MASTERARBEIT | MASTER'S THESIS

Titel | Title

The role of self-compassion in the stress-buffering effect of mindfulness and self-soothing touch

verfasst von | submitted by

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angestrebter akademischer Grad | in partial fulfilment of the requirements for the degree of

Master of Science (MSc)

Wien | Vienna, 2025

Studienkennzahl lt. Studienblatt | Degree programme code as it appears on the student record sheet:	UA 066 840
Studienrichtung lt. Studienblatt | Degree programme as it appears on the student record sheet:	Masterstudium Psychologie
Betreut von | Supervisor:	Univ.-Prof. Dr. Urs Markus Nater
Mitbetreut von | Co-Supervisor:	Dr. Aljoscha Dreisörner B.Sc. MSc

Acknowledgements

I would like to express my gratitude to the people that supported me throughout the process of writing this thesis. First and foremost, I want to thank Aljoscha Dreisörner, my co-supervisor. Thanks to him, I was allowed to be part of the Mind-Touch Study, which I became very passionate about, and part of his team, which became like a little family to me. Working with him, one always felt seen as a colleague and as a human. He trusted us with many tasks and at the same time supported and allowed us to reach him with questions at any time. Also, I want to thank Prof. Dr. Urs Nater, my supervisor and head of the Clinical Psychology team, for giving me the opportunity to write my Master's thesis in his department and for his input and support during the Master seminar. I am beyond grateful to have been surrounded by such great energy, fun and mutual support throughout this project. Connecting to that, I want to thank my dear colleagues, or friends, that helped me leading the project these past months – Sandrine and Justus, as well as my colleagues that gave me great support when handing the organisation over to me and throughout the process – Pelle and Lisa, and finally our colleagues from the Bachelor, who played the roles of TSST confederates and experiment conductors for us many times, and thereby greatly supported us – Nils, Benedikt, Laura, Carla, Katrin, Lea, Luna, Maja and Paula. Apart from our team, also without my family and friends the last months would not have been the same. A big Thanks is dedicated to my friend group from the Psychology Master, who supported me through exchanging ideas, working-sessions in the library, and most of all their friendship – to mention some, Giulie and Kai. Last but by far not least, I want to express my gratitude to my Mum and Dad, my brothers Jonathan and Benny, and my boyfriend Edu. Their open arms and ears, their love and just their presence have given me the strength and endurance to finish this last chapter of my Master's.

Abstract (English)

Mindfulness and self-soothing touch are emerging strategies for reducing stress, potentially through the enhancement of self-compassion. This study examined whether the stress-buffering effects of mindfulness, self-soothing touch, and combined mindful self-soothing touch interventions are moderated by individuals' trait self-compassion and mediated by intervention-induced state self-compassion. In an experiment, 135 participants completed 2-minute interventions before undergoing the Trier Social Stress Test (TSST), with stress responses assessed via self-report using a visual analog scale (0-100). Results of two multiple regression analyses showed no significant reductions in stress reactivity in the experimental conditions, measured as change in stress (*Δstress*) between T1 (pre-stressor) and T2 (post-stressor), and neither the moderation model ($p = .175$) nor the mediation model ($p = .266$) were significant. Only isolated significant findings emerged, including an increase in state self-compassion in the mind-touch condition ($p = .043$) and moderation of *Δstress* in the mind-only ($p = .029$) and mind-touch ($p = .044$) conditions, although directed contrary to expectations. Exploratory analyses indicated short-term stress-reductions in the mind-only ($p = .003$) and mind-touch ($p = .002$) conditions. These results suggest that brief interventions may reduce stress temporarily but stress-buffering effects in the TSST as well as moderator and mediator effects through self-compassion remain uncertain. Effects may depend on quantity and quality of practice, as well as measurements of self-compassion and stress. Despite limited effects, the study highlights the complexity of stress regulation and identifies key directions for advancing research on mindfulness, self-soothing touch, and self-compassion as low-threshold strategies for stress reduction.

Abstract (German)

Achtsamkeit und beruhigende Selbstberührung sind aufkommende Strategien zur Stressreduktion, möglicherweise vermittelt durch die Stärkung von Selbstmitgefühl. Diese Studie untersuchte, ob die stresspuffernden Effekte von Achtsamkeit, beruhigender Selbstberührung und kombinierter achtsamer Selbstberührung von *trait*-Selbstmitgefühl moderiert beziehungsweise von *state*-Selbstmitgefühl, hervorgerufen durch die Intervention, mediiert werden. In einem Experiment erhielten 135 Teilnehmer*innen eine zweiminütige Intervention und führten anschließend den Trier Social Stress Test (TSST) durch, wobei Stress anhand einer visuellen Analogskala (0-100) selbst eingeschätzt wurde. Die Ergebnisse zweier multipler Regressionsanalysen zeigten keine signifikante Verringerung der Stressreaktivität in den Interventionsgruppen, gemessen als Veränderung des Stressniveaus (*ΔStress*) zwischen T1 (vor dem Stressor) und T2 (nach dem Stressor) und weder das Moderationsmodell (p = .175) noch das Mediationsmodell (p = .266) waren signifikant. Es zeigten sich nur vereinzelte signifikante Ergebnisse, darunter eine Zunahme von state-Selbstmitgefühl in der Bedingung achtsame Selbstberührung (p = .043) und eine Moderation von *Δstress* in den Bedingungen Achtsamkeit (p = .029) und achtsame Selbstberührung (p = .044), jedoch entgegengesetzt der erwarteten Richtung. Explorative Analysen deuteten außerdem auf eine kurzfristige Stressreduktion in den Bedingungen Achtsamkeit (p = .003) und achtsame Selbstberührung (p = .002) hin. Diese Ergebnisse legen nahe, dass kurze Einzelinterventionen Stress vorübergehend reduzieren können, aber stresspuffernde Effekte im TSST, sowie Moderations- und Mediationseffekte durch Selbstmitgefühl bleiben ungewiss. Die Auswirkungen können von der Quantität und Qualität der Praktiken sowie von der Messung von Selbstmitgefühl und Stress abhängen. Trotz mangelnder Effekte unterstreicht die Studie die Komplexität von Stressregulation und identifiziert wichtige Richtungen für die Weiterentwicklung der Forschung zu Achtsamkeit, beruhigender Selbstberührung und Selbstmitgefühl als leicht zugängliche Stressreduktionsstrategien.

