequently, the hypothesis regarding differences between groups in empathic abilities both in the short and long term was refuted.

Within-group analysis of EPT performance in the MSC group showed increased cognitive empathy post-training, reflected in the accuracy of intentionality comprehension, i.e., the capacity to take the other's perspective (Decety & Jackson, 2004). This result demonstrated a high effect size. Remarkably, this increase was consistent with a higher score in self-reported perspective-taking post-training. Thus, the hypothesis regarding the consistency between empathic abilities and perceived empathy was partially confirmed, as it involved cognitive but not affective empathy. Notably, the effects of the training on empathic abilities were less evident than on self-reported empathy, which could be due to the fact that the empathy task is less influenced than self-reports by social desirability (Baez et al., 2017). Due to their caring role, teachers might perceive themselves as highly empathetic than real (Aldrup et al., 2022).

Meanwhile, it is interesting to note that the KY group showed a decrease in personal distress for intentional harm both in the short and long term, despite the lack of changes in self-reported empathy.

Self-report measures are useful in capturing how individuals perceive their own empathic abilities, but they are susceptible to social desirability bias, which can lead to responses being adjusted to appear more socially or morally appropriate (Paulhus, 2017; Vieten et al., 2024). However, certain items in questionnaires may foster affective mentalizing by generating mental images that could trigger physiological reactions (Segal et al., 2017). This process might be less likely to occur in lab tasks based on image visualization paradigms, which require rapid and more automatic responses. It could be argued that within the EPT, as a lab-based paradigm relying solely on visual stimuli, it may be easier to elicit cognitive empathy than affective empathy. This could explain, at least partially our results showing changes only in cognitive empathy. As noted by Singer & Lamm (2009), empathic responses vary depending on the context, and in purely visual pain empathy tasks, the lack of ecological validity might limit the extent of affective engagement. Considering that empathic responses involve both conscious and unconscious processes (Decety & Jackson, 2004), both self-report measures and performance-based tasks might fail to capture some meaningful data—either because individuals are unable to consciously detect or recognize certain elements (Murphy & Lilienfeld, 2019), or because some processes can only be identified through biological markers (Neumann et al., 2015).

Empathy is a multicomponent construct with various neural correlates, including structures, pathways, and systems that differ depending on whether they are related to the affective or cognitive dimension (Bailey & Tice, 2018; Eres et al., 2015; Neumann et al., 2015). Measures such as functional magnetic resonance imaging (fMRI), electroencephalography (EEG), facial electromyography (EMG), skin conductance, and heart rate can provide objective information about empathic abilities that self-report or performance-based tasks might not capture (Neumann et al., 2015). Therefore, some authors suggest that the most comprehensive approach to studying empathy involves integrating self-report measures, behavioral tasks, and biological markers (Neumann et al., 2015; Gerdes et al., 2010; Vieten et al., 2024). However, it is important to acknowledge that these approaches should be seen as complementary, as each has its limitations, and none is inherently superior or more sensitive than the others (Neumann et al., 2015).

Chapter II

This study hypothesized that teachers from Uruguay who completed a 9-week virtual MSC training would exhibit lower physiological stress and increased vagally-mediated HRV during a social stress test compared to those trained in KY. It was also hypothesized that participants trained in MSC would exhibit lower levels of perceived state anxiety and negative affect associated with the stress response, compared to participants trained in KY. Finally, it was hypothesized that the improved autonomic adaptability to stressors in the MSC group would be mediated by enhanced self-compassion and emotional regulation.

To test the physiological stress response, participants had their ECG recorded while being subjected to a semi-virtual adaptation of the TSST (Gunnar et al., 2021; Kirschbaum et al., 1993), and the physiological data, including HR and HRV, were compared between groups. This semi-virtual format was a novel approach imposed by the pandemic circumstances (Gunnar et al., 2021; Narvaez Linares et al., 2020). The mean HR and mean NN were used to assess cardiac reactivity to the stressor, together with time-domain, frequency-domain, and nonlinear metrics suitable for ultra-short-term recordings that also assessed HRV (Baek et al., 2015; Burma et al., 2021; Castaldo et al., 2019; Lee et al., 2022; Liu et al., 2023; McNames & Aboy, 2006; Munoz et al., 2015; Pereira et al., 2017; Shaffer et al., 2020; Wu et al., 2020). These parameters were analyzed across the TSST stages: Rest, Preparation, Speech, Math, and Recovery, the latter divided into 5 time-windows.

Overall analysis confirmed that this semi-virtual approach was effective in eliciting a physiological stress response in both groups, showing increased stress during stress-eliciting stages and decreased during recovery, as in previous studies (Bluth et al, 2016; Luo et al., 2019; Andorfer et al., 2023). This was particularly important, as the TSST had previously been conducted in-person or fully virtually (Gunnar et al., 2021; Narváez et al., 2020), but never until now in a semi-virtual format where the panel was remotely connected via videoconference.

Concerning within group findings, evaluation of trajectories across the TSST stages revealed some differences between groups. Both MSC and KY showed increased stress from Preparation through Speech and Math stages. However, while the MSC group increased HR and decreased vmHRV across these stages, the KY group showed this during Speech and Math but not during Preparation, where HR changes were observed without a corresponding decrease in vmHRV. This could reflect a less flexible autonomic response when facing the threat, possibly resisting the challenging situation during anticipation. Regarding recovery, the MSC group returned to baseline levels by Recovery 2 and maintained this through Recovery 3 and 4, while the KY group reached baseline levels exclusively during Recovery 3. As for Recovery 5, both groups exhibited a new stress peak, maybe related to the extended time required to complete the tests.

Comparison between groups showed similar changes in HR and HRV relative to baseline scores across all stages except for Recovery 3 and 5, where the MSC group exhibited higher HFnu than the KY group, and consequently lower LFnu and LF/HF ratio. Within Recovery 3, these results reflected a higher vmHRV in the MSC group, while within Recovery 5, results were primarily explained by a lower vmHRV and increased sympathetic activation in the KY group, as revealed by the absolute values of the normalized variables and the non-linear ratio SD2/SD1. Remarkably, while the MSC group did not demonstrate lower physiological stress during the stress-eliciting stages, they did achieve higher, faster and more sustained vmHRV during the recovery period. A stress response characterized by sympathetic dominance and parasympathetic withdrawal reflects necessary dynamic flexibility for survival, revealing healthy, adaptive, and flexible ANS regulation (Thayer & Sternberg, 2006; Berntson et al., 2008), which relates to the process of allostasis, i.e., achieving stability through change (Sterling, 2004). Such regulatory flexibility and dynamic physiological adjustments can be fostered by adaptive emotion regulation (Balzarotti et al., 2017; Jentsch & Wolf, 2020; Kim et al., 2018; Schiweck et al., 2018). Cognitive reappraisal, in particular, promotes phasic vagal withdrawal during stress and rapid vagal tone recovery post-stress (Schiweck et al., 2018). Considering self-compassion involves accepting adverse events, and it fosters stress recovery with higher adaptive emotion regulation by employing positive cognitive reframing (Allen & Leary, 2010; Arch et al., 2014; Luo et al., 2018), it is suggested that the MSC group may have had greater resources for post-stress recovery.

Summarizing, the hypothesis that participants trained in MSC who performed a social stress test would exhibit reduced levels of physiological stress and higher levels of vmHRV compared to KY participants was not fully confirmed. While both groups exhibited similar stress responses, the MSC group showed a faster and more sustained post-stress recovery with higher vmHRV throughout the recovery stage.

To evaluate the changes in perceived state anxiety and positive and negative affect, and ascertain the impact of the TSST on psychological variables, pre- and post-TSST self-reports were analyzed within groups and compared between groups. The electronic Visual Analogue Scale of Anxiety (eVAAS; van Duinen et al., 2008), the State-Trait Anxiety Inventory - State (STAI-S Buela-Casal et al., 2011; Spielberger et al., 1983) and the Positive and Negative Affect Schedule (PANAS; Saiz et al., 2013; Watson et al., 1988) were used following the guidelines of Narvaez Linares et al. (2020).

Within-group pre- to post-stress assessments revealed significant increases in state anxiety both in the MSC and KY groups, with high effect sizes. This confirmed the psychological impact of the social-evaluative threat, consistent with previous findings (Bluth et al., 2016; Hellhammer & Schubert, 2012). While no changes in positive or negative affect were observed in the MSC group, positive affect significantly decreased in the KY group, with high effect sizes. This suggests that self-compassion may provide a buffering effect, preserving the affective state of the MSC group beyond the stressful event (Allen & Leary, 2010; Luo et al., 2018). However, the difference found within the KY group was not reflected in the between-group comparison, as the comparison of state anxiety and positive and negative affective states between MSC and KY groups yielded no differences. This indicated that the TSST was equally efficacious for both groups, with no group experiencing better or worse anxiety outcomes. Therefore, the hypothesis that participants trained in MSC would exhibit lower levels of perceived state anxiety and negative affect in relation to the TSST compared to those trained in KY was refuted.

The third hypothesis of this chapter posited that the physiological outcomes exhibited by the MSC group, as compared to those in the KY group, were explained by improved psychological outcomes resulting from the MSC training. Hence, to determine if the physiological outcomes that exhibited differences between groups were attributable to improvements in self-compassion and emotion regulation, these psychological variables were tested in regression to the HFnu during Recovery 3 and 5.

Initially, mindfulness, self-compassion, expressive suppression and cognitive reappraisal were considered as predictors. However, due to the very high correlation between mindfulness and self-compassion, mindfulness was excluded to avoid redundancy. Although no significant correlations were found between the dependent variables (HFnu during Recovery periods 3 and 5) and the predictors, regression analysis was conducted to potentially uncover more complex relationships than those suggested by individual correlations (Pandey, 2020).

Three subsequent regression models were performed for each dependent variable. The first model included all predictors and group, the second included self-compassion, cognitive reappraisal, and group, and the third included expressive suppression and group. This approach was based on the rationale that expressive suppression might counteract the effects of the other predictors.

No significant predictors were found, indicating that these variables did not impact HFnu. However, when regression analysis for HFnu during Recovery 3 was conducted excluding predictors related to expressive suppression and focusing on group, self-compassion, and cognitive reappraisal, the group predictor showed a marginal trend, with the MSC group exhibiting a higher predicted value. This might suggest that a difference between the MSC and KY groups was not fully captured by self-compassion and cognitive reappraisal alone but instead reflected in the group predictor. Yet, these results did not reach the level of significance, and showed moderate effect size.

Based on these results, the hypothesis that the physiological outcomes in the MSC group, compared to those in the KY group, would be explained by improved psychological outcomes resulting from the MSC training could not be confirmed.

Main results and concluding remarks

In summary, the results of this study indicate that the 9-week virtual MSC training for female teachers in Uruguay provided significant benefits to the participants both in the short and middle term.

The first methodological challenge we encountered was whether it would be possible to achieve changes in mindfulness and self-compassion among participants by offering the MSC program in a virtual format. Changes evidenced in both within-group and between-group comparisons confirmed that it was indeed possible. However, it is important to note that the KY group also demonstrated favorable changes as observing within-group, particularly in mindfulness, which was not surprising given that yoga practice emphasizes present-moment awareness. Besides, within-group assessment showed both groups improved well-being and reduced stress. Overall, the MSC group showed improvements in a greater number of psychological variables as assessed by self-reports, and only this group showed improvements in all studied variables.

The improvements observed In the MSC group in the middle term were fewer than those in the short term, although still greater than those in the control group. Notably, while both mindfulness and self-compassion skills were maintained in the middle term, mindfulness skills were more robust in the MSC group as it exhibited a significant difference with KY. This raises the question of whether it is easier to maintain a non-judgmental observational attitude toward present experiences than to sustain an attitude of self-kindness beyond circumstances. Remarkably, this study was conducted during the pandemic, when teacher burnout increased (Weißenfels et al., 2022), which negatively correlated with self-efficacy, possibly impacting their self-evaluation and hindering the maintenance of a self-compassionate attitude.

This study focused on investigating the effect of self-compassion on empathy, understanding that the sense of shared humanity enables individuals to recognize their connection with others, comprehend others' experiences of suffering through their own, and thus facilitate compassion towards others (Neff, 2003a, 2003b). In this way, increasing self-compassion skills also enhances the ability to identify others' suffering, as well as to help prevent and alleviate it (Gilbert & Van Gordon, 2023; Neff, 2023). Previous studies have demonstrated a positive relationship between increased mindful self-compassion and empathy (Wallmark et al., 2013). Additionally, empathy increases when stress is reduced and well-being is enhanced, as it was the case in our results, promoting an empathetic attitude by increasing secure attachments (Lathren et al., 2021; Neff, 2023; Neff & Beretvas, 2012; Sotiropoulou et al., 2023; Wallmark et al., 2013).

With regard to empathy measurement, we were interested not only in how empathic the participants perceived themselves but also in evaluating their empathic abilities through an experimental task that assessed how they infer others' thoughts and feelings. Although we found changes in both perceived empathy and the EPT, these changes were not consistent, and between-group differences were only evident in perceived empathy. Nonetheless, following the general trend, this difference favored the MSC group, as participants showed a reduction in personal distress. Concerning the empathy for pain task, an increase in perspective-taking was observed within the MSC group, supported by similar findings in self-reports, although this was not significant when comparing the MSC group to the KY group. The disparity between teachers' perception of their empathy levels and their actual empathic abilities suggests the relevance of implementing approaches oriented to increase empathic abilities, thus contributing to developing “the prosocial classroom” model proposed by Jennings & Greenberg (2009). Additionally, and notably, recent studies have demonstrated a significant positive relationship between teachers' empathy and the development of self-compassion skills in their students (Fatima et al., 2024).

With regard to the results obtained through physiological measures, the most consistent findings were related to emotional regulation, with significant differences observed both in perception and physiological outcomes, in both the short and middle term. In the short term, perceived expressive suppression was significantly lower in the MSC group compared to the control group, while in the middle term, cognitive reappraisal was significantly higher in the MSC group. Regarding physiological outcomes, considering that HRV can be regarded as an index of emotional regulation (Balzarotti et al., 2017; Gullett et al., 2023; Jentsch & Wolf, 2020; Perna et al., 2020; Svendsen et al., 2016), and noting the increase in vmHRV during recovery following a social stress test in the MSC group, it is possible to conclude that emotional regulation also showed positive results when compared to the KY group. These results likely stem from the incorporation of self-compassion and mindfulness skills. Through mindfulness training, individuals learn to accept situations as they are, without attempting to suppress or alter them, which contrasts with the strategy of expressive suppression. Additionally, the attitude of self-kindness encourages individuals to navigate challenging situations more effectively, perceiving these situations not as personal failures but as part of the human experience, hence making the challenges less impactful. Considering the human as constituting an indivisible whole, with all dimensions working together to enable vital functioning, the way a challenge impacts an individual is crucial. This impact transcends emotional experience to affect physiological and neuroendocrine levels (Jentsch & Wolf, 2020), which can be clearly evidenced during a psychosocial stress test, as the one here utilized. The response to these challenges will differ depending on one's ability to employ allostatic mechanisms (Sterling, 2004) rather than rigid responses. By using reappraisal strategies, regulatory flexibility and dynamic physiological adjustment to changing environmental demands are facilitated. Furthermore, these flexible responses can be detected through both vagal withdrawal to allow for sympathetic predominance and the subsequent increase in vmHRV as a soothing response to stress, reflecting enhanced parasympathetic tone on the heart (Jentsch & Wolf, 2020; Kim et al., 2018; Balzarotti et al., 2017; Schiweck et al., 2018; Gullett et al., 2023).

The results obtained from physiological measures, showing a shorter recovery time and higher vmHRV values in the MSC group, suggest the positive impact of training in self-compassion skills, which counteract self-threats and self-reproaches (Neff, 2023). Although it was not possible to confirm that the physiological outcomes were predicted by self-compassion and cognitive reappraisal, a marginal effect was observed, which suggests that clearer results might have been achieved with a larger sample size. Contemplative practices that promote self-compassion elicit feelings of safety, calmness, and affection. This, in turn, facilitates emotional regulation and boosts vagal regulatory activity and HRV (Shaw & Kelly, 2024; Gilbert, 2024), the latter being an objective physiological metric that reflects the mind-body interconnectedness (Porges, 2007, 2009).

In an environment full of threats, coming not only from the outside but also from the negative way we tend to treat ourselves, -as reflected in the repetitive and recurrent negative thinking about ourselves, known as rumination (Watkins, 2008)-, the ability to cultivate self-compassion emerges as a valuable opportunity. Managing stress is crucial for teachers to avoid damaging relationships with students, create a classroom climate that promotes learning, and counteract work-related stress that may harm their health (Seibt et al., 2013; Scheuch et al., 2015). Otherwise, exposure to self-threats and self-reproaches may lead to non-adaptive biological stress responses such as lower HRV and prolonged recovery time (Dickerson & Kemeny, 2004; Gaidica & Dantzer, 2020), reflecting a less adaptive and flexible autonomic response.

This study aimed to shed light on the impact of virtual mindfulness and self-compassion skills on empathy, emotional regulation, wellbeing, stress and burnout. It provides evidence regarding the effectiveness and benefits of MSC training among female school teachers in Uruguay, enhancing the existing findings on contemplative practices. It also demonstrates the benefits of MSC practices to foster positive psychological states in teachers, possibly contributing to a rewarding classroom environment for all involved. Furthermore, these findings were obtained in a particularly challenging global context, supporting the suitability of online MSC when circumstances limit in-person training and/or are catastrophic.

We expect that this evidence will support the implementation of contemplative interventions aimed at promoting the physical and mental health of teachers, as well as harmonious coexistence in the workplace for school teachers in Uruguay and beyond.

Conclusions

In conclusion, female primary school teachers in Uruguay trained in a virtual MSC program during the COVID-19 pandemic exhibited:

- Improved perceived emotional regulation, cognitive and affective empathy and mindfulness dimensions as compared to a control group trained in KY
- Increased perceived mindfulness, self-compassion, emotion regulation, empathy and well-being, and reduced stress and burnout both in the short-term within-group comparison
- Increased perceived mindfulness, self-compassion, and empathy components in the middle-term within-group comparison
- No differences with the KY participants with regard to empathic abilities
- Increased cognitive empathy with regard to empathic abilities in the short-term within-group comparison
- Faster and more sustained recovery post-stress, reaching higher levels of vmHRV, in comparison to the KY participants

Limitations

The development of this thesis encountered several limitations, mostly, although not exclusively, due to the pandemic situation. The pandemic forced modifications and reformulations of the initial project, requiring new alternatives to address the originally planned questions, for which funding had already been obtained. These adjustments reduced the time available for completing the proposed objectives, leading to the postponement of some objectives for future work. Furthermore, all in-person procedures had to be adapted to virtual or semi-virtual formats. The pandemic context prevented in-person trainings and led to high absenteeism due to medical reasons or related circumstances.

Only 10% of interested teachers could participate due to exclusion criteria. The exclusion of candidates with psychological disorders (PD) contributed to the reduction in the sample size (8.5% of applicants). Although this exclusion potentially reduced sample representativeness, it was necessary to avoid inducing negative affective states in participants performing the TSST for physiological data collection. Analyzing non-clinical and clinical populations separately would have fragmented the sample, further decreasing the n of the sample for each experimental group. It would also exceed this study's scope. Although the sample was intended to be representative, encompassing teachers from schools in different socioeconomic contexts, this could not be achieved due to the requirement for voluntary participation and the exclusion criteria.

A significant dropout occurred, partly due to pandemic-related issues, increasingly affecting longitudinal measurements and requiring the separate analysis of short-term and middle-term data, as well as data related to the TSST. Higher dropout rates for in-person instances (EPT and TSST) reduced the number of participants for these evaluations. Attendance continuity in MSC and KY training participation was disrupted, causing some participants to drop out, partly by pandemic-related issues. Furthermore, post-intervention practice continuity, attendance, and daily practice were not strictly verified, although regular attendance was confirmed by instructors.

Parallel groups on a waiting list for subsequent training were planned but not possible due to the limited number of certified online instructors, the amount of funding received, and the final number of participants. Small sample sizes may have influenced the lack of significant differences between groups in self-compassion, empathic abilities, affect tests, and physiological outcomes. Furthermore, our small samples may have inflated effect sizes (Button et al., 2013).

The TSST panel was supposed to include both a male and a female member, but only women volunteered. However, it should be highlighted that results concerning the effectiveness of the task were as expected. The ECG recording across all TSST stages presented difficulties during the stressing stages due to interruptions and data loss. Noise from participant movements led to some data being discarded offline and prevented the EEG recording, as originally intended. It is worth considering whether a larger sample size might have accentuated the differences obtained through the TSST and revealed a marked difference between groups.

The exceptional global context likely influenced the follow-up measure. While participants may have applied their acquired skills to mitigate potential adverse effects post-training, the uncertainty and stress of those months may have impacted follow-up results. All these findings were obtained during a unique global situation, making them more comparable to results from catastrophic events than those of everyday life. Nonetheless, they are consistent with previous studies conducted under non-catastrophic conditions.

Perspectives

Future research may benefit from larger samples to improve reliability. It would also benefit from performing both MSC and control trainings in person. A higher sample would permit analyzing results in the context of sociodemographic information, and with regard to the TSST, considering the information provided prior to its commencement regarding intake, smoking, and menstrual cycle phase. Future meditation-based intervention effects should be contrasted also with a passive control condition to enhance our understanding of whether this response was attributable to the skills developed during the training. In this regard, the choice of yoga as an active control for MSC should be carefully evaluated, in view of the likelihood of obtaining similar results in both conditions. This raises the question whether KY, despite not being specifically aimed at training self-compassion, was a suitable active control training for MSC. A future study should monitor attendance to ensure participants meet a minimum attendance to be considered for analysis. Post-training informal practice should be monitored. More specific questionnaires adapted to our population will be needed. Evaluating the impact of extended interventions would also be advantageous as some individuals adopt mindfulness as a lifestyle and may show different results. Sustained daily practice beyond the initial training could yield clearer outcomes, so it would be valuable to evaluate whether participants who maintain the practice—or incorporate mindfulness into their lifestyle—show a greater impact on heart rate variability (HRV). For this purpose, a rigorous follow-up on post-training practice levels would be recommended, and administering the TSST several months after completing the training, rather than immediately, would better capture the long-term effects of sustained practice. It would be advisable to conduct all recordings within the same time range. If this is not possible due to the teachers' work shifts, the analysis should discriminate based on the time of day when the ECG recording was performed. Conducting a future study with a representative sample is advisable, but the challenge of voluntary participation must be addressed. Finally, a subsequent study should aim to explore the neurobiological mechanisms through which self-compassion exerts its effects. We hope that the analysis of the data we collected through EEG will help answer this question.

References

Abend, R., Dan, O., Maoz, K., Raz, S., & Bar-Haim, Y. (2014). Reliability, validity and sensitivity of a computerized visual analog scale measuring state anxiety. *Journal of Behavior Therapy and Experimental Psychiatry*, *45*(4), 447–453. https://doi.org/10.1016/j.jbtep.2014.06.004

Administración Nacional de Educación Pública. (2019). *Censo Nacional Docente 2018: Informe de resultados*. ANEP. ISBN 978-9974-94-763-4

Agyapong, B., Obuobi-Donkor, G., Burback, L., & Wei, Y. (2022). Stress, Burnout, Anxiety and Depression among Teachers: A Scoping Review. *International Journal of Environmental Research and Public Health, 19*(17), 10706. https://doi.org/10.3390/ijerph191710706

Akselrod, S., Gordon, D., Ubel, F. A., Shannon, D. C., Berger, A. C., & Cohen, R. J. (1981). Power spectrum analysis of heart rate fluctuation: a quantitative probe of beat-to-beat cardiovascular control. *Science (New York, N.Y.)*, *213*(4504), 220–222. https://doi.org/10.1126/science.6166045

Alarcón, A. & Mendez, G. (2020). *Early opening of schools in Uruguay during the COVID-19 pandemic. Overview and lessons learnt.* UNICEF Uruguay. https://www.unicef.org/uruguay/en/reports/early-opening-schools-uruguay-during-covid-19-pandemic

Aldrup, K., Carstensen, B. & Klusmann, U. (2022). Is Empathy the Key to Effective Teaching? A Systematic Review of Its Association with Teacher-Student Interactions and Student Outcomes. *Educational Psychology Review, 34*, 1177–1216. https://doi.org/10.1007/s10648-021-09649-y

Allen, A. B., & Leary, M. R. (2010). Self-compassion, stress, and coping. *Social and Personality Psychology Compass*, *4*(2), 107–118. https://doi.org/10.1111/j.1751-9004.2009.00246.x

Allen, A. P., Kennedy, P. J., Cryan, J. F., Dinan, T. G., & Clarke, G. (2014). Biological and psychological markers of stress in humans: focus on the Trier Social Stress Test. *Neuroscience and Biobehavioral Reviews*, *38*, 94–124. https://doi.org/10.1016/j.neubiorev.2013.11.005

Allen, R., Jerrim, J. & Sims, S. (2020). *How did the early stages of the COVID-19 pandemic affect teacher wellbeing? (*CEPEO Working Paper No. 20 – 15). Centre for Education Policy and Equalising Opportunities, UCL. https://EconPapers.repec.org/RePEc:ucl:cepeow:20-15

Alves, R., Lopes, T., & Precioso, J. (2020). Teachers' well-being in times of COVID-19 pandemic: factors that explain professional well-being. *IJERI: International Journal of Educational Research and Innovation*, (15), 203–217. https://doi.org/10.46661/ijeri.5120

American Psychological Association. (2018). Anxiety. In *APA Dictionary of Psychology*. Retrieved May 25, 2024, from https://dictionary.apa.org/anxiety

Andorfer, A., Kraler, S., Kaufmann, P., Pollheimer, E., Spah, C., Fuchshuber, J., Rominger, C., Traunmüller, C., Schwerdtfeger, A., & Unterrainer, H. F. (2023). Psychophysiological stress response after a 6-week Mindful Self-Compassion training in psychiatric rehabilitation inpatients: a randomized post-test only study. *Frontiers in Psychiatry*, *14*, 1098122. https://doi.org/10.3389/fpsyt.2023.1098122

Ansori, A. N. M., (2023). Health Impacts of Yoga: A Brief Review. *Genbinesia Journal of Biology*, *2*(2), 73-80. https://doi.org/10.55655/genbinesia.v2i2.36

Arch, J. J., Brown, K. W., Dean, D. J., Landy, L. N., Brown, K. D., & Laudenslager, M. L. (2014). Self-compassion training modulates alpha-amylase, heart rate variability, and subjective responses to social evaluative threat in women. *Psychoneuroendocrinology*, *42*, 49–58. https://doi.org/10.1016/j.psyneuen.2013.12.018

Baek, H. J., Cho, C. H., Cho, J., & Woo, J. M. (2015). Reliability of ultra-short-term analysis as a surrogate of standard 5-min analysis of heart rate variability. *Telemedicine Journal and e-Health: the Official Journal of the American Telemedicine Association*, *21*(5), 404–414. https://doi.org/10.1089/tmj.2014.0104

Baer, R., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using Self-Report Assessment to Explore Facets of Mindfulness. *Assessment*, *13*(1), 27–45. https://doi.org/10.1177/1073191105283504

Baer, R. A., Smith, G. T., Lykins, E., Button, D., Krietemeyer, J., Sauer, S., Walsh, E., Duggan, D., & Williams, J. M. (2008). Construct validity of the five facet mindfulness questionnaire in meditating and nonmeditating samples. *Assessment*, *15*(3), 329–342. https://doi.org/10.1177/1073191107313003

Baez, S., Manes, F., Huepe, D., Torralva, T., Fiorentino, N., Richter, F., Huepe-Artigas, D., Ferrari, J., Montañes, P., Reyes, P., Matallana, D., Vigliecca, N. S., Decety, J., & Ibanez, A. (2014). Primary empathy deficits in frontotemporal dementia. *Frontiers in Aging Neuroscience*, *6*, 262. https://doi.org/10.3389/fnagi.2014.00262

Baez, S., Morales, J. P., Slachevsky, A., Torralva, T., Matus, C., Manes, F., & Ibanez, A. (2016). Orbitofrontal and limbic signatures of empathic concern and intentional harm in the behavioral variant frontotemporal dementia. *Cortex; a Journal Devoted to the Study of the Nervous System and Behavior, 75*, 20–32. https://doi.org/10.1016/j.cortex.2015.11.007

Baez, S., Flichtentrei, D., Prats, M., Mastandueno, R., García, A. M., Cetkovich, M., & Ibáñez, A. (2017). Men, women… who cares? A population-based study on sex differences and gender roles in empathy and moral cognition. *PloS one*, *12*(6), e0179336. https://doi.org/10.1371/journal.pone.0179336

Bailey, D., & Tice, C. (2018). [Review of the book *Assessing Empathy*, by E. A. Segal, K. E. Gerdes, C. A. Lietz, M. A. Wagaman, & J. M. Geiger]. *Journal of Teaching in Social Work, 38*(1), 106–109. https://doi.org/10.1080/08841233.2018.1384259

Balzarotti, S., Biassoni, F., Colombo, B., & Ciceri, M. R. (2017). Cardiac vagal control as a marker of emotion regulation in healthy adults: A review. *Biological Psychology, 130*, 54–66. https://doi.org/10.1016/j.biopsycho.2017.10.008

Bauer, J., Stamm, A., Virnich, K., Wissing, K., Müller, U., Wirsching, M., & Schaarschmidt, U. (2006). Correlation between burnout syndrome and psychological and psychosomatic symptoms among teachers*. International Archives of Occupational and Environmental Health, 79*(3), 199–204. https://doi.org/10.1007/s00420-005-0050-y

Bauer, J., Unterbrink, T., Hack, A., Pfeifer, R., Buhl-Griesshaber, V., Müller, U., Wesche, H., Frommhold, M., Seibt, R., Scheuch, K., & Wirsching, M. (2007). Working conditions, adverse events and mental health problems in a sample of 949 German teachers. *International Archives of Occupational and Environmental Health, 80*(5), 442–449. https://doi.org/10.1007/s00420-007-0170-7

Behar, J., Ganesan, A., Zhang, J., & Yaniv, Y. (2016). The Autonomic Nervous System Regulates the Heart Rate through cAMP-PKA Dependent and Independent Coupled-Clock Pacemaker Cell Mechanisms. *Frontiers in Physiology*, *7*, 419. https://doi.org/10.3389/fphys.2016.00419

Bellingrath, S., Weigl, T., & Kudielka, B. M. (2009). Chronic work stress and exhaustion is associated with higher allostastic load in female school teachers. *Stress* (Amsterdam, Netherlands), *12*(1), 37–48. https://doi.org/10.1080/10253890802042041

Berkovich-Ohana, A., Jennings, P. A., & Lavy, S. (2019). Contemplative neuroscience, self-awareness, and education. *Progress in Brain Research*, 244, 355–385. https://doi.org/10.1016/bs.pbr.2018.10.015

Bernhardt, B. C., & Singer, T. (2012). The neural basis of empathy. *Annual Review of Neuroscience*, *35*, 1–23. https://doi.org/10.1146/annurev-neuro-062111-150536

Berntson, G. G., Norman, G. J., Hawkley, L. C., & Cacioppo, J. T. (2008). Cardiac autonomic balance versus cardiac regulatory capacity. *Psychophysiology*, *45*(4), 643–652. https://doi.org/10.1111/j.1469-8986.2008.00652.x

Biber D. (2022). Mindful self-compassion for nurses: a systematic review. *Nursing Management (Harrow, London, England: 1994)*, *29*(3), 18–24. https://doi.org/10.7748/nm.2021.e2028

Billman G. E. (2013). The LF/HF ratio does not accurately measure cardiac sympatho-vagal balance. *Frontiers in Physiology*, *4*, 26. https://doi.org/10.3389/fphys.2013.00026

Birnie, K., Speca, M., & Carlson, L. E. (2010). Exploring self-compassion and empathy in the context of mindfulness-based stress reduction (MBSR). *Stress and Health*, *26*(5), 359-371. https://doi.org/10.1002/smi.1305

Blatt, S. J. (1995). The destructiveness of perfectionism: Implications for the treatment of depression. *American Psychologist, 50*(12), 1003–1020. https://doi.org/10.1037/0003-066X.50.12.1003

Bluth, K., Roberson, P. N., Gaylord, S. A., Faurot, K. R., Grewen, K. M., Arzon, S., & Girdler, S. S. (2016). Does Self-compassion Protect Adolescents from Stress?.*Journal of Child and Family Studies*, *25*(4), 1098–1109. https://doi.org/10.1007/s10826-015-0307-3

Bluth, K., Lathren, C., Clepper-Faith, M., Larson, L. M., Ogunbamowo, D. O., & Pflum, S. (2023). Improving mental health among transgender adolescents: Implementing mindful self-compassion for teens. *Journal of Adolescent Research*, *38*(2), 271-302. https://doi.org/10.1177/07435584211062126

Bornemann, B., Kovacs, P., & Singer, T. (2019). Voluntary upregulation of heart rate variability through biofeedback is improved by mental contemplative training. *Scientific Reports*, *9*, 7860. https://doi.org/10.1038/s41598-019-44201-7

Brandmeyer, T., Delorme, A., & Wahbeh, H. (2019). The neuroscience of meditation: classification, phenomenology, correlates, and mechanisms. *Progress in Brain Research*, *244*, 1–29. https://doi.org/10.1016/bs.pbr.2018.10.020

Breines, J. G., McInnis, C. M., Kuras, Y. I., Thoma, M. V., Gianferante, D., Hanlin, L., Chen, X., & Rohleder, N. (2015). Self-compassionate young adults show lower salivary alpha-amylase responses to repeated psychosocial stress. *Self and Identity*, *14*(4), 390–402. https://doi.org/10.1080/15298868.2015.1005659

Breines, J. G., Thoma, M. V., Gianferante, D., Hanlin, L., Chen, X., & Rohleder, N. (2014). Self-compassion as a predictor of interleukin-6 response to acute psychosocial stress. *Brain, Behavior, and Immunity*, *37*, 109–114. https://doi.org/10.1016/j.bbi.2013.11.006

Brennan, M., Palaniswami, M., & Kamen, P. (2002). Do existing measures of Poincaré plot geometry reflect nonlinear features of heart rate variability? *IEEE Transactions on Biomedical Engineering*, *48*(11), 1342–1347. https://doi.org/10.1109/10.959330

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. https://doi.org/10.1016/j.neubiorev.2015.04.004

Brennan, M., Palaniswami, M., & Kamen, P. (2002). Poincaré plot interpretation using a physiological model of HRV based on a network of oscillators. *American Journal of Physiology. Heart and Circulatory Physiology*, *283*(5), H1873–H1886. https://doi.org/10.1152/ajpheart.00405.2000

Buela-Casal, G., Guillén-Riquelme, A., & Seisdedos-Cubero, N. (2011). *STAI State-Trait Anxiety Questionnaire*. TEA-Ediciones.

Buhle, J. T., Silvers, J. A., Wager, T. D., Lopez, R., Onyemekwu, C., Kober, H., Weber, J., & Ochsner, K. N. (2014). Cognitive reappraisal of emotion: A meta-analysis of human neuroimaging studies. *Cerebral Cortex, 24*(11), 2981–2990. https://doi.org/10.1093/cercor/bht154

Burma, J. S., Graver, S., Miutz, L. N., Macaulay, A., Copeland, P. V., & Smirl, J. D. (2021). The validity and reliability of ultra-short-term heart rate variability parameters and the influence of physiological covariates. *Journal of Applied Physiology (Bethesda, Md.: 1985)*, *130*(6), 1848–1867. https://doi.org/10.1152/japplphysiol.00955.2020

Burr R. L. (2007). Interpretation of normalized spectral heart rate variability indices in sleep research: a critical review. *Sleep, 30*(7), 913–919. https://doi.org/10.1093/sleep/30.7.913

Button, K. S., Ioannidis, J. P., Mokrysz, C., Nosek, B. A., Flint, J., Robinson, E. S., & Munafò, M. R. (2013). Power failure: why small sample size undermines the reliability of neuroscience. *Nature Reviews. Neuroscience, 14*(5), 365–376. https://doi.org/10.1038/nrn3475

Cacioppo, J. T. (2002). Social neuroscience: Understanding the pieces fosters understanding the whole and vice versa. *American Psychologist, 57*(11), 819–831. https://doi.org/10.1037/0003-066X.57.11.819

Cacioppo, J. T., Gardner, W. L., & Berntson, G. G. (1999). The affect system has parallel and integrative processing components: Form follows function. *Journal of Personality and Social Psychology, 76*(5), 839–855. https://doi.org/10.1037/0022-3514.76.5.839

Cacioppo, J. T., Tassinary, L. G., & Berntson, G. G. (Eds.). (2000). *Handbook of psychophysiology* (2nd ed.). Cambridge University Press.

Cambón, V. & de León, D. (2007). El desgaste laboral de los maestros de educación inicial. Resultados de la Investigación. *XIV Jornadas de Investigación y Tercer Encuentro de Investigadores en Psicología del Mercosur.* Facultad de Psicología - Universidad de Buenos Aires, Buenos Aires. Recuperado de: https://www.aacademica.org/000-073/261

Cantus, D. S., López, N. S., Ballester, M. C., Gómez, S. S., & de la Rubia Ortí, J. E. (2019). El estrés en la enfermedad de Parkinson. Biomarcadores cortisol y amilasa. Revisión sistemática. *Revista Científica de la Sociedad Española de Enfermería Neurológica, 50*, 12-22.

Castaldo, R., Montesinos, L., Melillo, P., James, C., & Pecchia, L. (2019). Ultra-short term HRV features as surrogates of short term HRV: a case study on mental stress detection in real life. *BMC Medical Informatics and Decision Making*, *19*(1), 12. https://doi.org/10.1186/s12911-019-0742-y

Cebolla, A., García-Palacios, A., Soler, J., Guillen, V., Baños, R., & Botella, C. (2012). Psychometric properties of the Spanish validation of the Five Facets of Mindfulness Questionnaire (FFMQ). *The European Journal of Psychiatry, 26*(2), 118-126. https://dx.doi.org/10.4321/S0213- 61632012000200005

Ciccone, A. B., Siedlik, J. A., Wecht, J. M., Deckert, J. A., Nguyen, N. D., & Weir, J. P. (2017). Reminder: RMSSD and SD1 are identical heart rate variability metrics. *Muscle & Nerve*, *56*(4), 674–678. https://doi.org/10.1002/mus.25573

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

Cohen, L. (1989). Time-frequency distributions - a review. *Proceedings of the IEEE*, *77*(7), 941-981. https://doi.org/10.1109/5.30749

Cohen, S., Kamarck, T. Y Merlmestein, R. (1983). A Global Measures of Perceived Stress. *Journal of Health and Social Behavior, 24*, 385–396. https://doi.org/10.2307/2136404

Conversano, C., Ciacchini, R., Orrù, G., Di Giuseppe, M., Gemignani, A., & Poli, A. (2020). Mindfulness, compassion, and self-compassion among health care professionals: What's new? A systematic review. *Frontiers in Psychology, 11*, 1683. https://doi.org/10.3389/fpsyg.2020.01683

Coolican, H. (2017). *Research methods and statistics in psychology*. Psychology Press. https://doi.org/10.4324/9780203769836

Corbin, C. M., Alamos, P., Lowenstein, A. E., Downer, J. T. & Brown, J. L. (2019). The role of teacher- student relationships in predicting teachers' personal accomplishment and emotional exhaustion. *Journal of School Psychology, 77*, 1–12. https://doi.org/10.1016/j.jsp.2019.10.001

Creswell J. D. (2017). Mindfulness Interventions. *Annual Review of Psychology, 68*, 491–516. https://doi.org/10.1146/annurev-psych-042716-051139

Cuschieri, S. (2019). The CONSORT statement. *Saudi Journal of Anesthesia, 13*(Suppl 1), S27–S30. https://doi.org/10.4103/sja.SJA_559_18

Dahl, C.J., Wilson-Mendenhall, C.D., & Davidson, R.J. (2020). The plasticity of well-being: A training-based framework for the cultivation of human flourishing. *Proceedings of the National Academy of Sciences of the United States of America, 117*, 32197 – 32206. https://doi.org/10.1073/pnas.2014859117

Danielsson, M., Heimerson, I., Lundberg, U., Perski, A., Stefansson, C. G., & Åkerstedt, T. (2012). Psychosocial stress and health problems: Health in Sweden: The National Public Health Report 2012. Chapter 6. *Scandinavian Journal of Public Health*, *40*(9 Suppl), 121–134. https://doi.org/10.1177/1403494812459469

Davidson, R. J., & Dahl, C. J. (2017). Varieties of Contemplative Practice. *JAMA Psychiatry, 74*(2), 121–123. https://doi.org/10.1001/jamapsychiatry.2016.3469

Davidson, R. J., & Kaszniak, A. W. (2015). Conceptual and methodological issues in research on mindfulness and meditation. *The American Psychologist, 70*(7), 581–592. https://doi.org/10.1037/a0039512

Davidson, R., & McEwen, B. (2012). Social influences on neuroplasticity: Stress and interventions to promote well-being. *Nature Neuroscience, 15*(5), 689–695. https://doi.org/10.1038/nn.3093

Davis, M. H. (1980). A multidimensional approach to individual differences in empathy. *JSAS Catalog of Selected Documents in Psychology*, *10*, 85.

Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology, 44* (1), 113–126. https://doi.org/10.1037/0022-3514.44.1.113

de Carvalho, J. S., Oliveira, S., Roberto, M. S., Gonçalves, C., Bárbara, J. M., de Castro, A. F., Pereira, R., Franco, M., Cadima, J., Leal, T., Lemos, M. S., & Marques-Pinto, A. (2021). Effects of a Mindfulness-Based Intervention for Teachers: A Study on Teacher and Student Outcomes. *Mindfulness, 12*, 1719–1732. DOI: https://doi.org/10.1007/s12671-021-01635-3

De Ocampo, C. A. J. (2023). Teachers’ Self-Compassion, Motivation, Engagement, and Commitment in the New Normal: Role to School Performance. *Psychology and Education: A Multidisciplinary Journal, 6*(9), 855-879. https://doi.org/10.5281/zenodo.7531595

Decety J. (2010). The neurodevelopment of empathy in humans. *Developmental Neuroscience, 32*(4), 257–267. https://doi.org/10.1159/000317771

Decety, J., & Jackson, P.L. (2004). The functional architecture of human empathy. *Behavioral and Cognitive Neuroscience Reviews*, *3*(2), 71–100. https://doi.org/10.1177/1534582304267187 PMID

Decety, J., Michalska, K. J., & Kinzler, K. D. (2012). The contribution of emotion and cognition to moral sensitivity: A neurodevelopmental study. *Cerebral Cortex, 22*, 209–220. https://doi.org/10.1093/cercor/bhr111

DeLoach, L. J., Higgins, M. S., Caplan, A. B., & Stiff, J. L. (1998). The visual analog scale in the immediate postoperative period: intrasubject variability and correlation with a numeric scale. *Anesthesia and Analgesia*, *86*(1), 102–106. https://doi.org/10.1097/00000539-199801000-00020

Di Bello, M., Carnevali, L., Petrocchi, N., Thayer, J. F., Gilbert, P., & Ottaviani, C. (2020). The compassionate vagus: A meta-analysis on the connection between compassion and heart rate variability. *Neuroscience and Biobehavioral Reviews, 116*, 21–30. https://doi.org/10.1016/j.neubiorev.2020.06.016

Dickerson, S. S., & Kemeny, M. E. (2004). Acute stressors and cortisol responses: a theoretical integration and synthesis of laboratory research. *Psychological Bulletin*, *130*(3), 355–391. https://doi.org/10.1037/0033-2909.130.3.355

Diedrich, A., Grant, M., Hofmann, S. G., Hiller, W., & Berking, M. (2014). Self-compassion as an emotion regulation strategy in major depressive disorder. *Behaviour Research and Therapy, 58*, 43–51. https://doi.org/10.1016/j.brat.2014.05.006

Diedrich, A., Hofmann, S. G., Cuijpers, P., & Berking, M. (2016). Self-compassion enhances the efficacy of explicit cognitive reappraisal as an emotion regulation strategy in individuals with major depressive disorder. *Behaviour Research and Therapy*, *82*, 1–10. https://doi.org/10.1016/j.brat.2016.04.003

Donker, M. H., Erisman, M. C., van Gog, T., & Mainhard, T. (2020). Teachers' emotional exhaustion: Associations with their typical use of and implicit attitudes toward emotion regulation strategies. *Frontiers in Psychology*, *11*, 867. https://doi.org/10.3389/fpsyg.2020.00867

Dorjee D. (2016). Defining contemplative science: The metacognitive self-regulatory capacity of the mind, context of meditation practice and modes of existential awareness. *Frontiers in Psychology, 7*, 1788. https://doi.org/10.3389/fpsyg.2016.01788

Dupasquier, J.R., Kelly, A.C., Moscovitch, D.A., & Vidovic, V. (2018). Practicing Self-Compassion Weakens the Relationship Between Fear of Receiving Compassion and the Desire to Conceal Negative Experiences from Others. *Mindfulness*, *9*(2), 500-511. https://doi.org/10.1007/s12671-017-0792-0

Echevarría, H. D. (2016). *Diseños de investigación cuantitativa en psicología y educación*. UniRio.

Ehrenreich, Y. (2020). A happy heart comes first: Heart-based compassion training. *Biofeedback 1*, 48 (4): 73–80. https://doi.org/10.5298/1081-5937-48.4.3

Eisenberg, N. & Eggum, N. D. (2009). Empathic responding: Sympathy and personal distress. In J. Decety & W. Ickes (Eds.), *The social neuroscience of empathy* (pp. 71–83). MIT Press. https://doi.org/10.7551/mitpress/9780262012973.003.0007

Emerson, L. M., Leyland, A., Hudson, K., Rowse, G., Hanley, P., & Hugh-Jones, S. (2017). Teaching Mindfulness to Teachers: A systematic review and narrative synthesis. *Mindfulness*, *8*(5), 1136– 1149. https://doi.org/10.1007/s12671-017-0691-4

Engert, V., Plessow, F., Miller, R., Kirschbaum, C., & Singer, T. (2014). Cortisol increase in empathic stress is modulated by emotional closeness and observation modality. *Psychoneuroendocrinology*, *45*, 192–201. https://doi.org/10.1016/j.psyneuen.2014.04.005

Eres, R., Decety, J., Louis, W. R., & Molenberghs, P. (2015). Individual differences in local gray matter density are associated with differences in affective and cognitive empathy. *NeuroImage*, *117*, 305–310. https://doi.org/10.1016/j.neuroimage.2015.05.038

Ernst G. (2017). Heart-rate variability-More than heart beats? *Frontiers in Public Health, 5*, 240. https://doi.org/10.3389/fpubh.2017.00240

Erten, I. H. (2015). Social desirability bias in altruistic motivation for choosing teaching as a career. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi [Hacettepe University Journal of Education], 30*(1), 77–89.

Etkin, A., Büchel, C., & Gross, J. J. (2015). The neural bases of emotion regulation. *Nature reviews. Neuroscience*, *16*(11), 693–700. https://doi.org/10.1038/nrn4044

Fabi, S., Weber, L. A., & Leuthold, H. (2019). Empathic concern and personal distress depend on situational but not dispositional factors. *PloS one, 14*(11), e0225102. https://doi.org/10.1371/journal.pone.0225102

Falsafi, N. (2016). A randomised controlled trial of mindfulness versus yoga: Effects on depression and/or anxiety in college students. *Journal of the American Psychiatric Nurses Association, 22*(6), 483–497. https://doi.org/10.1177/1078390316663307

Fatima, N. un N., Lela, U. I., & Khan, S. (2024). The impact of teacher's empathy on students' self-compassion: An evidence-based intervention study. *Annals of Human and Social Sciences*, *5*(2), 401–412. https://doi.org/10.35484/ahss.2024(5-II)38

Fernández, A. M., Dufey, M., & Kramp, U. (2011). Testing the psychometric properties of the Interpersonal Reactivity Index (IRI) in Chile: Empathy in a different cultural context. *European Journal of Psychological Assessment, 27*(3), 179–185. http://dx.doi.org/10.1027/1015-5759/a000065

Ferrando, L., Bobes, J., Gibert, J., Soto, M., & Soto, O. (2000). *MINI. Entrevista Neuropsiquiátrica Internacional. Versión en Español 5.0.0. DSM-IV.* Traducida por L. Franco-Alfonso, L. Franco. https://www.fundacionforo.com/pdfs/mini.pdf

Fisher, J. P., Zera, T., & Paton, J. F. R. (2022). Chapter 10 - Respiratory–cardiovascular interactions. In R. Chen & P. G. Guyenet (Eds.), *Handbook of Clinical Neurology* (Vol. 188, pp. 279-308). Elsevier. https://doi.org/10.1016/B978-0-323-91534-2.00006-0

Frenzel, A. C. (2014). Teacher emotions. In E. A. Linnenbrink-Garcia & R. Pekrun (Eds.), *International handbook of emotions in education* (pp. 494-519). New York: Routledge.

Friis, A. M., Johnson, M. H., Cutfield, R. G., & Consedine, N. S. (2016). Kindness matters: A randomized controlled trial of a Mindful Self-Compassion intervention improves depression, distress, and HbA1c among patients with diabetes. *Diabetes Care, 39*(11), 1963–1971. https://doi.org/10.2337/dc16-0416

Frisch, J. U., Häusser, J. A., & Mojzisch, A. (2015). The Trier Social Stress Test as a paradigm to study how people respond to threat in social interactions. *Frontiers in Psychology*, *6*, 14. https://doi.org/10.3389/fpsyg.2015.00014

Fuochi, G., Veneziani, C. A., & Voci, A. (2018). Exploring the social side of self-compassion: Relations with empathy and outgroup attitudes. *European Journal of Social Psychology, 48*(6), 769-783.

Gaidica, M., & Dantzer, B. (2020). Quantifying the autonomic response to stressors–One way to expand the definition of "stress" in animals. *Integrative and Comparative Biology, 60*(1), 113–125. https://doi.org/10.1093/icb/icaa009

Gaiswinkler, L., & Unterrainer, H. F. (2016). The relationship between yoga involvement, mindfulness and psychological well-being. *Complementary Therapies in Medicine, 26*, 123-127.

García-Campayo, J., Navarro-Gil, M., Andrés, E., Montero-Marin, J., López-Artal, L., & Demarzo, M. M. P. (2014). Validation of the Spanish versions of the long (26 items) and short (12 items) forms of the Self-Compassion Scale (SCS). *Health and Quality of Life Outcomes, 12*, 4. http://doi.org/10.1186/1477-7525-12-4

Gerdes, K. E., Segal, E. A., & Lietz, C. A. (2010). Conceptualising and measuring empathy. *British Journal of Social Work, 40*(7), 2326–2343. https://doi.org/10.1093/bjsw/bcq048

Germer, C. & Neff, K. D. (2019). Mindful Self-Compassion (MSC). In I. Ivtzan (Ed.) *The handbook of mindfulness-based programs: Every established intervention, from medicine to education* (pp. 357– 367). Routledge.

Gift A. G. (1989). Visual analogue scales: measurement of subjective phenomena. *Nursing Research*, *38*(5), 286–288.

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*(6):353–79

Gilbert, P. (2009). *The Compassionate mind: A new approach to life challenges.* Constable and Robinson Ltd.

Gilbert, P., & Van Gordon, W. (2023). Compassion as a skill: A comparison of contemplative and evolution-based approaches. *Mindfulness, 14*(8), 2395–2416. https://doi.org/10.1007/s12671-023-02173-w

Gilbert P. (2024). Threat, safety, safeness and social safeness 30 years on: Fundamental dimensions and distinctions for mental health and well-being. *The British Journal of Clinical Psychology*, *63*(3), 453–471. https://doi.org/10.1111/bjc.12466

Gil-Monte, P. R., Carlotto, M. S., & Gonçalves Câmara, S. (2011). Prevalence of burnout in a sample of Brazilian teachers. *The European Journal of Psychiatry, 25*(4), 205-212. https://doi.org/10.4321/S0213-61632011000400003

Goldberg, S. B., & Davidson, R. J. (2024). Contemplative Science Comes of Age: Looking Backward and Forward 20 Years After Baer (2003). *Clinical psychology: a publication of the Division of Clinical Psychology of the American Psychological Association*, *31*(1), 39–41. https://doi.org/10.1037/cps0000186

Goldberger, A. L., & West, B. J. (1987). Applications of nonlinear dynamics to clinical cardiology. *Annals of the New York Academy of Sciences*, *504*, 195–213. https://doi.org/10.1111/j.1749-6632.1987.tb48733.x

Goldin, P. R., McRae, K., Ramel, W., & Gross, J. J. (2008). The neural bases of emotion regulation: reappraisal and suppression of negative emotion. *Biological Psychiatry, 63*(6), 577–586. https://doi.org/10.1016/j.biopsych.2007.05.031

Goldstein, D. S., & Kopin, I. J. (2007). Evolution of concepts of stress. *Stress, 10*(2), 109–120. https://doi.org/10.1080/10253890701288935

Goldstein, D. S., Bentho, O., Park, M. Y., & Sharabi, Y. (2011). Low-frequency power of heart rate variability is not a measure of cardiac sympathetic tone but may be a measure of modulation of cardiac autonomic outflows by baroreflexes. *Experimental Physiology*, *96*(12), 1255–1261. https://doi.org/10.1113/expphysiol.2010.056259

Goodman, W. K., Janson, J., & Wolf, J. M. (2017). Meta-analytical assessment of the effects of protocol variations on cortisol responses to the Trier Social Stress Test. *Psychoneuroendocrinology*, *80*, 26–35. https://doi.org/10.1016/j.psyneuen.2017.02.030

Gormally, B. M. G., & Romero, L. M. (2020). What are you actually measuring? A review of techniques that integrate the stress response on distinct time-scales. *Functional Ecology, 34*, 2030–2044. https://doi.org/10.1111/1365-2435.13648

Gormally, B. M. G., Ramos, S., Yin, H., & Romero, L. M. (2019). Recovery periods during repeated stress impact corticosterone and behavioral responses differently in house sparrows. *Hormones and Behavior*, *112*, 81–88. https://doi.org/10.1016/j.yhbeh.2019.04.009

Gross, J. J. & John, O. (2003). Individual Differences in two emotion regulation processes: Implications for affect, relationship, and well-being. *Journal of Personality and Social Psychology, 85*, 2, 348-362

Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of General Psychology, 2*, 271–299.

Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry, 26*(1), 1–26. https://doi.org/10.1080/1047840X.2014.940781

Grossman, P. (2015). Mindfulness: Awareness informed by an embodied ethic. *Mindfulness*, *6*(1), 17–22. https://doi.org/10.1007/s12671-014-0372-5

Gullett, N., Zajkowska, Z., Walsh, A., Harper, R., & Mondelli, V. (2023). Heart rate variability (HRV) as a way to understand associations between the autonomic nervous system (ANS) and affective states: A critical review of the literature. *International Journal of Psychophysiology: Official Journal of the International Organization of Psychophysiology, 192*, 35–42. https://doi.org/10.1016/j.ijpsycho.2023.08.001

Gunnar, M. R., Reid, B. M., Donzella, B., Miller, Z. R., Gardow, S., Tsakonas, N. C., Thomas, K. M., DeJoseph, M., & Bendezú, J. J. (2021). Validation of an online version of the Trier Social Stress Test in a study of adolescents. *Psychoneuroendocrinology*, *125*, 105111. https://doi.org/10.1016/j.psyneuen.2020.105111

Hair, J. F., Anderson, R. E., Babin, B. J., & Black, W. C. (2010). *Multivariate data analysis: A global perspective* (7th ed.). Pearson

Heffernan, M., Quinn Griffin, M. T., Sister Rita McNulty, & Fitzpatrick, J. J. (2010). Self-compassion and emotional intelligence in nurses. *International Journal of Nursing Practice*, *16*(4), 366–373. https://doi.org/10.1111/j.1440-172X.2010.01853.x

Hellhammer, J., & Schubert, M. (2012). The physiological response to Trier Social Stress Test relates to subjective measures of stress during but not before or after the test. *Psychoneuroendocrinology, 37*(1), 119–124. https://doi.org/10.1016/j.psyneuen.2011.05.012

Hidajat, T.J., Edwards, E.J., Wood, R. & Campbell, M. (2023). Mindfulness-based interventions for stress and burnout in teachers: A systematic review. *Teaching and Teacher Education, 134*, 104303-104303. https://doi.org/10.1016/j.tate.2023.104303

Holguín E. C. (2021). Implicaciones de la pandemia por COVID-19 en la salud docente. Revisión sistemática. *Revista Temas Sociológicos, 28*, 113–142. https://doi.org/10.29344/07196458.28.2794

Hollis-Walker, L. H., & Colosimo, K. (2011). Mindfulness, Self-Compassion, and Happiness in Non-Meditators: A Theoretical and Empirical Examination. *Personality and Individual Differences, 50*, 222-227. http://dx.doi.org/10.1016/j.paid.2010.09.033

Honkonen, T., Ahola, K., Pertovaara, M., Isometsä, E., Kalimo, R., Nykyri, E., Aromaa, A., & Lönnqvist, J. (2006). The association between burnout and physical illness in the general population--Results from the Finnish Health 2000 Study. *Journal of Psychosomatic Research, 61*(1), 59–66. https://doi.org/10.1016/j.jpsychores.2005.10.002

Hornblow, A. R., & Kidson, M. A. (1976). The visual analogue scale for anxiety: A validation study. *The Australian and New Zealand Journal of Psychiatry*, *10*(4), 339–341. https://doi.org/10.3109/00048677609159523

Huikuri, H. V., Mäkikallio, T. H., & Perkiömäki, J. (2003). Measurement of heart rate variability by methods based on nonlinear dynamics. *Journal of Electrocardiology*, *36 Suppl*, 95–99. https://doi.org/10.1016/j.jelectrocard.2003.09.021

Hwang, Y.S., Bartlett, B., Greben, M. & Hand, K. (2017). A systematic review of mindfulness interventions for in-service teachers: A tool to enhance teacher wellbeing and performance. *Teaching and Teachers Education*, *64,* 26-42. https://doi.org/10.1016/j.tate.2017.01.015

Ickes, W. (2009). Empathic accuracy: Its links to clinical, cognitive, developmental, social, and physiological psychology. In J. Decety & W. Ickes (Eds), *The Social Neuroscience of Empathy* (pp. 55-70). MIT Press.

INEEd. (2020). *Estudio de salud ocupacional docente*. Montevideo: INEEd. https://www.ineed.edu.uy/images/EstudioSaludOcupacionalDocente/Estudio.pdf

INEEd. (2021a). *Percepciones de los docentes uruguayos de educación media ante la pandemia de COVID-19*. https://www.ineed.edu.uy/images/publicaciones/informes/Percepciones-docentes-uruguayos- educacion-media-pandemiacovid-19.pdf

INEEd. (2021b). *Informe sobre el estado de la educación en Uruguay 2019–2020. Tomo 2.* https://www.ineed.edu.uy/images/ieeuy/2019-2020/Informe-estado-educacion-Uruguay-2019- 2020-Tomo2.pdf

Inwood, E., & Ferrari, M. (2018). Mechanisms of change in the relationship between self-compassion, emotion regulation, and mental health: A systematic review. *Applied Psychology: Health and Well-Being, 10*(2), 215-235. https://doi.org/10.1111/aphw.12127

Iskender, M. (2009). The Relationship Between Self-Compassion, Self-Efficacy, and Control Belief about Learning in Turkish University Students. *Social Behavior and Personality: An International Journal, 37*. 711-720. 10.2224/sbp.2009.37.5.711.

James, K. A., Stromin, J. I., Steenkamp, N., & Combrinck, M. I. (2023). Understanding the relationships between physiological and psychosocial stress, cortisol and cognition. *Frontiers in Endocrinology, 14*, 1085950. https://doi.org/10.3389/fendo.2023.1085950

Jamieson, J. P., Nock, M. K., & Mendes, W. B. (2012). Mind over matter: Reappraising arousal improves cardiovascular and cognitive responses to stress. *Journal of Experimental Psychology: General, 141*(3), 417–422. https://doi.org/10.1037/a0025719

Janssen, M., Heerkens, Y., Van der Heijden, B., Korzilius, H., Peters, P., & Engels, J. (2023). Effects of mindfulness-based stress reduction and an organizational health intervention on Dutch teachers' mental health. *Health Promotion International*, *38*(3), daac008. https://doi.org/10.1093/heapro/daac008

Jennings, P. A. (2015). Early childhood teachers' well-being, mindfulness and self-compassion in relation to classroom quality and attitudes towards challenging students. *Mindfulness, 6*(4), 732–743. https://doi.org/10.1007/s12671-014-0312-4

Jennings, P. A., & Greenberg, M. T. (2009). The prosocial classroom: Teacher social and emotional competence in relation to student and classroom outcomes. *Review of Educational Research, 79*(1), 491–525. https://doi.org/10.3102/0034654308325693

Jennings, P. A., & Min, H. H. (2023). Transforming empathy-based stress to compassion: Skillful means to preventing teacher burnout. *Mindfulness, 14*, 2311–2322. https://doi.org/10.1007/s12671-023-02115-6

Jennings, P. A., Brown, J. L., Frank, J. L., Doyle, S., Oh, Y., Davis, R., Rasheed, D., DeWeese, A., DeMauro, A. A., Cham, H., & Greenberg, M. T. (2017). Impacts of the CARE for Teachers program on teachers' social and emotional competence and classroom interactions. *Journal of Educational Psychology, 109*(7), 1010–1028. https://doi.org/10.1037/edu0000187

Jennings, P.A., 2015. Early childhood teachers' well-being, mindfulness and self-compassion in relation to classroom quality and attitudes towards challenging students. *Mindfulness, 6*, 732– 743.https://doi.org/10.1007/s12671-014-0312-4.

Jentsch, V. L., & Wolf, O. T. (2020). The impact of emotion regulation on cardiovascular, neuroendocrine and psychological stress responses. *Biological Psychology*, *154*, 107893. https://doi.org/10.1016/j.biopsycho.2020.107893

Jiang, J., Vauras, M., Volet, S., & Wang, Y. (2016). Teachers' emotions and emotion regulation strategies: Self- and students' perceptions. *Teaching and Teacher Education*, *54*, 22–31. https://doi.org/10.1016/j.tate.2015.11.008

Jose, A. D., & Taylor, R. R. (1969). Autonomic blockade by propranolol and atropine to study intrinsic myocardial function in man. *The Journal of Clinical Investigation*, *48*(11), 2019–2031. https://doi.org/10.1172/JCI106167

Kabat-Zinn J. (1982). An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. *General Hospital Psychiatry*, *4*(1), 33–47. https://doi.org/10.1016/0163-8343(82)90026-3

Kabat-Zinn, J. (1990). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness*. Delta.

Kabat-Zinn, J. (1994). *Wherever you go, there you are: Mindfulness meditation in everyday life*. Hyperion

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice, 10*(2), 144-156. https://doi.org/10.1093/clipsy.bpg016

Karatsoreos, I. N., & McEwen, B. S. (2011). Psychobiological allostasis: resistance, resilience and vulnerability. *Trends in Cognitive Sciences*, *15*(12), 576–584. https://doi.org/10.1016/j.tics.2011.10.005

Karing, C. & Beelmann, A. (2021). Evaluating the implementation and effectiveness of a low-dose mindfulness-based intervention in a student sample: A randomized controlled trial. *Mindfulness, 12*, 1438–1450. https://doi.org/10.1007/s12671-021-01613-9

Kemeny, M. E. (2003). The psychobiology of stress. *Current Directions in Psychological Science, 12*(4), 124-129. https://doi.org/10.1111/1467-8721.01246

Kiken, L. G., Garland, E. L., Bluth, K., Palsson, O. S., & Gaylord, S. A. (2015). From a state to a trait: Trajectories of state mindfulness in meditation during intervention predict changes in trait mindfulness. *Personality and Individual Differences*, *81*, 41–46. https://doi.org/10.1016/j.paid.2014.12.044

Kim, H. G., Cheon, E. J., Bai, D. S., Lee, Y. H., & Koo, B. H. (2018). Stress and heart rate variability: A meta-analysis and review of the literature. *Psychiatry Investigation, 15*(3), 235–245. https://doi.org/10.30773/pi.2017.08.17

Kirby, J. N., Doty, J. R., Petrocchi, N., & Gilbert, P. (2017a). The current and future role of heart rate variability for assessing and training compassion. *Frontiers in Public Health*, *5*, 40. https://doi.org/10.3389/fpubh.2017.00040

Kirby, J. N., Tellegen, C. L., & Steindl, S. R. (2017b). A meta-analysis of compassion-based interventions: Current state of knowledge and future directions. *Behavior Therapy*, *48*(6), 778–792. https://doi.org/10.1016/j.beth.2017.06.003

Kirschbaum, C., Pirke, K. M., & Hellhammer, D. H. (1993). The 'Trier Social Stress Test'--A tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology*, *28*(1-2), 76–81. https://doi.org/10.1159/000119004

Kleiger, R. E., Stein, P. K., & Bigger, J. T., Jr (2005). Heart rate variability: measurement and clinical utility. *Annals of noninvasive electrocardiology: The official journal of the International Society for Holter and Noninvasive Electrocardiology, Inc*, *10*(1), 88–101. https://doi.org/10.1111/j.1542-474X.2005.10101.x

Klingbeil, D.A., & Renshaw, T.L. (2018). Mindfulness-based interventions for teachers: A meta-analysis of the emerging evidence base. *School Psychology Quarterly, 33*(4), 501–511. https://doi.org/10.1037/spq0000291

Klumbies, E., Braeuer, D., Hoyer, J., & Kirschbaum, C. (2014). The reaction to social stress in social phobia: Discordance between physiological and subjective parameters. *PloS one*, *9*(8), e105670. https://doi.org/10.1371/journal.pone.0105670

Klusmann, U., Kunter, M., Trautwein, U., Lüdtke, O., & Baumert, J. (2008). Teachers' occupational well-being and quality of instruction: The important role of self-regulatory patterns. *Journal of Educational Psychology, 100*(3), 702–715. https://doi.org/10.1037/0022-0663.100.3.702

Koenker, R. (2005). *Quantile Regression*. Cambridge University Press.

Kok, B.E., Coffey, K. A., Cohn, M. A., Catalino, L. I., Vacharkulksemsuk, T., Algoe, S. B., & Fredrickson, B.L. (2013). How positive emotions build physical health: Perceived positive social connections account for the upward spiral between positive emotions and vagal tone. *Psychological Science, 24*(7): 1123–1132. DOI: 10.1177/0956797612470827

Kudielka, B. M., Hellhammer, D. H., & Kirschbaum, C. (2007). Ten Years of Research with the Trier Social Stress Test--Revisited. In E. Harmon-Jones & P. Winkielman (Eds.), *Social neuroscience: Integrating biological and psychological explanations of social behavior* (pp. 56–83). The Guilford Press.

Kyriacou, C. (2001). Teacher stress: Directions for future research. *Educational Review, 53*(1), 27–35. https://doi.org/10.1080/00131910120033628

Lackschewitz, H., Hüther, G., & Kröner-Herwig, B. (2008). Physiological and psychological stress responses in adults with attention-deficit/hyperactivity disorder (ADHD). *Psychoneuroendocrinology*, *33*(5), 612–624. https://doi.org/10.1016/j.psyneuen.2008.01.016

Lalanza, J. F., Lorente, S., Bullich, R., García, C., Losilla, J. M., & Capdevila, L. (2023). Methods for heart rate variability biofeedback (HRVB): A systematic review and guidelines. *Applied Psychophysiology and Biofeedback*, *48*(3), 275–297. https://doi.org/10.1007/s10484-023-09582-6

Lara-Cabrera, M. L., Betancort, M., Muñoz-Rubilar, A., Rodríguez-Novo, N., Bjerkeset, O., & De Las Cuevas, C. (2022). Psychometric properties of the WHO-5 Well-Being Index among nurses during the COVID-19 pandemic: A cross-sectional study in three countries. *International Journal of Environmental Research and Public Health*, *19*(16), 10106. https://doi.org/10.3390/ijerph191610106

Larkin, K. T., Tiani, A. G., & Brown, L. A. (2021). Cardiac vagal tone and stress. In *Oxford Research Encyclopedia of Neuroscience*. Oxford University Press.

Larrieux, M. L. B. (2008). *Identificación y expresión emocional: Mecanismos regulatorios y creencias personales* (Doctoral dissertation, Universidad de Murcia).

Lathren, C.R., Rao, S.S., Park, J. et al. (2021). Self-compassion and current close interpersonal relationships: A scoping literature review. *Mindfulness, 12*, 1078–1093 https://doi.org/10.1007/s12671-020-01566-5

Lazarus, R. S. (1966). *Psychological stress and the coping process*. McGraw-Hill.

Lazarus, R. S., & Alfert, E. (1964). Short-circuiting of threat by experimentally altering cognitive appraisal. *Journal of Abnormal and Social Psychology, 69*, 195–205

Leary, M. R., Tate, E. B., Adams, C. E., Allen, A. B., & Hancock, J. (2007). Self-compassion and reactions to unpleasant self-relevant events: The implications of treating oneself kindly. *Journal of Personality and Social Psychology, 92*(5), 887–904. https://doi.org/10.1037/0022-3514.92.5.887

Lee, S., Hwang, H. B., Park, S., Kim, S., Ha, J. H., Jang, Y., Hwang, S., Park, H. K., Lee, J., & Kim, I. Y. (2022). Mental stress assessment using ultra short term HRV analysis based on non-linear method. *Biosensors*, *12*(7), 465. https://doi.org/10.3390/bios12070465

Liu, K., Jiao, Y., Du, C., Zhang, X., Chen, X., Xu, F., & Jiang, C. (2023). Driver stress detection using ultra-short-term HRV analysis under real world driving conditions. *Entropy*, *25*(2), 194. https://doi.org/10.3390/e25020194

Lopez, R. B., & Denny, B. T. (2019). Negative affect mediates the relationship between use of emotion regulation strategies and general health in college-aged students. *Personality and Individual Differences, 151*, 109529.

Lu, S., Wei, F., & Li, G. (2021). The evolution of the concept of stress and the framework of the stress system. *Cell Stress*, *5*(6), 76–85. https://doi.org/10.15698/cst2021.06.250

Luberto, C. M., Shinday, N., Song, R., Philpotts, L. L., Park, E. R., Fricchione, G. L., & Yeh, G. Y. (2018). A systematic review and meta-analysis of the effects of meditation on empathy, compassion, and prosocial behaviors. *Mindfulness*, *9*(3), 708–724. https://doi.org/10.1007/s12671-017-0841-8

Luo, X., Qiao, L., & Che, X. (2018). Self-compassion modulates heart rate variability and negative affect to experimentally induced stress. *Mindfulness*, *9*, 1522–1528. https://doi.org/10.1007/s12671-018-0900-9

Lv, J., Jiang, Y., Li, R., Chen, Y., Gu, X., Zhou, J., Zheng, Y., Yan, L., Chen, Y., Zhang, X., Zhao, X., Luo, W., Lang, Y., Wang, Z., Gao, C., & Zeng, X. (2024). Effects of loving-kindness and compassion meditations on self-compassion: A systematic review and meta-analysis. *Clinical Psychology: Science and Practice, 31*(1), 19–35. https://doi.org/10.1037/cps0000177

Ma, Y., & Liu, Z. (2024). Emotion regulation and well-being as factors contributing to lessening burnout among Chinese EFL teachers. *Acta Psychologica*, *245*, 104219. https://doi.org/10.1016/j.actpsy.2024.104219

MacIntyre, V. A., MacIntyre, P. D., & Carre, G. (2010). Heart rate variability as a predictor of speaking anxiety. *Communication Research Reports*, *27*(4), 286–297. https://doi.org/10.1080/08824096.2010.496323

Maeda S. (2022). Trait and state self-compassion interactively predict cortisol recovery following an acute stressor in healthy males. *Psychoneuroendocrinology*, *144*, 105864. https://doi.org/10.1016/j.psyneuen.2022.105864

Mahmoodi-Shahrebabaki, M. (2019). Teacher burnout. In *The TESOL encyclopedia of English language teaching* (pp. 1–8). Wiley. https://doi.org/10.1002/9781118784235.eelt0964

Man, I. S. C., Shao, R., Hou, W. K., Xin Li, S., Liu, F. Y., Lee, M., Wing, Y. K., Yau, S. Y., & Lee, T. M. C. (2023). Multi-systemic evaluation of biological and emotional responses to the Trier Social Stress Test: A meta-analysis and systematic review. *Frontiers in Neuroendocrinology*, *68*, 101050. https://doi.org/10.1016/j.yfrne.2022.101050

Marshall, D. T., Shannon, D. M., & Love, S. M. (2020). How teachers experienced the COVID-19 transition to remote instruction. *Phi Delta Kappan*, *102*(3), 46–50. https://doi.org/10.1177/0031721720970702

Martínez-Pernía, D., Cea, I., Troncoso, A., Blanco, K., Calderón Vergara, J., Baquedano, C., Araya-Veliz, C., Useros-Olmo, A., Huepe, D., Carrera, V., Mack Silva, V., & Vergara, M. (2023). "I am feeling tension in my whole body": An experimental phenomenological study of empathy for pain. *Frontiers in Psychology, 13*, 999227. https://doi.org/10.3389/fpsyg.2022.999227

Maslach, C., & Jackson, S.E. (1986). *Maslach burnout inventory manual*. Consulting Psychologists Press.

Maslach, C., & Jackson, S. E. (1981). The measurement of experienced burnout. *Journal of Organizational Behavior, 2*(2), 99-113. https://doi.org/10.1002/job.4030020205

Maslach, C., Jackson, S. E., & Schwab, R. L. (1996). Maslach burnout inventory-Educators survey (MBI-ES). In C. Maslach, S. E. Jackson, & M. P Leiter (Eds.), *MBI Study*, (3rd ed.). Consulting Psychologists Press.

Massaro, S., & Pecchia, L. (2019). Heart rate variability (HRV) analysis: A methodology for organizational neuroscience. *Organizational Research Methods, 22*(1), 354-393. https://doi.org/10.1177/1094428116681072

Matos, M., Duarte, C., Duarte, J., Pinto-Gouveia, J., Petrocchi, N., Basran, J., & Gilbert, P. (2017). Psychological and physiological effects of compassionate mind training: A pilot randomised controlled study. *Mindfulness, 8*(6), 1699–1712. https://doi.org/10.1007/s12671-017-0745-7

McCormick, J. & Barnett, K. (2011). Teachers' attributions for stress and their relationships with burnout. *International Journal of Educational Management, 25*(3), 278-293. https://doi.org/10.1108/09513541111120114

McCraty, R., & Shaffer, F. (2015). Heart Rate Variability: New perspectives on physiological mechanisms, assessment of self-regulatory capacity, and health risk. *Global Advances in Health and Medicine*, *4*(1), 46–61. https://doi.org/10.7453/gahmj.2014.073

McMakin, D., Ballin, A., & Fullerton, D. (2022). Secondary trauma, burnout, and teacher self-care during COVID19: A mixed-methods case study. *Psychology in the Schools, 10*.1002/pits.22764. Advance online publication. https://doi.org/10.1002/pits.22764

McNames, J., & Aboy, M. (2006). Reliability and accuracy of heart rate variability metrics versus ECG segment duration. *Medical & Biological Engineering & Computing*, *44*(9), 747–756. https://doi.org/10.1007/s11517-006-0097-2

Meiklejohn, J., Phillips C., Freedman M. L., Griffin M. L., Biegel G., Roach A., Frank J., Burke C., Pinger L., Soloway G., Isberg R., Sibinga E., Grossman, L. & Saltzman A. (2021). Integrating mindfulness training into K-12 education: Fostering the resilience of teachers and students. *Mindfulness, 3*, 291–307. https://doi.org/10.1007/s12671-012-0094-5

Melamed, S., Shirom, A., Toker, S., Berliner, S., & Shapira, I. (2006). Burnout and risk of cardiovascular disease: Evidence, possible causal paths, and promising research directions. *Psychological Bulletin, 132*(3), 327–353. https://doi.org/10.1037/0033-2909.132.3.327

Migliaro, E., Canetti, R., Contreras, P., Hakas, M., Eirea, G., & Machado, A. (2004). Procesamiento de señales para el estudio de la variabilidad de la frecuencia cardiaca. En *Procesamiento de señales e imágenes: teoría y aplicaciones* (pp. 189-204). Buenos Aires, Argentina: Universidad Tecnológica Nacional.

Miklósi, M., Martos, T., Szabó, M., Kocsis-Bogár, K. & Forintos, D. (2014). Cognitive emotion regulation and stress: A multiple mediation approach. *Translational Neuroscience*, *5*(1), 64-71. https://doi.org/10.2478/s13380-014-0207-9

Møller, S. A. Q., Sami, S., & Shapiro, S. L. (2019). Health benefits of (mindful) self-compassion meditation and the potential complementarity to mindfulness-based interventions: A review of randomized-controlled trials. *OBM Integrative and Complementary Medicine, 4*(1), 1-20. https://doi.org/10.21926/obm.icm.1901002

Moriana, J. A., Herruzo, J. (2004). Estrés y burnout en profesores. *International Journal of Clinical and Health Psychology 4*(3), 597-621. http://hdl.handle.net/10396/20924

Motiejunaite, J., Amar, L., & Vidal-Petiot, E. (2021). Adrenergic receptors and cardiovascular effects of catecholamines. *Annales d'Endocrinologie, 82*(3-4), 193-197. https://doi.org/10.1016/j.ando.2021.04.003

Munoz, M. L., van Roon, A., Riese, H., Thio, C., Oostenbroek, E., Westrik, I., de Geus, E. J., Gansevoort, R., Lefrandt, J., Nolte, I. M., & Snieder, H. (2015). Validity of (ultra-)short recordings for heart rate variability measurements. *PloS one*, *10*(9), e0138921. https://doi.org/10.1371/journal.pone.0138921

Muraiwa, S. (2015). Voluntary sampling design. *International Journal of Advanced Research in Management and Social Sciences, 4,* 185–200.

Murphy, B. A., & Lilienfeld, S. O. (2019). Are self-report cognitive empathy ratings valid proxies for cognitive empathy ability? Negligible meta-analytic relations with behavioral task performance. *Psychological Assessment*, *31*(8), 1062–1072. https://doi.org/10.1037/pas0000732

Murray, R. J., Apazoglou, K., Celen, Z., Dayer, A., Aubry, J. M., Ville, D. V., Vuilleumier, P., & Piguet, C. (2021). Maladaptive emotion regulation traits predict altered corticolimbic recovery from psychosocial stress. *Journal of Affective Disorders*, *280*(Pt A), 54–63. https://doi.org/10.1016/j.jad.2020.09.122

Muscatell, K. A., & Eisenberger, N. I. (2012). A social neuroscience perspective on stress and health. *Social and Personality Psychology Compass, 6*(12), 890-904. https://doi.org/10.1111/j.1751-9004.2012.00467.x

Nair B. (2019). Clinical trial designs. *Indian Dermatology Online Journal*, *10*(2), 193–201. https://doi.org/10.4103/idoj.IDOJ_475_18

Narvaez Linares, N. F., Charron, V., Ouimet, A. J., Labelle, P. R., & Plamondon, H. (2020). A systematic review of the Trier Social Stress Test methodology: Issues in promoting study comparison and replicable research. *Neurobiology of Stress*, *13*, 100235. https://doi.org/10.1016/j.ynstr.2020.100235

Nater, U. M., Rohleder, N., Gaab, J., Berger, S., Jud, A., Kirschbaum, C., & Ehlert, U. (2005). Human salivary alpha-amylase reactivity in a psychosocial stress paradigm. *International Journal of Psychophysiology, 55*(3), 333–342. https://doi.org/10.1016/j.ijpsycho.2004.09.009

National Research Council (US) Committee on Recognition and Alleviation of Distress in Laboratory Animals. (2008). *Recognition and Alleviation of Distress in Laboratory Animals*. National Academies Press (US).

Neff, K. D. (2003a). Development and validation of a scale to measure self-compassion. *Self and Identity*, *2*(3), 223–250. https://doi.org/10.1080/15298860309027

Neff, K. D. (2003b). Self-compassion: an alternative conceptualization of a healthy attitude toward oneself. *Self and Identity*, *2*(2), 85–101. https://doi.org/10.1080/15298860309032

Neff, K. D., Rude, S. S., & Kirkpatrick, K. L. (2007). An examination of self-compassion in relation to positive psychological functioning and personality traits. *Journal of Research in Personality*, *41*(4), 908–916. https://doi.org/10.1016/j.jrp.2006.08.002

Neff, K. D., & Beretvas, N. (2012). The role of self-compassion in romantic relationships. *Self and Identity, 12* (1), 78–98. https://doi.org/10.1080/15298868.2011.639548

Neff, K. D., & Germer, C.K. (2013). A pilot study and randomised controlled trial of the mindful self-compassion program. *Journal of Clinical Psychology*, *69*(1), 28–44 https://doi.org/10.1002/jclp.21923

Neff, K. D., & Pommier, E. (2013). The relationship between self-compassion and other-focused concern among college undergraduates, community adults, and practicing meditators. *Self and Identity*, *12*(2), 160–176. https://doi.org/10.1080/15298868.2011.649546

Neff, K. (2021). Self-compassion scale (SCS) information. https://self-compassion.org/wp-content/uploads/2021/03/SCS-information.pdf

Neff, K. D. (2023). Self-compassion: Theory, method, research, and intervention. *Annual Review of Psychology, 74*, 193–218. https://doi.org/10.1146/annurev-psych-032420-031047

Neumann, D. L., Chan, R. C. K., Boyle, G. J., Wang, Y., & Westbury, H. R. (2015). Measures of empathy: Self-report, behavioral, and neuroscientific approaches. In G. J. Boyle, D. H. Saklofske, & G. Matthews (Eds.), *Measures of personality and social psychological constructs* (pp. 257–289). Elsevier Academic Press. https://doi.org/10.1016/B978-0-12-386915-9.00010-3

Nunan, D., Sandercock, G. R., & Brodie, D. A. (2010). A quantitative systematic review of normal values for short-term heart rate variability in healthy adults. *Pacing and Clinical Electrophysiology: PACE*, *33*(11), 1407–1417. https://doi.org/10.1111/j.1540-8159.2010.02841.x

O'Hara-Gregan, J. (2023). Supporting early childhood teacher well-being through the practice of mindful self-compassion. *Australasian Journal of Early Childhood, 48*(4), 319-331. https://doi.org/10.1177/18369391231202833

Obada, D. (2022). School during the pandemic. Challenges and uncertainties. *Labor et Educatio,* (10), 125-136. https://doi.org/10.4467/25439561LE.22.010.17536

O'Connor, D. B., Thayer, J. F., & Vedhara, K. (2021). Stress and health: A review of psychobiological processes. *Annual Review of Psychology, 72*(1), 663-688. https://doi.org/10.1146/annurev-psych-062520-122331

OECD (2020). *Schooling disrupted, schooling rethought: How the Covid-19 pandemic is changing education*. OECD Policy Responses to Coronavirus (COVID-19) OECD Publishing. https://doi.org/10.1787/68b11faf-en

Pan, J., & Tompkins, W. J. (1985). A real-time QRS detection algorithm. *IEEE Transactions on bio-medical Engineering*, *32*(3), 230–236. https://doi.org/10.1109/TBME.1985.325532

Pandey, S. (2020). Principles of correlation and regression analysis. *Journal of the Practice of Cardiovascular Sciences, 6*(1), 7-11. https://doi.org/10.4103/jpcs.jpcs_2_20

Paulhus, D. (2017). Socially desirable responding on self-reports. In *The Encyclopedia of Personality and Individual Differences* (pp. 1-5). Springer. https://doi.org/10.1007/978-3-319-28099-8_1349-1

Paradies, Y. (2010). A theoretical review of psychosocial stress and health. *International Journal of Psychology Research, 5*(3), 205–222.

Pellerone, M. (2021). Self-perceived instructional competence, self-efficacy, and burnout during the Covid-19 pandemic: A study of a group of Italian school teachers. *European Journal of Investigation in Health, Psychology and Education, 11*(2), 496–512. https://doi.org/10.3390/ejihpe11020035

Pereira, T., Almeida, P. R., Cunha, J. P. S., & Aguiar, A. (2017). Heart rate variability metrics for fine-grained stress level assessment. *Computer Methods and Programs in Biomedicine*, *148*, 71–80. https://doi.org/10.1016/j.cmpb.2017.06.018

Perna, G., Riva, A., Defillo, A., Sangiorgio, E., Nobile, M., & Caldirola, D. (2020). Heart rate variability: Can it serve as a marker of mental health resilience? *Journal of Affective Disorders, 263*, 754–761. https://doi.org/10.1016/j.jad.2019.10.017

Petrocchi, N., Ottaviani, C., & Couyoumdjian, A. (2017). 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, 12*(6), 525–536. https://doi.org/10.1080/17439760.2016.1209544

Piazza, J. R., Charles, S. T., Sliwinski, M. J., Mogle, J., & Almeida, D. M. (2013). Affective reactivity to daily stressors and long-term risk of reporting a chronic physical health condition. *Annals of Behavioral Medicine, 45*(1), 110–120. https://doi.org/10.1007/s12160-012-9423-0

Pietarinen, J., Pyhältö, K., Soini, T., & Salmela-Aro, K. (2013). Reducing teacher burnout: A socio-contextual approach. *Teaching and Teacher Education, 35*, 62-72. https://doi.org/10.1016/j.tate.2013.05.003

Pham, T., Lau, Z. J., Chen, S. H. A., & Makowski, D. (2021). Heart rate variability in psychology: A review of HRV indices and an analysis tutorial. *Sensors, 21*(12), 3998. https://doi.org/10.3390/s21123998

Porges S. W. (2007). The polyvagal perspective. *Biological Psychology, 74*(2), 116–143. https://doi.org/10.1016/j.biopsycho.2006.06.009

Porges S. W. (2009). The polyvagal theory: New insights into adaptive reactions of the autonomic nervous system. *Cleveland Clinic Journal of Medicine, 76*(Suppl 2), S86–S90. https://doi.org/10.3949/ccjm.76.s2.17

Pressley, T. (2021). Factors contributing to teacher burnout during COVID-19. *Educational Researcher, 50*(5), 325–327. https://doi.org/10.3102/0013189X211004138

Pressley, T., Ha, C. & Learn, E. (2021). Teacher stress and anxiety during COVID-19: An empirical study. *School Psychology*, *36*(5), 367–376. https://doi.org/10.1037/spq0000468

Preston, S. D. & Hofelich, A. J. (2012). The many faces of empathy: Parsing empathic phenomena through a proximate, dynamic-systems view of representing the other in the self. *Emotion Review*, *4*, 24-33.

Rahman, S., Habel, M., & Contrada, R. J. (2018). Poincaré plot indices as measures of sympathetic cardiac regulation: Responses to psychological stress and associations with pre-ejection period. *International Journal of Psychophysiology*, *133*, 79–90. https://doi.org/10.1016/j.ijpsycho.2018.08.005

Robalino, M. & Körner, A. (2005). *Condiciones de trabajo y salud docente: Estudios de casos en Argentina, Chile, Ecuador, México, Perú y Uruguay.* UNESCO Office Santiago and Regional Bureau for Education in Latin America and the Caribbean. http://unesdoc.unesco.org/images/0014/001425/142551s.pdf

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. *Clinical Neuropsychiatry: Journal of Treatment Evaluation, 5*(3), 132–139.

Roemer, A., & Medvedev, O. N. (2023). Positive and Negative Affect schedule (PANAS). In O. N. Medvedev, C. U. Krägeloh, R. J. Siegert, & N. N. Singh (Eds.), *Handbook of Assessment in Mindfulness Research*. Springer. https://doi.org/10.1007/978-3-030-77644-2_86-1

Roeser, R. R., & Zelazo, P. D. (2012). Contemplative science, education and child development: Introduction to the special section. *Child Development Perspectives, 6*(2), 143-145. https://doi.org/10.1111/j.1750-8606.2012.00242.x

Roeser, R. W., Schonert-Reichl, K. A., Jha, A., Cullen, M., Wallace, L., Wilensky, R., Oberle, E., Thomson, K., Taylor, C. & Harrison, J. (2013). Mindfulness training and reductions in teacher stress and burnout: Results from two randomised, waitlist-control field trials. *Journal of Educational Psychology, 105*(3), 787–804. https://doi.org/10.1037/a0032093

Saiz, M., Palacios, T., Balladares, S., & Machín, D. (2013). Traducción y adaptación de la Escala de Afecto Positivo y Negativo (PANAS) en estudiantes universitarios en Uruguay. Análisis psicométricos preliminares. In *IV Simposio de Investigación en Psicología. Posibilidades y Realidades de Innovación.* UCU.

Scheuch, K., Haufe, E., & Seibt, R. (2015). Teachers' health. *Deutsches Arzteblatt International, 112*(20), 347–356. https://doi.org/10.3238/arztebl.2015.0347

Schiweck, C., Piette, D., Berckmans, D., Claes, S., & Vrieze, E. (2018). Heart rate and high frequency heart rate variability during stress as biomarker for clinical depression. A systematic review. *Psychological Medicine, 49*(2), 200–211. https://doi.org/10.1017/S0033291718001988

Schommer, N., Hellhammer, D., Kirschbaum, C., (2003). Dissociation between reactivity of the hypothalamus-pituitary-adrenal axis and the sympathetic-adrenal-medullary system to repeated psychosocial stress. *Psychosomatic Medicine, 65*(3), 450—460. https://doi.org/10.1097/01.psy.0000035721.12441.17

Schonert-Reichl, K. A., & Roeser, R. W. (Eds.). (2016). *Handbook of mindfulness in education: Integrating theory and research into practice*. Springer-Verlag Publishing/Springer Nature. https://doi.org/10.1007/978-1-4939-3506-2

Seddon, J. A., Rodriguez, V. J., Provencher, Y., Raftery-Helmer, J., Hersh, J., Labelle, P. R., & Thomassin, K. (2020). Meta-analysis of the effectiveness of the Trier Social Stress Test in eliciting physiological stress responses in children and adolescents. *Psychoneuroendocrinology*, *116*, 104582. https://doi.org/10.1016/j.psyneuen.2020.104582

Sedlmeier, P., Eberth, J., Schwarz, M., Zimmermann, D., Haarig, F., Jaeger, S., & Kunze, S. (2012). The psychological effects of meditation: A meta-analysis. *Psychological Bulletin*, *138*(6), 1139–1171. https://doi.org/10.1037/a0028168

Segal, E. A., Gerdes, K. E., Lietz, C. A., Wagaman, M. A., & Geiger, J. M. (2017). *Assessing empathy*. Columbia University Press.

Seibt, R., Spitzer, S., Druschke, D., Scheuch, K., & Hinz, A. (2013). Predictors of mental health in female teachers. *International Journal of Occupational Medicine and Environmental Health, 26*(6), 856–869. https://doi.org/10.2478/s13382-013-0161-8

Seisdedos, N. (1997). *Manual MBI: Inventario burnout de Maslach*. TEA Ediciones.

Selye, H. (1936). A syndrome produced by diverse nocuous agents. *Nature, 138*(3479): 32-32. https://doi.org/10.1038/138032a0

Shaffer, F., & Ginsberg, J. P. (2017). An overview of heart rate variability metrics and norms. *Frontiers in Public Health, 5*, 258. https://doi.org/10.3389/fpubh.2017.00258

Shaffer, F., McCraty, R., & Zerr, C. L. (2014). A healthy heart is not a metronome: an integrative review of the heart's anatomy and heart rate variability. *Frontiers in Psychology, 5,* 1040. https://doi.org/10.3389/fpsyg.2014.01040

Shaffer, F., Meehan, Z. M., & Zerr, C. L. (2020). A critical review of ultra-short-term heart rate variability norms research. *Frontiers in Neuroscience*, *14*, 594880. https://doi.org/10.3389/fnins.2020.594880

Shah, K., Kumari, R., & Jain, M. (2024). Unveiling stress markers: A systematic review investigating psychological stress biomarkers. *Developmental Psychobiology*, *66*(5), e22490. https://doi.org/10.1002/dev.22490

Shaw, J.L., Kelly, A.C. (2024). How exposure to personal distress with and without self-compassion affects distress tolerance: Results from a two-sample randomized trial. *Mindfulness, 15*, 570–585. https://doi.org/10.1007/s12671-024-02312-x

She, Z., Li, D., Zhang, W., Zhou, N., Xi, J., & Ju, K. (2021). Three versions of the perceived stress scale: psychometric evaluation in a nationally representative sample of Chinese adults during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health, 18*(16), 8312. https://doi.org/10.3390/ijerph18168312

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., Hergueta, T., Baker, R., & Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I): The development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *The Journal of Clinical Psychiatry, 59*(20), 22–33.

Shin, H., Oh, K., Song, Y., Kim, Y. S., Hur, B. Y., Kim, W., & Kang, B. (2023). Efficacy of the online Mindful Self-Compassion for Healthcare Communities program for surgical trainees: A prospective pilot study. *Annals of Surgical Treatment and Research*, *104*(4), 229-236. https://doi.org/10.4174/astr.2023.104.4.229

Shoham, A., Goldstein, P., Oren, R., Spivak, D., & Bernstein, A. (2017). Decentering in the process of cultivating mindfulness: An experience-sampling study in time and context. *Journal of Consulting and Clinical Psychology*, *85*(2), 123–134. https://doi.org/10.1037/ccp0000154

Signorini, M. G., Cerutti, S., Guzzetti, S., & Parola, R. (1994). Non-linear dynamics of cardiovascular variability signals. *Methods of Information in Medicine, 33*(1), 81–84. https://doi.org/10.1055/s-0038-1634981

Silva, M. I., García Pérez, R. C., González, M. del C., & Ratto, A. (2015). Prevalencia del síndrome de quemarse por el trabajo y variables sociodemográficas en un grupo de maestras de Montevideo. *Ciencias Psicológicas*, *9*(1), 55–62. https://doi.org/10.22235/cp.v9i1.165

Singer, T., & Lamm, C. (2009). The social neuroscience of empathy. *Annals of the New York Academy of Sciences*, *1156*, 81–96. https://doi.org/10.1111/j.1749-6632.2009.04418.x

Sleilaty, J. (2022). The impacts of a regular mindfulness practice on teachers: A critical review. *Emerging Perspectives*, *6*(1).32–49 https://journalhosting.ucalgary.ca/index.php/ep/article/view/74938

Smith, T. W., Deits-Lebehn, C., Williams, P. G., W. Baucom, B. R., & Uchino, B. N. (2020). Toward a social psychophysiology of vagally mediated heart rate variability: Concepts and methods in self-regulation, emotion, and interpersonal processes. *Social and Personality Psychology Compass, 14*(3), e12516. https://doi.org/10.1111/spc3.12516

Society for Social Neuroscience. (n.d.). Mission & history. Retrieved February 23, 2024, from https://www.s4sn.org/mission

Solomon, C., DiLorenzo-Garcia, A., & Johnson, S. M. (2022). Safe healing circles: Mindful self-compassion interventions to address racial battle fatigue with teachers of colour. *The Journal of Humanistic Counselling*. https://doi.org/10.1002/johc.12175

Sotiropoulou, K., Patitsa, C., Giannakouli, V., Galanakis, M., Koundourou, C., & Tsitsas, G. (2023). Self-compassion as a key factor of subjective happiness and psychological well-being among Greek adults during COVID-19 lockdowns. *International Journal of Environmental Research and Public Health, 20*(15), 6464. https://doi.org/10.3390/ijerph20156464

Spielberger, C.D. (1971) Notes and comments trait-state anxiety and motor behavior, *Journal of Motor Behavior, 3*(3), 265-279, DOI: 10.1080/00222895.1971.1073490

Speilberger, C. D., Gorsuch, R., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). Manual for the state-trait anxiety inventory. *Consulting Psychologists*.

Spilt, J. L., Koomen, H. M. Y. & Thijs, J. T. (2011). Teacher wellbeing: The importance of teacher–student relationships. *Educational Psychology Review, 23*, 457–477. https://doi.org/10.1007/s10648-011-9170-y

Sterling, P. (2004). Principles of allostasis: Optimal design, predictive regulation, pathophysiology, and rational therapeutics. In J. Schulkin (Ed.), *Allostasis* (pp. 17-64). MIT Press.

Sterling, P. (2012). Allostasis: a model of predictive regulation. *Physiology & Behavior*, *106*(1), 5–15. https://doi.org/10.1016/j.physbeh.2011.06.004

Stoet G. (2010). PsyToolkit: A software package for programming psychological experiments using Linux. *Behavior Research Methods, 42*(4), 1096–1104. https://doi.org/10.3758/BRM.42.4.1096

Stoet, G. (2017). PsyToolkit: A novel web-based method for running online questionnaires and reaction-time experiments. *Teaching of Psychology, 44*, 24-31. https://doi.org/10.1177/0098628316677643

Streeter, C. C., Whitfield, T. H., Owen, L., Rein, T., Karri, S. K., Yakhkind, A., Perlmutter, R., Prescot, A., Renshaw, P. F., Ciraulo, D. A., & Jensen, J. E. (2010). Effects of yoga versus walking on mood, anxiety, and brain GABA levels: A randomised controlled MRS study. *Journal of Alternative and Complementary Medicine*, *16*(11), 1145–1152. https://doi.org/10.1089/acm.2010.0007

Svendsen, J. L., Osnes, B., Binder, P. E., Dundas, I., Visted, E., Nordby, H., Schanche, E., & Sørensen, L. (2016). Trait self-compassion reflects emotional flexibility through an association with high vagally mediated heart rate variability. *Mindfulness, 7*(5), 1103–1113. https://doi.org/10.1007/s12671-016-0549-1

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Allyn & Bacon/Pearson Education.

Tang, W., Shen, G., Lin, Y., & Huang, J. (2022). Nonparametric quantile regression: Non-crossing constraints and conformal prediction. *ArXiv*. https://arxiv.org/abs/2210.10161

Tapia, D., Cruz, C., Gallardo, I., & Dasso, M. (2007). Adaptación de la escala de percepción global de estrés (EPGE) en estudiantes adultos de escasos recursos en Santiago, Chile. *Psiquiatría y Salud Mental*, *24,* 109–119.

Tarrasch, R., Berger, R., & Grossman, D. (2020). Mindfulness and compassion as key factors in improving teacher's well-being. *Mindfulness, 11*, 1049–1061. https://doi.org/10.1007/s12671-020-01304-

Tarvainen, M. P., Lipponen, J. A., Niskanen, J.-P., & Ranta-aho, P. O. (2021). *Kubios HRV software user's guide*. Retrieved from https://www.kubios.com

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*(5), 1043–1065. https://doi.org/10.1161/01.CIR.93.5.1043

Tayel, M. B., & AlSaba, E. I. (2015). Poincaré plot for heart rate variability. *International Journal of Biomedical and Biological Engineering*, *9*(9), 708-711.

Thayer, J. F., & Lane, R. D. (2000). A model of neurovisceral integration in emotion regulation and dysregulation. *Journal of Affective Disorders, 61*(3), 201–216. https://doi.org/10.1016/s0165-0327(00)00338-4

Thayer, J. F., & Lane, R. D. (2009). Claude Bernard and the heart-brain connection: Further elaboration of a model of neurovisceral integration. *Neuroscience and Biobehavioral Reviews, 33*(2), 81–88. https://doi.org/10.1016/j.neubiorev.2008.08.004

Thayer, J. F., & Sternberg, E. (2006). Beyond heart rate variability: Vagal regulation of allostatic systems. *Annals of the New York Academy of Sciences, 1088*(1), 361–372. https://doi.org/10.1196/annals.1366.014

Thayer, J. F., Åhs, F., Fredrikson, M., Sollers III, 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.

Tomasi, J., Zai, C. C., Pouget, J. G., Tiwari, A. K., & Kennedy, J. L. (2024). Heart rate variability: Evaluating a potential biomarker of anxiety disorders. *Psychophysiology, 61*, e14481. https://doi.org/10.1111/psyp.14481

Tomczak, M & Tomczak, E. (2014). The need to report effect size estimates revisited. An overview of some recommended measures of effect size. *Trends Sport Sciences*, *1*(21), 19–25.

Topp, C. W., Østergaard, S. D., Søndergaard, S., & Bech, P. (2015). The WHO-5 Well-Being Index: a systematic review of the literature. *Psychotherapy and Psychosomatics*, *84*(3), 167–176. https://doi.org/10.1159/000376585

Troman, G., & Woods, P. (2001). *Primary teachers' stress.* Psychology Press.

Tsang, K. K. Y., Shum, K. K., Chan, W. W. L., Li, S. X., Kwan, H. W., Su, M. R., Wong, B. P. H., & Lam, S. F. (2021). Effectiveness and mechanisms of mindfulness training for school teachers in difficult times: A randomised controlled trial. *Mindfulness*, *12*(11), 2820–2831. https://doi.org/10.1007/s12671-021-01750-1

Tung, Y.-H., & Hsieh, J.-C. (2019). The impacts of mindfulness on heart rate variability: A brief review. International *Journal of Pharma Medicine and Biological Sciences*, *8*(4), 132-137. doi:10.18178/ijpmbs.8.4.132-137

Tyra, A. T., Fergus, T. A., & Ginty, A. T. (2023). Emotion suppression and acute physiological responses to stress in healthy populations: A quantitative review of experimental and correlational investigations. *Health Psychology Review*, *18*(2), 396–420. https://doi.org/10.1080/17437199.2023.2251559

Unterbrink, T., Zimmermann, L., Pfeifer, R., Wirsching, M., Brähler, E., & Bauer, J. (2008). Parameters influencing health variables in a sample of 949 German teachers. *International Archives of Occupational and Environmental Health, 82*(1), 117–123. https://doi.org/10.1007/s00420-008-0336-y

Vaidya, N., Marquand, A. F., Nees, F., Siehl, S., & Schumann, G. (2024). The impact of psychosocial adversity on brain and behaviour: An overview of existing knowledge and directions for future research. *Molecular Psychiatry*. Advance online publication. https://doi.org/10.1038/s41380-024-02556-y

van Duinen, M., Rickelt, J., & Griez, E. (2008). Validation of the electronic Visual Analogue Scale of Anxiety. *Progress in Neuro-Psychopharmacology & Biological psychiatry*, *32*(4), 1045–1047. https://doi.org/10.1016/j.pnpbp.2008.02.002

Vanhollebeke, G., De Smet, S., De Raedt, R., Baeken, C., van Mierlo, P., & Vanderhasselt, M. A. (2022). The neural correlates of psychosocial stress: A systematic review and meta-analysis of spectral analysis EEG studies. *Neurobiology of Stress*, *18*, 100452. https://doi.org/10.1016/j.ynstr.2022.100452

Vanman, E. J., Kappas, A., & Ito, T. A. (2021). Social neuroscience is more than the study of the human brain: The legacy of John Cacioppo. *Social Neuroscience, 16*(1), 1–5. https://doi.org/10.1080/17470919.2021.1879459

Vieten C, Rubanovich CK, Khatib L, Sprengel M, Tanega C, Polizzi C, et al. (2024) Measures of empathy and compassion: A scoping review. *PLoS One 19*(1): e0297099. https://doi.org/10.1371/journal.pone.0297099

von Rosenberg, W., Chanwimalueang, T., Adjei, T., Jaffer, U., Goverdovsky, V., & Mandic, D. P. (2017). Resolving ambiguities in the LF/HF ratio: LF-HF scatter plots for the categorization of mental and physical stress from HRV. *Frontiers in Physiology, 8,* 360. https://doi.org/10.3389/fphys.2017.00360

Wallmark, E., Safarzadeh, K., Daukantaitė, D., & Maddux, R. E. (2013). Promoting altruism through meditation: An 8-week randomized controlled pilot study. *Mindfulness, 4,* 223-234 https://doi.org/10.1007/s12671-012-0115-4

Wang, F., & Szabo, A. (2020). Effects of yoga on stress among healthy adults: A systematic review. *Alternative Therapies in Health and Medicine, 26*(4), AT6214.

Watkins E. R. (2008). Constructive and unconstructive repetitive thought. *Psychological Bulletin*, *134*(2), 163–206. https://doi.org/10.1037/0033-2909.134.2.163

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063–1070. https://doi.org/10.1037//0022-3514.54.6.1063

Wearne, T. A., Lucien, A., Trimmer, E. M., Logan, J. A., Rushby, J., Wilson, E., Filipčíková, M., & McDonald, S. (2019). Anxiety sensitivity moderates the subjective experience but not the physiological response to psychosocial stress. *International Journal of Psychophysiology: Official Journal of the International Organization of Psychophysiology, 141*, 76–83. https://doi.org/10.1016/j.ijpsycho.2019.04.012

Weißenfels M., Klopp E. & Perels F. (2022). Changes in teacher burnout and self-efficacy during the COVID-19 pandemic: Interrelations and eLearning variables related to change. *Frontiers in Education, 6,* 736992. https://doi.org/10.3389/feduc.2021.736992

WHO (1998). *Wellbeing measures in primary health care: The Depcare project.* WHO Regional Office for Europe. https://iris.who.int/handle/10665/349766

Wiklund, G. L., & Wagner, L. (2013). The butterfly effect of caring - clinical nursing teachers' understanding of self-compassion as a source to compassionate care. *Scandinavian Journal of Caring Sciences*, *27*(1), 175–183. https://doi.org/10.1111/j.1471-6712.2012.01033.x

Wong, V., Ruble, L. A., Yu, Y., & McGrew, J. H. (2017). Too stressed to teach? Teaching quality, student engagement, and IEP outcomes. *Exceptional Children*, *83*(4), 412–427. https://doi.org/10.1177/0014402917690729

Woods, A. D., Gerasimova, D., Dusen, B. V., Nissen, J., Bainter, S., Uzdavines, A., Davis-Kean, P. E., Halvorson, M., King, K. M., Logan, J. A. R., Xu, M., Vasilev, M. R., Clay, J. M., Moreau, D., Joyal-Desmarais, K., Cruz, R. A., Brown, D. M. Y., Schmidt, K., & Elsherif, M. M. (2024). Best practices for addressing missing data through multiple imputation. *Infant and Child Development, 33*(1), e2407. https://doi.org/10.1002/icd.2407

Wu, L., Shi, P., Yu, H., & Liu, Y. (2020). An optimization study of the ultra-short period for HRV analysis at rest and post-exercise. *Journal of Electrocardiology*, *63*, 57–63. https://doi.org/10.1016/j.jelectrocard.2020.10.002

Xu, Y. (2013). Language teacher emotion in relationships: A multiple case study. In X. Zhu & K. Zeichner (Eds.), *Preparing teachers for the 21st century*. New Frontiers of Educational Research. Springer. https://doi.org/10.1007/978-3-642-36970-4_22

Yu, X., Wang, P., Zhai, X., Dai, H., & Yang, Q. (2015). The effect of work stress on job burnout among teachers: The mediating role of self-efficacy. *Social Indicators Research*, *Q-25* = quartile 25*; Q-75* = quartile 75*;* (3), 701–708. https://doi.org/10.1007/s11205-014-0716-5

Zessin, U., Dickhäuser, O., & Garbade, S. (2015). The relationship between self-compassion and well-being: A meta-analysis. *Applied Psychology. Health and Well-being*, *7*(3), 340–364. https://doi.org/10.1111/aphw.12051

Appendix 1

Table 5 *Summary of Results of Psychometric Tests Comparing Pre vs Post Mindful Self-Compassion Training (n = 19)*

Test	Factor	Q-25 pre	Median pre	Q-75 pre	Q-25 post	Median post	Q-75 post	*p**	*ES*
FFMQ	Observing (1-5)	2.63	3.25	3.75	3.38	3.75	4.25	0.000	0.84
	Describing (1-5)	3.38	3.88	4.00	3.38	3.86	4.75	0.055	0.44
	Acting with Awareness (1-5)	3.25	3.63	4.13	3.38	3.75	4.38	0.085	0.40
	Non-judging (1-5)	3.25	3.75	4.25	3.38	3.88	4.50	0.132	0.35
	Non-reactivity (1-5)	2.86	3.14	3.43	3.00	3.43	3.71	0.038	0.48
	Total (1-5)	3.10	3.41	3.97	3.46	3.80	4.05	0.004	0.66
SCS	Self-kindness (1-5)	2.60	3.00	3.80	3.60	4.20	4.80	0.001	0.75
	Common Humanity (1-5)	2.50	3.25	3.50	3.25	3.50	4.25	0.010	0.59
	Mindfulness (1-5)	3.00	3.50	4.50	3.50	4.00	4.75	0.034	0.49
	Self-Judgment (1-5)	2.40	3.40	4.00	3.40	4.00	4.20	0.044	0.46
	Isolation (1-5)	2.75	3.25	3.75	3.25	3.75	4.00	0.099	0.38
	Over-Identification (1-5)	2.75	3.75	4.00	3.50	3.75	4.50	0.111	0.37
IRI	Perspective-taking (7-35)	21.00	24.00	28.00	23.00	28.00	32.00	0.028	0.51
	Fantasy (7-35)	18.00	21.00	23.00	18.00	21.00	28.00	0.297	0.24
	Empathic Concern (7-35)	25.00	31.00	33.00	27.00	31.00	34.00	0.203	0.29
	Personal Distress (7-35)	17.00	18.00	22.00	14.00	17.00	18.00	0.011	0.59
MBI	Emotional Exhaustion (0-54)	17.00	22.00	32.00	14.00	19.00	25.00	0.033	0.49
	Personal Accomplishment (0-48)	33.00	38.00	43.00	35.00	41.00	45.00	0.343	0.22
	Depersonalization (0-30)	0.00	0.00	5.00	0.00	0.00	2.00	0.350	0.21
PSS	Total (0-56)	15.00	21.00	25.00	11.00	16.00	20.00	0.050	0.45
ERQ	Cognitive Reappraisal (6-42)	27.00	34.00	37.00	30.00	36.00	40.00	0.295	0.24
	Expressive Suppression (4-28)	7.00	10.00	15.00	4.00	7.00	11.00	0.039	0.47
WHO-5	Total (0-100)	44.00	60.00	72.00	60.00	68.00	80.00	0.008	0.61

Note. ERQ = Emotional Regulation Questionnaire; *ES* = effect size; *FFMQ* = Five Facet Mindfulness Questionnaire; *IRI* = Interpersonal Reactivity Index; MBI = Maslach Burnout Inventory; *p* = *p*-value; *PSS* = Perceived Stress Scale; *Q-25* = quartile 25; *Q-75* = quartile 75; *SCS* = Self-Compassion Scale; *WHO-5* = World Health Organization-Five Well-Being Index; Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
*Based on the Wilcoxon signed rank test

Table 6 *Summary of Results of Psychometric Tests Comparing Pre vs Post Kundalini Yoga Training (n = 18)*

Test	Factor	Q-25 pre	Median pre	Q-75 pre	Q-25 post	Median post	Q-75 post	*p**	*ES*
FFMQ	Observing (1-5)	2.94	3.25	3.53	3.34	3.63	3.91	0.010	0.61
	Describing (1-5)	2.97	3.63	4.13	3.34	3.88	4.16	0.274	0.26
	Acting with Awareness (1-5)	3.06	3.50	3.78	3.47	3.75	4.34	0.014	0.58
	Non-judging (1-5)	3.00	3.69	4.06	3.28	4.00	4.50	0.124	0.36
	Non-reactivity (1-5)	2.96	3.29	3.61	2.54	3.29	3.75	0.979	0.01
	Total (1-5)	3.08	3.41	3.64	3.47	3.56	3.86	0.029	0.51
SCS	Self-kindness (1-5)	2.15	3.10	4.00	3.25	3.60	4.45	0.015	0.57
	Common Humanity (1-5)	2.81	3.25	3.81	2.50	3.25	4.00	0.668	0.10
	Mindfulness (1-5)	2.75	3.38	4.31	3.00	3.75	4.56	0.145	0.34
	Self-Judgment (1-5)	2.35	3.40	4.50	3.20	3.70	4.70	0.012	0.59
	Isolation (1-5)	2.44	3.38	4.00	2.94	3.38	4.00	0.437	0.18
	Over-Identification (1-5)	2.50	3.50	4.00	3.25	3.88	4.31	0.002	0.72
IRI	Perspective-taking (7-35)	22.75	26.50	31.00	22.75	27.00	28.75	0.353	0.22
	Fantasy (7-35)	20.50	22.50	28.00	19.75	22.50	28.25	0.569	0.13
	Empathic Concern (7-35)	27.00	30.50	34.25	26.75	29.00	34.00	0.574	0.13
	Personal Distress (7-35)	18.00	20.50	23.00	16.75	19.00	21.00	0.275	0.26
MBI	Emotional Exhaustion (0-54)	12.50	22.00	28.25	8.75	17.50	30.00	0.245	0.27
	Personal Accomplishment (0-48)	34.00	40.50	42.00	36.75	40.50	45.25	0.097	0.39
	Depersonalization (0-30)	0.00	2.00	5.25	0.00	1.00	2.75	0.710	0.09
ERQ	Cognitive Reappraisal (6-42)	26.75	33.00	34.50	29.50	33.00	35.25	0.760	0.07
	Expressive Suppression (4-28)	5.75	11.00	16.25	7.50	10.50	19.25	0.224	0.29
PSS	Total (0-56)	18.75	25.00	29.50	12.50	19.50	23.25	0.003	0.70
WHO-5	Total (0-100)	40.00	50.00	77.00	52.00	68.00	80.00	0.022	0.54

Note. ERQ = Emotional Regulation Questionnaire; *ES* = effect size; *FFMQ* = Five Facet Mindfulness Questionnaire; *IRI* = Interpersonal Reactivity Index; MBI = Maslach Burnout Inventory; *p* = *p*-value; *PSS* = Perceived Stress Scale; *Q-25* = quartile 25; *Q-75* = quartile 75; *SCS* = Self-Compassion Scale; *WHO-5* = World Health Organization-Five Well-Being Index
Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
*Based on the Wilcoxon signed rank test

Table 7 *Summary of Results of Psychometric Tests Comparing Pre vs Post Mindful Self-Compassion Training as part of the middle-term analysis (n =10)*

Test	Factor	Q-25 pre	Median pre	Q-75 pre	Q-25 post	Median post	Q-75 post	*p**	*p***	*ES*
FFMQ	Observing (1-5)	3.03	3.50	3.78	3.34	3.75	4.34	0.046	0.015	0.77
	Describing (1-5)	2.97	3.94	4.03	3.22	3.88	4.31	0.191		0.30
	Acting with Awareness (1-5)	3.34	3.81	4.53	3.59	3.88	4.34	0.313		0.32
	Non-judging (1-5)	3.34	3.69	4.50	3.44	3.75	4.59	0.030	0.635	0.15
	Non-reactivity (1-5)	2.70	3.15	3.78	2.96	3.14	3.57	0.900		0.02
	Total (1-5)	3.18	3.48	4.17	3.44	3.73	3.94	0.045	0.169	0.44
SCS	Self-kindness (1-5)	2.60	3.00	4.25	3.45	4.00	4.35	0.067		0.73
	Common Humanity (1-5)	2.69	3.25	3.50	2.94	3.50	4.38	0.003	0.011	0.80
	Mindfulness (1-5)	2.88	3.13	4.50	3.00	3.63	4.06	0.814		0.28
	Self-Judgment (1-5)	2.35	3.10	4.15	3.30	3.80	4.50	0.146		0.43
	Isolation (1-5)	2.75	3.25	3.75	3.25	3.50	4.00	0.256		0.38
	Over-Identification (1-5)	2.69	3.88	4.13	3.63	3.75	4.38	0.110		0.41
IRI	Perspective-taking (7-35)	22.75	24.00	28.50	22.75	26.50	32.00	0.191		0.34
	Fantasy (7-35)	17.75	20.00	23.25	18.00	21.50	28.25	0.784		0.32
	Empathic Concern (7-35)	26.25	31.500	33.00	29.00	33.00	34.25	0.378		0.41
	Personal Distress (7-35)	16.75	20.00	24.00	15.50	17.50	20.25	0.011	0.049	0.62
MBI	Emotional Exhaustion (0-54)	19.25	27.00	36.00	14.00	22.50	29.25	0.26		0,60
	Personal Accomplishment (0-48)	32.75	40.00	43.50	37.25	41.00	45.25	0.70		0,10
	Depersonalization (0-30)	0.00	0.00	2.25	0.00	0.00	1.00	0.02	0,357	0,29
PSS	Total (0-56)	14.75	22.00	25.25	15.50	19.00	21.75	0.527		0.30
ERQ	Cognitive Reappraisal (6-42)	30.00	35.00	37.25	28.50	35.00	38.50	0.90		0,06
	Expressive Suppression (4-28)	6.00	9.50	15.75	5.75	9.00	12.75	0.82		0,13
PSS	Total (0-56)	14.75	22.00	25.25	15.50	19.00	21.75	0.527		0.30
WHO-5	Total (0-100)	35.00	60.00	73.00	60.00	70.00	77.00	0.097	0.021	0.73

Note. ERQ = Emotional Regulation Questionnaire; ES = effect size; FFMQ = Five Facet Mindfulness Questionnaire; IRI = Interpersonal Reactivity Index; MBI = Maslach Burnout Inventory; p = p-value; PSS = Perceived Stress Scale; Q-25 = quartile 25*; Q-75 =* quartile 75*; SCS = Self-Compassion Scale; WHO-5 = World Health Organization-Five Well-Being Index*
Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$.
*Based on the Friedman ANOVA test.
**Based on the post-hoc Wilcoxon signed rank test.

Table 8 *Summary of Results of Psychometric Tests Comparing Post vs Follow-up Mindful Self-Compassion Training as part of the middle-term analysis (n = 10)*

Test	Factor	Q-25 post	Median post	Q-75 post	Q-25 follow-up	Median follow-up	Q-75 follow-up	*p**	*p***	*ES*
FFMQ	Observing (1-5)	3.34	3.75	4.34	3.34	4.13	4.66	0.046	0.797	0.08
	Describing (1-5)	3.22	3.88	4.31	3.66	4.19	4.44	0.191		0.36
	Acting with Awareness (1-5)	3.59	3.88	4.34	3.69	3.94	4.50	0.313		0.11
	Non-judging (1-5)	3.44	3.75	4.59	3.88	4.06	4.69	0.030	0.035	0.67
	Non-reactivity (1-5)	2.96	3.14	3.57	2.79	3.29	4.11	0.900		0.08
	Total (1-5)	3.45	3.73	3.94	3.53	3.89	4.47	0.045	0.575	0.18
SCS	Self-kindness (1-5)	3.45	4.00	4.35	3.30	4.50	4.85	0.067		0.21
	Common Humanity (1-5)	2.94	3.50	4.38	3.19	3.75	4.81	0.003	0.135	0.48
	Mindfulness (1-5)	3.00	3.63	4.06	3.13	3.75	4.56	0.814		0.09
	Self-Judgment (1-5)	3.30	3.80	4.50	3.35	4.40	4.85	0.146		0.37
	Isolation (1-5)	3.25	3.50	4.00	3.00	3.75	4.00	0.256		0.09
	Over-Identification (1-5)	3.63	3.75	4.38	3.50	4.13	4.50	0.110		0.41
IRI	Perspective-taking (7-35)	22.75	26.50	32.00	24.50	28.50	29.50	0.191		0.02
	Fantasy (7-35)	18.00	21.50	28.25	19.00	22.00	27.25	0.784		0.23
	Empathic Concern (7-35)	29.00	33.00	34.25	26.75	30.00	35.00	0.378		0.13
	Personal Distress (7-35)	15.50	17.50	20.25	12.50	15.50	22.00	0.011	0.260	0.56
MBI	Emotional Exhaustion (0-54)	14.00	22.50	29.25	14.00	18.50	42.25	0.255		0.18
	Personal Accomplishment (0-48)	37.25	41.00	45.25	30.00	39.00	45.75	0.697		0.46
	Depersonalization (0-30)	0.00	0.00	1.00	0.00	5.00	6.00	0.022	0.026	0.71
ERQ	Cognitive Reappraisal (6-42)	28.50	35.00	38.50	32.50	34.50	36.75	0.898		0.02
	Expressive Suppression (4-28)	5.75	9.00	12.75	5.75	9.00	11.50	0.823		0.02
PSS	Total (0-56)	15.50	19.00	21.75	10.25	20.50	24.00	0.527		0.00
WHO-5	Total (0-100)	60.00	70.00	77.00	52.00	66.00	77.00	0.097		0.30

Note. ERQ = Emotional Regulation Questionnaire; *ES* = effect size; *FFMQ* = Five Facet Mindfulness Questionnaire; *IRI* = Interpersonal Reactivity Index; MBI = Maslach Burnout Inventory; *p* = *p*-value; *PSS* = Perceived Stress Scale; *Q-25* = quartile 25; *Q-75* = quartile 75; *SCS* = Self-Compassion Scale; *WHO-5* = World Health Organization-Five Well-Being Index.
Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
*Based on the Friedman ANOVA test
**Based on the post-hoc Wilcoxon signed rank test.

Table 9 *Summary of Results of Psychometric Tests Comparing Pre vs Follow-up Mindful Self-Compassion Training as part of the middle term analysis (n =10)*

Test	Factor	Q-25 pre	Median pre	Q-75 pre	Q-25 follow-up	Median follow-up	Q-75 follow-up	*p**	*p***	*ES*
FFMQ	Observing (1-5)	3.03	3.50	3.78	3.34	4.13	4.66	0.046	0.033	0.68
	Describing (1-5)	2.97	3.94	4.03	3.66	4.19	4.44	0.191		0.66
	Acting with Awareness (1-5)	3.34	3.81	4.53	3.69	3.94	4.50	0.313		0.41
	Non-judging (1-5)	3.34	3.69	4.50	3.88	4.06	4.69	0.030	0.036	0.66
	Non-reactivity (1-5)	2.70	3.15	3.78	2.79	3.29	4.11	0.900		0.18
	Total (1-5)	3.18	3.49	4.17	3.53	3.89	4.47	0.045	0.017	0.76
SCS	Self-kindness (1-5)	2.60	3.00	4.25	3.30	4.50	4.85	0.067		0.66
	Common Humanity (1-5)	2.69	3.25	3.50	3.19	3.75	4.81	0.003	0.014	0.78
	Mindfulness (1-5)	2.88	3.13	4.50	3.13	3.75	4.56	0.814		0.29
	Self-Judgment (1-5)	2.35	3.10	4.15	3.35	4.40	4.85	0.146		0.66
	Isolation (1-5)	2.75	3.25	3.75	3.00	3.75	4.00	0.256		0.36
	Over-Identification (1-5)	2.69	3.88	4.13	3.50	4.13	4.50	0.110		0.65
IRI	Perspective-taking (7-35)	22.75	24.00	28.50	24.50	28.50	29.50	0.191		0.45
	Fantasy (7-35)	17.75	20.00	23.25	19.00	22.00	27.25	0.784		0.34
	Empathic Concern (7-35)	26.25	31.50	33.00	26.75	30.00	35.00	0.378		0.11
	Personal Distress (7-35)	16.75	20.00	24.00	12.50	15.50	22.00	0.011	0.007	0.86
MBI	Emotional Exhaustion (0-54)	19.25	27.00	36.00	14.00	18.50	42.25	0.255		0.30
	Personal Accomplishment (0-48)	32.75	40.00	43.50	30.00	39.00	45.75	0.697		0.20
	Depersonalization (0-30)	0.00	0.00	2.25	0.00	5.00	6.00	0.022	0.043	0.64
ERQ	Cognitive Reappraisal (6-42)	30.00	35.00	37.25	32.50	34.50	36.75	0.898		0.24
	Expressive Suppression (4-28)	6.00	9.50	15.75	5.75	9.00	11.50	0.823		0.13
PSS	Total (0-56)	14.75	22.00	25.25	10.25	20.50	24.00	0.527		0.24
WHO-5	Total (0-100)	35.00	60.00	73.00	52.00	66.00	77.00	0.097		0.49

Note. ERQ = Emotional Regulation Questionnaire; *ES* = effect size; *FFMQ* = Five Facet Mindfulness Questionnaire; *IRI* = Interpersonal Reactivity Index; MBI = Maslach Burnout Inventory; *p* = *p*-value; *PSS* = Perceived Stress Scale; *Q-25* = quartile 25; *Q-75* = quartile 75; *SCS* = Self-Compassion Scale; *WHO-5* = World Health Organization-Five Well-Being Index
Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$.
*Based on the Friedman ANOVA test.
**Based on the post-hoc Wilcoxon signed rank test.

Table 10 *Summary of Results of Psychometric Tests Comparing Pre vs Post Kundalini Yoga Training as part of the middle-term analysis (n = 13)*

Test	Factor	Q-25 pre	Median pre	Q-75 pre	Q-25 post	Median post	Q-75 post	*p**	*p***	*ES*
FFMQ	Observing (1-5)	2.88	3.25	3.69	3.31	3.50	3.81	0.276		1.44
	Describing (1-5)	3.00	3.50	4.25	3.31	3.75	4.06	0.939		0.09
	Acting with Awareness (1-5)	3.00	3.38	3.75	3.38	3.63	4.44	0.027	0.033	0.59
	Non-judging (1-5)	3.25	3.75	4.13	3.19	3.75	4.50	0.008	0.540	0.17
	Non-reactivity (1-5)	3.00	3.30	3.45	2.50	3.14	3.79	0.232		0.00
	Total (1-5)	3.05	3.36	3.78	3.37	3.56	3.78	0.199		0.33
SCS	Self-kindness (1-5)	2.40	3.20	4.00	3.10	3.60	4.70	0.029	0.037	0.58
	Common Humanity (1-5)	3.00	3.25	4.13	2.75	3.50	4.00	0.754		0.01
	Mindfulness (1-5)	2.88	3.50	4.63	3.25	3.75	4.38	0.494		0.20
	Self-Judgment (1-5)	2.70	3.80	4.80	3.20	3.80	5.00	0.047	0.072	0.50
	Isolation (1-5)	3.00	3.50	4.13	2.88	3.50	4.00	0.359		0.25
	Over-Identification (1-5)	3.38	3.50	4.13	3.38	4.00	4.50	0.076		0.62
IRI	Perspective-taking (7-35)	23.50	27.00	31.00	22.50	27.00	30.00	0.763		0.08
	Fantasy (7-35)	18.50	22.00	28.00	19.50	22.00	26.00	0.864		0.09
	Empathic Concern (7-35)	27.00	30.00	34.50	27.50	29.00	34.00	0.543		0.10
	Personal Distress (7-35)	18.00	21.00	23.00	18.50	20.00	23.50	0.120		0.05
MBI	Emotional Exhaustion (0-54)	14.00	24.00	33.00	10.00	19.00	30.00	0.771		0.33
	Personal Accomplishment (0-48)	34.00	40.00	42.00	36.50	40.00	44.50	0.763		0.28
	Depersonalization (0-30)	0.00	2.00	5.50	0.00	1.00	3.50	0.836		0.14
ERQ	Cognitive Reappraisal (6-42)	27.00	33.00	37.00	30.00	33.00	34.50	0.368		0.03
	Expressive Suppression (4-28)	7.50	11.00	14.50	8.50	10.00	15.50	0.360		0.21
PSS	Total (0-56)	18.50	23.00	30.00	11.50	16.00	24.50	0.001	0.001	0.88
WHO-5	Total (0-100)	40.00	52.00	80.00	50.00	64.00	80.00	0.240		0.41

Note. ERQ = Emotional Regulation Questionnaire; *ES* = effect size; *FFMQ* = Five Facet Mindfulness Questionnaire; *IRI* = Interpersonal Reactivity Index; MBI = Maslach Burnout Inventory; *p* = *p*-value; *PSS* = Perceived Stress Scale; *Q-25* = quartile 25; *Q-75* = quartile 75; *SCS* = Self-Compassion Scale; *WHO-5* = World Health Organization-Five Well-Being Index Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$.
*Based on the Friedman ANOVA test.
**Based on the post-hoc Wilcoxon signed rank test.

Table 11 *Summary of Results of Psychometric Tests Comparing Post vs Follow-up in Kundalini Yoga Training as part of the middle-term analysis (n = 13)*

Test	Factor	Q-25 post	Median post	Q-75 post	Q-25 follow-up	Median follow-up	Q-75 follow-up	*p**	*p***	*ES*
FFMQ	Observing (1-5)	3.31	3.50	3.81	2.94	3.38	3.50	0.276		0.51
	Describing (1-5)	3.31	3.75	4.06	3.38	3.63	3.94	0.939		0.05
	Acting with Awareness (1-5)	3.38	3.63	4.44	3.38	3.87	4.19	0.027	0.813	0.07
	Non-judging (1-5)	3.19	3.75	4.50	3.38	4.50	4.75	0.008	0.028	0.61
	Non-reactivity (1-5)	2.50	3.14	3.79	2.57	2.86	3.14	0.232		0.42
	Total (1-5)	3.37	3.56	3.78	3.32	3.46	3.71	0.199		0.09
SCS	Self-kindness (1-5)	3.10	3.60	4.70	2.80	4.00	4.60	0.029	0.823	0.06
	Common Humanity (1-5)	2.75	3.50	4.00	2.88	3.50	4.13	0.754		0.01
	Mindfulness (1-5)	3.25	3.75	4.38	3.00	3.50	4.00	0.494		0.42
	Self-Judgment (1-5)	3.20	3.80	5.00	3.40	4.20	4.90	0.047	0.636	0.13
	Isolation (1-5)	2.88	3.50	4.00	3.38	3.50	4.00	0.359		0.35
	Over-Identification (1-5)	3.38	4.00	4.50	3.50	4.00	4.38	0.076		0.04
IRI	Perspective-taking (7-35)	22.50	27.00	30.00	21.50	28.00	29.50	0.763		0.16
	Fantasy (7-35)	19.50	22.00	26.00	18.50	23.00	27.50	0.864		0.04
	Empathic Concern (7-35)	27.50	29.00	34.00	27.50	30.00	33.00	0.543		0.09
	Personal Distress (7-35)	18.50	20.00	23.50	15.00	18.00	21.00	0.120		0.53
MBI	Emotional Exhaustion (0-54)	10.00	19.00	30.00	11.00	21.00	39.50	0.771		0.14
	Personal Accomplishment (0-48)	36.50	40.00	44.50	31.00	42.00	45.50	0.763		0.32
	Depersonalization (0-30)	0.00	1.00	3.50	0.00	1.00	4.50	0.836		0.07
ERQ	Cognitive Reappraisal (6-42)	30.00	33.00	34.50	22.00	29.00	34.50	0.368		0.57
	Expressive Suppression (4-28)	8.50	10.00	15.50	5.50	10.00	12.50	0.360		0.48
PSS	Total (0-56)	11.50	16.00	24.50	13.00	25.00	33.50	0.001	0.015	0.67
WHO-5	Total (0-100)	50.00	64.00	80.00	36.00	52.00	78.00	0.240		0.40

Note. ERQ = Emotional Regulation Questionnaire; *ES* = effect size; *FFMQ* = Five Facet Mindfulness Questionnaire; *IRI* = Interpersonal Reactivity Index; MBI = Maslach Burnout Inventory; *p* = *p*-value; *PSS* = Perceived Stress Scale; *Q-25* = quartile 25; *Q-75* = quartile 75; *SCS* = Self-Compassion Scale; *WHO-5* = World Health Organization-Five Well-Being Index
Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$.
*Based on Friedman ANOVA test.
**Based on the post-hoc Wilcoxon signed rank test.

Table 12 *Summary of Results of Psychometric Tests Comparing Pre vs Follow-up Kundalini Yoga Training as part of the middle-term analysis (n = 13)*

Test	Factor	Q-25 pre	Median pre	Q-75 pre	Q-25 follow-up	Median follow-up	Q-75 follow-up	*p**	*p***	*ES*
FFMQ	Observing (1-5)	2.88	3.25	3.69	2.94	3.38	3.50	0.276		0.00
	Describing (1-5)	3.00	3.50	4.25	3.38	3.63	3.94	0.939		0.14
	Acting with Awareness (1-5)	3.00	3.38	3.75	3.38	3.88	4.19	0.027	0.016	0.67
	Non-judging (1-5)	3.25	3.75	4.13	3.38	4.50	4.75	0.008	0.027	0.61
	Non-reactivity (1-5)	3.00	3.30	3.45	2.57	2.86	3.14	0.232		0.33
	Total (1-5)	3.05	3.36	3.78	3.32	3.46	3.71	0.199		0.32
SCS	Self-kindness (1-5)	2.40	3.20	4.00	2.80	4.00	4.60	0.029	0.028	0.61
	Common Humanity (1-5)	3.00	3.25	4.13	2.88	3.50	4.13	0.754		0.07
	Mindfulness (1-5)	2.88	3.50	4.63	3.00	3.50	4.00	0.494		0.17
	Self-Judgment (1-5)	2.70	3.80	4.80	3.40	4.20	4.90	0.047	0.080	0.49
	Isolation (1-5)	3.00	3.50	4.13	3.38	3.50	4.00	0.359		0.27
	Over-Identification (1-5)	3.38	3.50	4.13	3.50	4.00	4.38	0.076		0.45
IRI	Perspective-taking (7-35)	23.50	27.00	31.00	21.50	28.00	29.50	0.763		0.23
	Fantasy (7-35)	18.50	22.00	28.00	18.50	23.00	27.50	0.864		0.20
	Empathic Concern (7-35)	27.00	30.00	34.50	27.50	30.00	33.00	0.543		0.02
	Personal Distress (7-35)	18.00	21.00	23.00	15.00	18.00	21.00	0.120		0.43
MBI	Emotional Exhaustion (0-54)	14.00	24.00	33.00	11.00	21.00	39.50	0.771		0.06
	Personal Accomplishment (0-48)	34.00	40.00	42.00	31.00	42.00	45.50	0.763		0.04
	Depersonalization (0-30)	0.00	2.00	5.50	0.00	1.00	4.50	0.836		0.10
ERQ	Cognitive Reappraisal (6-42)	27.00	33.00	37.00	22.00	29.00	34.50	0.368		0.36
	Expressive Suppression (4-28)	7.50	11.00	14.50	5.50	10.00	12.50	0.360		0.36
PSS	Total (0-56)	18.50	23.00	30.00	13.00	25.00	33.50	0.001	0.753	0.09
WHO-5	Total (0-100)	40.00	52.00	80.00	36.00	52.00	78.00	0.240		0.17

Note. Note. ERQ = Emotional Regulation Questionnaire; *ES* = effect size; *FFMQ* = Five Facet Mindfulness Questionnaire; *IRI* = Interpersonal Reactivity Index; MBI = Maslach Burnout Inventory; *p* = *p*-value; *PSS* = Perceived Stress Scale; *Q-25* = quartile 25*; Q-75* = quartile 75*. SCS* = Self-Compassion Scale; *WHO-5* = World Health Organization-Five Well-Being Index
Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$.
*Based on the Friedman ANOVA test.
**Based on the post-hoc Wilcoxon signed rank test.

Appendix 2

Table 17 *Summary of Results of the Empathy for Pain Task Comparing Pre vs Post Mindful Self-Compassion Training (n = 13)*

	Q-25 pre	Median pre	Q-75 pre	Q-25 post	Median post	Q-75 post	*p**	*ES*
Empathic Concern for Intentional Harm	-1.13	3.50	6.37	0.28	3.80	6.75	0.861	0.05
Empathic Concern for Accidental Harm	-4.40	-3.25	2.35	-6.75	-3.50	1.15	0.700	0.11
Personal Distress for Intentional Harm	-0.25	3.30	5.38	0.90	4.00	5.90	0.463	0.20
Personal Distress for Accidental Harm	-5.03	-1.80	-0.15	-7.63	-6.00	-0.13	0.208	0.35
Accuracy for Intentional Harm	75	100	100	100	100	100	0.034	0.59
Accuracy for Accidental Harm	50	75	100	75	100	100	0.154	0.40

Note. Q-25 = quartile 25; *Q-75* = quartile 75. Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$.
*Based on the Wilcoxon signed rank test.

Table 18 *Summary of Results of the Empathy for Pain Task Comparing Pre vs Post Mindful Self-Compassion Training as part of the middle-term analysis (n = 10)*

	Q-25 pre	Median pre	Q-75 pre	Q-25 post	Median post	Q-75 post	*p**	*p***	*ES*
Empathic Concern for Intentional Harm	2.13	3.65	7.25	-1.69	4.55	6.63	0.584		0.16
Empathic Concern for Accidental Harm	-4.26	-0.28	2.78	-6.76	-2.25	1.68	0.670		0.37
Personal Distress for Intentional Harm	1.81	3.65	7.14	1.44	4.25	6.35	0.407		0.02
Personal Distress for Accidental Harm	-4.01	-1.63	0.73	-7.44	-5.00	1.38	0.614		0.32
Accuracy for Intentional Harm	75	100	100	100	100	100	0.039	0.059	0.60
Accuracy for Accidental Harm	50	75	100	75	100	100	0.318		0.25

Note. Q-25 = quartile 25; *Q-75* = quartile 75. Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
*Based on the Friedman ANOVA test.
**Based on the post-hoc Wilcoxon signed rank test.

Table 19 *Summary of Results of the Empathy for Pain Task Comparing Post vs Follow-up Mindful Self-Compassion Training as part of the middle-term analysis (n = 10)*

	Q-25 post	Median post	Q-75 post	Q-25 follow-up	Median follow-up	Q-75 follow-up	*p**	*p***	*ES*
Empathic Concern for Intentional Harm	-1.69	4.55	6.63	0.06	2.63	4.81	0.584		0.17
Empathic Concern for Accidental Harm	-6.76	-2.25	1.68	-3.38	-1.88	0.19	0.670		0.50
Personal Distress for Intentional Harm	1.44	4.25	6.35	1.31	3.38	6.19	0.407		0.18
Personal Distress for Accidental Harm	-7.44	-5.00	1.38	-5.56	-2.38	-0.75	0.614		0.15
Accuracy for Intentional Harm	100	100	100	100	100	100	0.039	0.317	0.10
Accuracy for Accidental Harm	75	100	100	75	75	100	0.318		0.22

Note. Q-25 = quartile 25*; Q-75* = quartile 75*.* Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
*Based on the Friedman ANOVA test.
**Based on the post-hoc Wilcoxon signed rank test.

Table 20 *Summary of Results of the Empathy for Pain Task Comparing Pre vs Follow-up Mindful Self-Compassion Training as part of the middle-term analysis (n = 10)*

	Q-25 pre	Median pre	Q-75 pre	Q-25 follow-up	Median follow-up	Q-75 follow-up	*p**	*p***	*ES*
Empathic Concern for Intentional Harm	2.13	3.65	7.25	-0.88	2.38	6.06	0.584		0.18
Empathic Concern for Accidental Harm	-4.26	-0.28	2.78	-4.31	0.63	2.89	0.670		0.15
Personal Distress for Intentional Harm	1.81	3.65	7.14	-0.71	3.25	6.31	0.407		0.13
Personal Distress for Accidental Harm	-4.01	-1.63	0.73	-4.01	-1.63	0.73	0.614		0.03
Accuracy for Intentional Harm	75	100	100	100	100	100	0.039	0.102	0.16
Accuracy for Accidental Harm	50	75	100	75	75	100	0.318		0.37

Note. Q-25 = quartile 25*; Q-75* = quartile 75*.* Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
*Based on the Friedman ANOVA test.
**Based on the post-hoc Wilcoxon signed rank test.

Table 21 *Summary of Results of the Empathy for Pain Task Comparing Pre vs Post Kundalini Yoga Training (n = 15)*

	Q-25 pre	Median pre	Q-75 pre	Q-25 post	Median post	Q-75 post	*p**	*ES*
Empathic Concern for Intentional Harm	2.30	4.80	7. 25	2.00	4.00	6.00	0.211	0.32
Empathic Concern for Accidental Harm	-5.75	0. 80	2. 90	-5.80	-1.80	3.30	0.650	0.12
Personal Distress for Intentional Harm	2.50	4.80	7.80	-0.20	4.00	6.00	0.038	0.54
Personal Distress for Accidental Harm	-7.25	-3.30	0.30	-7.80	-2.50	-0.25	0.932	0.02
Accuracy for Intentional Harm	100	100	100	75	100	100	0.157	0.37
Accuracy for Accidental Harm	75	100	100	75	75	100	0.430	0.20

Note. Q-25 = quartile 25*; Q-75* = quartile 75*.* Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
*Based on the Wilcoxon signed rank test

Table 22 *Summary of Results of the Empathy for Pain Task Comparing Pre vs Post Kundalini Yoga Training as part of the middle-term analysis (n = 12)*

	Q-25 pre	Median pre	Q-75 pre	Q-25 post	Median post	Q-75 post	*p**	*p***	*ES*
Empathic Concern for Intentional Harm	3.38	6.13	7.29	2.06	3.63	5.69	0.040	0.050	0.57
Empathic Concern for Accidental Harm	-5.69	0.25	3.58	-5.10	-0.25	3.45	0.338		0.02
Personal Distress for Intentional Harm	3.56	5.65	8.18	1.44	3.65	5.81	0.017	0.004	0.84
Personal Distress for Accidental Harm	-6.94	-2.78	0.44	-4.75	-2.13	-0.06	0.436		0.22
Accuracy for Intentional Harm	100	100	100	75	100	100	0.305		0.41
Accuracy for Accidental Harm	81.25	100	100	56.25	75	100	0.102		0.52

Note. Q-25 = quartile 25*; Q-75* = quartile 75*.* Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
*Based on the Wilcoxon signed rank test

Table 23 *Summary of Results of the Empathy for Pain Task Comparing Post vs Follow-up Kundalini Yoga Training as part of the middle-term analysis (n = 12)*

	Q-25 post	Median post	Q-75 post	Q-25 follow-up	Median follow-up	Q-75 follow-up	*p**	*p***	*ES*
Empathic Concern for Intentional Harm	2.06	3.63	5.69	0.06	2.63	4.81	0.040	0.197	0.37
Empathic Concern for Accidental Harm	-5.10	-0.25	3.45	-3.38	-1.88	0.19	0.338		0.23
Personal Distress for Intentional Harm	1.44	3.65	5.81	1.31	3.38	6.19	0.017	0.875	0.05
Personal Distress for Accidental Harm	-4.75	-2.13	-0.06	-5.56	-2.38	-0.75	0.436		0.26
Accuracy for Intentional Harm	75	100	100	100	100	100	0.305		0.33
Accuracy for Accidental Harm	56.25	75	100	75	75	100	0.102		0.33

Note. Q-25 = quartile 25*; Q-75* = quartile 75*;* Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
*Based on the Friedman ANOVA test.
**Based on the post-hoc Wilcoxon signed rank test.

Table 24 *Summary of Results of the Empathy for Pain Task Comparing Pre vs Follow-up Kundalini Yoga Training as part of the middle-term analysis (n = 12)*

	Q-25 pre	Median pre	Q-75 pre	Q-25 follow-up	Median follow-up	Q-75 follow-up	*p**	*p***	*ES*
Empathic Concern for Intentional Harm	3.38	6.13	7.29	0.06	2.63	4.81	0.040	0.071	0.52
Empathic Concern for Accidental Harm	-5.69	0.25	3.58	-3.38	-1.88	0.19	0.338		0.31
Personal Distress for Intentional Harm	3.56	5.65	8.18	1.31	3.38	6.19	0.017	0.021	0.67
Personal Distress for Accidental Harm	-6.94	-2.78	0.44	-5.56	-2.38	-0.75	0.436		0.11
Accuracy for Intentional Harm	100	100	100	100	100	100	0.305		0.13
Accuracy for Accidental Harm	81.25	100	100	75	75	100	0.102		0.31

Note. Q-25 = quartile 25*; Q-75* = quartile 75*;* Effect sizes (*ES*) were calculated using $r = Z/\sqrt{N}$
*Based on the Friedman ANOVA test
**Based on the post-hoc Wilcoxon signed rank test

Appendix 3

Table 24 *Comparison of Physiological Results Across Stages of the Trier Social Stress Test with Respect to Baseline in the Mindful Self-Compassion Group (n = 11)*

Parameter	Stage	Q-25	Median	Q-75	*p**	*p***	*ES*
Mean NN	Rest	810.17	924.32	951.32	0.000		
	Preparation	638.63	706.97	774		0.003	0.88
	Speech	544.92	623.32	708.44		0.003	0.88
	Math	565.68	575.79	677.39		0.003	0.88
	Recovery 1	717.91	789.34	877.71		0.021	0.70
	Recovery 2	762.73	843.76	907.93		0.182	0.40
	Recovery 3	796.75	861.47	891.27		0.091	0.51
	Recovery 4	784.22	880.46	889.63		0.062	0.56
	Recovery 5	774.1	861.52	896.93		0.026	0.67
SDNN	Rest	26.04	35.26	38.19	0.241		
	Preparation	26.92	32.13	53.83			
	Speech	15.56	38.79	52.35			
	Math	12.76	32.43	51.22			
	Recovery 1	32.35	37.87	64.13			
	Recovery 2	22.95	42.41	58.40			
	Recovery 3	23.95	36.33	59.71			
	Recovery 4	25.73	38.65	58.24			
	Recovery 5	22.54	37.41	58.09			
Mean HR	Rest	63.07	64.91	74.06	0.000		
	Preparation	77.52	84.87	93.95		0.003	0.88
	Speech	84.69	96.26	110.11		0.003	0.88
	Math	88.58	104.20	106.07		0.003	0.88
	Recovery 1	68.36	76.01	83.58		0.021	0.70
	Recovery 2	66.08	71.11	78.67		0.213	0.38
	Recovery 3	67.32	69.65	75.31		0.182	0.40
	Recovery 4	67.44	68.15	76.51		0.075	0.54
	Recovery 5	66.90	69.64	77.51		0.041	0.62
RMSSD	Rest	19.34	32.27	54.22	0.000		
	Preparation	17.03	28.66	48.92		0.041	0.62
	Speech	10.95	20.08	33.66		0.033	0.64
	Math	10.71	16.83	31.30		0.003	0.88
	Recovery 1	21.26	44.44	51.13		0.722	0.11

	Recovery 2	17.66	34.45	61.00		0.657	0.13
	Recovery 3	18.64	38.02	59.34		1	0.00
	Recovery 4	17.07	51.55	69.81		0.929	0.03
	Recovery 5	19.46	44.62	64.96		0.477	0.21
LF ms^2	Rest	154.54	392.03	736.98	0.502		
	Preparation	248.68	574.94	1186.40			
	Speech	165.74	1084.72	1931.39			
	Math	85.66	1145.04	1632.34			
	Recovery 1	294.44	974.06	1717.56			
	Recovery 2	172.90	426.39	1130.28			
	Recovery 3	254.24	328.17	1434.88			
	Recovery 4	312.99	493.87	938.13			
	Recovery 5	245.03	594.63	1367.79			
HF ms^2	Rest	163.27	477.51	1117.56	0.000		
	Preparation	123.22	449.47	570.18		0.033	0.64
	Speech	67.38	220.78	510.54		0.010	0.78
	Math	67.95	217.60	442.58		0.008	0.80
	Recovery 1	159.99	366.80	1306.36		0.374	0.27
	Recovery 2	192.75	336.80	1615.32		0.594	0.16
	Recovery 3	146.71	604.99	1270.38		0.594	0.16
	Recovery 4	113.48	588.89	1703.15		0.859	0.05
	Recovery 5	164.09	397.53	1613.85		0.374	0.27
LF nu	Rest	29.61	44.07	69.72	0.000		
	Preparation	54.94	61.71	77.43		0.033	0.64
	Speech	67.96	76.87	90.76		0.01	0.78
	Math	58.58	79.54	86.72		0.01	0.78
	Recovery 1	41.96	58.62	75.26		0.155	0.43
	Recovery 2	31.15	46.83	68.86		0.657	0.13
	Recovery 3	40.19	43.67	63.40		0.929	0.03
	Recovery 4	37.65	41.98	62.03		0.248	0.35
	Recovery 5	40.62	45.98	59.76		0.534	0.19
HF nu	Rest	30.28	55.92	70.38	0.000		
	Preparation	22.54	38.28	45.05		0.033	0.64
	Speech	9.24	23.13	32.02		0.01	0.78
	Math	13.27	20.45	41.42		0.01	0.78
	Recovery 1	24.55	41.30	58.01		0.155	0.43

	Recovery 2	31.13	53.16	68.82		0.657	0.13
	Recovery 3	36.59	56.31	59.81		0.929	0.03
	Recovery 4	37.97	58.01	62.34		0.248	0.35
	Recovery 5	39.60	53.99	59.38		0.477	0.21
LF/HF	Rest	0.42	0.79	2.30	0.000		
	Preparation	1.22	1.62	3.44		0.213	0.38
	Speech	2.12	3.32	9.83		0.026	0.67
	Math	1.41	3.89	6.53		0.041	0.62
	Recovery 1	0.72	1.42	3.06		0.155	0.43
	Recovery 2	0.45	0.88	2.21		0.929	0.03
	Recovery 3	0.67	0.78	1.73		0.424	0.24
	Recovery 4	0.60	0.72	1.63		0.594	0.16
	Recovery 5	0.68	0.85	1.51		0.929	0.03
SD1	Rest	13.71	22.88	38.45	0.000		
	Preparation	12.07	21.19	34.67		0.041	0.62
	Speech	7.76	14.22	23.84		0.033	0.64
	Math	7.59	11.92	22.18		0.003	0.88
	Recovery 1	15.06	31.51	36.23		0.722	0.11
	Recovery 2	12.51	24.42	43.24		0.657	0.13
	Recovery 3	13.21	26.95	42.06		1	0.00
	Recovery 4	12.10	36.54	49.48		0.929	0.03
	Recovery 5	13.79	31.64	46.05		0.477	0.21
SD2	Rest	31.09	38.09	49.19	0.594		
	Preparation	34.74	44.23	64.14			
	Speech	21.37	53.05	62.19			
	Math	17.28	44.19	65.44			
	Recovery 1	33.85	49.94	79.51			
	Recovery 2	30.24	42.09	72.72			
	Recovery 3	31.64	38.01	70.61			
	Recovery 4	34.19	40.19	65.09			
	Recovery 5	28.72	45.52	68.85			
SD2/SD1	Rest	1.19	1.54	2.65	0.000		
	Preparation	1.82	2.31	3.05		0.008	0.80
	Speech	2.42	3.37	3.74		0.003	0.88
	Math	2.61	3.62	3.89		0.003	0.88
	Recovery 1	1.54	1.90	2.61		0.033	0.64

	Recovery 2	1.30	1.86	2.54		0.722	0.11
	Recovery 3	1.34	1.76	2.27		0.965	0.01
	Recovery 4	1.21	1.78	2.26		0.799	0.08
	Recovery 5	1.36	2.07	2.27		0.657	0.13

Note. Stages from Preparation to Recovery 5 are compared to Stage Rest, which serves as the baseline measure. *ES* = effect size; *HF* = high-frequency power*; HR* = heart rate*; LF = low-frequency power; NN* = normal-to-normal interval*; p = p-value; Q-25* = quartile 25*; Q-75* = quartile 75*; RMSSD* = root mean square of successive differences between normal-to-normal intervals; *SDNN* = standard deviation of normal-to-normal intervals
ES were calculated using $r = Z/\sqrt{N}$
*Based on the Friedman ANOVA
** Based on the Wilcoxon signed-rank test

Table 25 *Comparison of Physiological Results Across Stages of the Trier Social Stress Test with Respect to Baseline in the Kundalini Yoga Group (n = 10)*

Parameter	Stage	Q-25	Median	Q-75	*p**	*p***	*ES*
Mean NN	Rest	755.10	825.27	889.07	0.000		
	Preparation	662.23	703.11	757.43		0.005	0.89
	Speech	515.15	609.66	666.15		0.005	0.89
	Math	521.71	592.78	703.18		0.005	0.89
	Recovery 1	662.43	766.17	835.53		0.009	0.82
	Recovery 2	697.75	785.06	924.28		0.074	0.56
	Recovery 3	711.79	783.10	915.83		0.114	0.50
	Recovery 4	725.52	769.56	811.15		0.007	0.85
	Recovery 5	732.92	786.61	835.17		0.017	0.76
SDNN	Rest	22.76	32.36	42.80	0.056		
	Preparation	24.87	27.60	35.58			
	Speech	15.89	33.85	43.83			
	Math	17.13	25.34	31.40			
	Recovery 1	21.49	33.54	43.23			
	Recovery 2	18.86	34.60	46.49			
	Recovery 3	21.57	38.63	46.39			
	Recovery 4	14.83	31.23	43.26			
	Recovery 5	14.66	36.54	41.97			
Mean HR	Rest	67.51	72.70	79.48	0.000		
	Preparation	79.25	85.34	90.71		0.005	0.89
	Speech	90.18	100.28	116.57		0.005	0.89
	Math	85.33	101.72	115.18		0.005	0.89
	Recovery 1	71.85	78.35	90.68		0.009	0.82

	Recovery 2	64.95	76.43	86.00		0.047	0.63
	Recovery 3	65.54	76.67	84.33		0.093	0.53
	Recovery 4	74.78	78.01	82.71		0.007	0.85
	Recovery 5	71.91	76.38	81.90		0.017	0.76
RMSSD	Rest	18.10	28.36	37.88	0.000		
	Preparation	16.93	23.93	31.95		0.241	0.37
	Speech	8.97	21.70	25.48		0.009	0.82
	Math	8.64	14.46	19.40		0.005	0.89
	Recovery 1	15.38	26.60	44.44		0.799	0.08
	Recovery 2	17.25	25.07	49.84		0.721	0.11
	Recovery 3	17.59	26.36	46.86		0.959	0.02
	Recovery 4	13.57	27.76	36.07		0.169	0.44
	Recovery 5	12.70	30.25	39.16		0.333	0.31
LF ms^2	Rest	145.02	532.46	1384.33	0.261		
	Preparation	270.08	457.84	607.03			
	Speech	231.15	653.61	1968.26			
	Math	167.90	447.42	816.36			
	Recovery 1	196.74	327.18	853.24			
	Recovery 2	161.48	671.20	923.57			
	Recovery 3	264.48	702.10	1622.05			
	Recovery 4	59.73	557.63	890.97			
	Recovery 5	130.00	791.30	1126.01			
HF ms^2	Rest	124.48	408.21	557.62	0.013		
	Preparation	145.69	389.25	637.59		0.959	0.02
	Speech	70.43	205.55	393.73		0.169	0.44
	Math	40.61	197.69	339.14		0.028	0.69
	Recovery 1	111.61	212.17	802.44		0.959	0.02
	Recovery 2	101.83	255.83	742.75		0.333	0.31
	Recovery 3	141.27	357.52	896.72		0.646	0.15
	Recovery 4	75.81	347.51	539.01		0.074	0.56
	Recovery 5	75.91	386.57	729.67		0.721	0.11
LF nu	Rest	39.98	54.90	72.55	0.005		
	Preparation	44.94	53.04	70.91		0.878	0.05
	Speech	73.05	80.32	86.53		0.013	0.79
	Math	66.47	74.77	80.35		0.047	0.63
	Recovery 1	35.11	52.22	65.54		0.241	0.37

	Recovery 2	47.89	64.34	80.20		0.241	0.37
	Recovery 3	58.17	63.26	76.31		0.333	0.31
	Recovery 4	50.60	62.31	74.79		0.333	0.31
	Recovery 5	57.11	63.90	74.71		0.093	0.53
HF nu	Rest	27.44	45.08	59.94	0.000		
	Preparation	29.07	46.94	55.02		0.878	0.05
	Speech	13.45	19.62	26.48		0.013	0.79
	Math	19.64	26.14	33.47		0.047	0.63
	Recovery 1	34.45	47.77	64.80		0.241	0.37
	Recovery 2	19.79	35.65	52.07		0.241	0.37
	Recovery 3	23.69	36.72	41.79		0.333	0.31
	Recovery 4	25.19	37.65	49.35		0.333	0.31
	Recovery 5	25.26	36.09	41.93		0.114	0.50
LF/HF	Rest	0.67	1.24	2.65	0.000		
	Preparation	0.82	1.13	2.45		0.878	0.05
	Speech	2.88	4.45	6.77		0.013	0.79
	Math	1.99	2.97	4.22		0.114	0.50
	Recovery 1	0.37	0.95	1.43		0.074	0.56
	Recovery 2	0.92	1.83	4.06		0.333	0.31
	Recovery 3	1.40	1.73	3.26		0.508	0.21
	Recovery 4	1.06	1.66	3.12		0.386	0.27
	Recovery 5	1.49	2.31	2.96		0.169	0.44
SD1	Rest	12.83	20.10	26.84	0.000		
	Preparation	11.99	16.96	22.64		0.241	0.37
	Speech	6.35	14.65	18.05		0.009	0.82
	Math	6.12	10.68	15.28		0.005	0.89
	Recovery 1	10.90	18.86	31.49		0.799	0.08
	Recovery 2	12.22	17.77	35.33		0.721	0.11
	Recovery 3	12.47	18.68	33.22		0.959	0.02
	Recovery 4	9.62	19.67	25.50		0.169	0.44
	Recovery 5	9.00	21.43	27.75		0.333	0.31
SD2	Rest	27.87	39.50	53.62	0.594		
	Preparation	28.82	35.34	46.46			
	Speech	21.56	44.14	59.85			
	Math	23.27	34.08	42.08			
	Recovery 1	28.11	38.19	54.98			

	Recovery 2	23.76	45.85	54.89			
	Recovery 3	27.89	45.98	60.01			
	Recovery 4	18.56	40.73	54.88			
	Recovery 5	18.68	45.91	52.55			
SD2/SD1	Rest	1.38	1.88	2.47	0.000		
	Preparation	1.65	2.44	2.59		0.241	0.37
	Speech	3.14	3.37	3.55		0.005	0.89
	Math	2.81	3.16	3.71		0.005	0.89
	Recovery 1	1.50	2.39	2.93		0.126	0.48
	Recovery 2	1.61	2.05	2.69		0.799	0.08
	Recovery 3	1.45	2.23	2.65		0.508	0.21
	Recovery 4	1.73	2.04	2.69		0.285	0.34
	Recovery 5	1.78	2.61	3.93		0.009	0.82

Note. Stages from Preparation to Recovery 5 are compared to Stage Rest, which serves as the baseline measure. *ES* = effect size; *HF* = high-frequency power*; HR* = heart rate*; LF = low-frequency power; NN* = normal-to-normal interval*; p* = p-value*; Q-25* = quartile 25*; Q-75* = quartile 75*; RMSSD* = root mean square of successive differences between normal-to-normal intervals; *SDNN* = standard deviation of normal-to-normal intervals
ES were calculated using $r = Z/\sqrt{N}$
*Based on the Friedman ANOVA
** Based on the Wilcoxon signed-rank test

Table 29 *Anxiety and Affect Measures Comparing Pre- vs Post-Stress in the Trier Social Stress Test for the Mindful Self-Compassion group (n = 11)*

Measure	Q-25 pre	Median pre	Q-75 pre	Q-25 post	Median post	Q-75 post	*p**	*ES*
VAAS	10.00	25.00	35.00	45.00	50.00	80.00	0.003	0.89
Positive Affect	28.00	30.00	35.00	26.00	30.00	37.00	0.350	0.28
Negative Affect	15.00	16.00	20.00	15.00	16.00	25.00	0.602	0.16
STAI-S	5.00	12.00	19.00	18.00	24.00	29.00	0.012	0.75

Note. ES = effect size; *p* = *p*-value; *Q-25* = quartile 25*; Q-75* = quartile 75*; STAI-S* = State-Trait Anxiety Inventory – State; *VAAS* = Visual Analogue Scale of Anxiety
Effect sizes were calculated using $r = Z/\sqrt{N}$
*Based on the Wilcoxon signed-rank test

Table 30 *Anxiety and Affect Measures Comparing Pre- vs Post-Stress in the Trier Social Stress Test for the Kundalini Yoga group (n = 10)*

Measure	Q-25 pre	Median pre	Q-75 pre	Q-25 post	Median post	Q-75 post	*p**	*ES*
VAAS	15.00	30.00	52.50	47.50	57.50	82.50	0.011	0.81
Positive Affect	28.75	32.00	35.00	25.25	29.00	33.25	0.016	0.76
Negative Affect	15.25	20.00	24.50	13.75	17.50	26.50	0.189	0.42
STAI-S	7.00	12.50	19.50	16.00	25.00	31.75	0.022	0.73

Note. ES = effect size; *p* = *p*-value; *Q-25* = quartile 25*; Q-75* = quartile 75; *STAI-S* = State-Trait Anxiety Inventory – State; *VAAS* = Visual Analogue Scale of Anxiety
Effect sizes were calculated using $r = Z/\sqrt{N}$
*Based on the Wilcoxon signed-rank test