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1 Introduction

Physical touch is a fundamental aspect of human life, often taken for granted, yet it profoundly influences both physical and mental health. A lack of physical touch has been linked to reduced physiological and psychological well-being, while receiving physical touch is associated with improved health outcomes on both levels (Gallace & Spence, 2010).

Perceived stress in everyday life has steadily increased over the past decades (Gallup, 2025), leading to physical and mental health issues such as cardiovascular disease, depression and anxiety as consequences of chronic stress (APA, 2013; WHO, 2023). Therefore, stress-reducing interventions such as Cognitive Behavioral Therapy (CBT) or mindfulness-based programs have been developed (Kiecolt-Glaser et al., 2020). As these are often not easily accessible, however, research has increasingly examined the potential of other stress-reducing factors, such as physical touch received from partners, friends or health-care professionals (Eckstein et al., 2020; Gallace & Spence, 2010; Packheiser et al., 2024). Those studies show that receiving social touch, such as a massage or a hug, can indeed lower stress and enhance well-being.

However, physical touch from others is not always available. During the COVID-19 pandemic for example, social distancing reached an extreme, and also perceived stress was particularly high, with a worldwide average of around 40% of people experiencing daily stress and worry (Gallup, 2025). This highlights the need of low-threshold stress-reducing practices that can be performed individually, thereby raising the question of whether the stress-buffering effects of social touch could also be achieved through self-touch – touch delivered from oneself to oneself (von Au et al., 2024). Early findings by Dreisörner et al. (2021) suggest that self-touch may indeed reduce stress reactivity in ways comparable to social touch. When exposed to a stressor, participants who had received social or self-touch before the stress task showed lower cortisol responses compared to a control group. However, no effects on self-reported stress were found. Therefore, further studies are needed to support the stress-buffering effects of touch and to clarify underlying mechanisms.

Dreisörner et al. (2021) suggested mindfulness as a possible pathway through which self-touch could unfold its soothing effects, as in reducing stress reactivity. Mindfulness is a state of present-moment awareness that itself has well-established stress-reducing effects (Kabat-Zinn, 1990). Within this context, self-compassion,

which is defined as treating oneself with kindness in moments of suffering, appears especially relevant, as it is both an important component of mindfulness and a process often fostered through self-touch practices (Neff & Germer, 2013; Neff & Germer, 2019).

The present thesis explores the interaction between the three concepts – self-soothing touch, mindfulness, and self-compassion – in buffering stress reactivity. Specifically, it explores whether the stress-buffering effects of mindfulness, self-soothing touch, and mindful self-soothing touch as their combination depend on individuals' levels of trait or state self-compassion. A study was conducted where participants (N = 135) received one of four two-minute interventions: a self-soothing touch intervention (placing one hand on the heart and one on the abdomen), a mindfulness intervention (guided mindful breathing exercise), a combined intervention (placing one hand on the heart and one on the abdomen while being guided towards mindful awareness of the touch sensation), or a control task (building a paper plane). Afterwards, participants went through the Trier Social Stress Test (TSST; Kirschbaum et al., 1993). Stress was assessed as a self-report measure using a visual analog scale (VAS; 0-100) at multiple timepoints. In the following, two analyses were conducted that examined whether change in stress ($\Delta stress$) from T1 (after the intervention/ before the stressor) to T2 (after the stressor) was moderated by trait self-compassion (Hypothesis 1) and mediated by state self-compassion induced by the interventions (Hypothesis 2). An exploratory analysis explored short-term stress-reducing intervention effects from T0 (before the intervention) to T1.

The present thesis is divided into multiple chapters. Chapter 2 reviews the theoretical background leading to the research question and hypotheses, which are presented in Chapter 3. Chapter 4 describes the methodology, Chapter 5 the results, and Chapter 6 discusses the findings in relation to existing literature, highlighting limitations and directions for future research. Chapter 7 finally provides a conclusion of the study.

2 Theoretical Background

2.1 Stress

Stress has been defined in several ways. A widely cited definition comes from Lazarus and Folkman (1984), who describe stress as a relationship between the person and the environment that is appraised as exceeding one's resources and

threatening one's well-being. The American Psychological Association (2018) provides a broader definition, describing stress as a physiological and psychological response to an external or internal stressor.

The physiological stress response involves two main systems: the sympathetic adreno-medullary (SAM) system and the hypothalamic-pituitary-adrenal (HPA) axis. The SAM system, part of the autonomic nervous system, responds immediately to stressors, preparing the body for "fight or flight" by increasing heart rate, blood pressure, and glucose mobilization through the release of catecholamines (epinephrine and norepinephrine) (McEwen, 2017; Ulrich-Lai & Herman, 2009). The HPA axis responds more slowly, releasing corticotropin-releasing hormone (CRH), adrenocorticotropic hormone (ACTH) and ultimately cortisol, which modulates numerous physiological functions (Hellhammer et al., 2009). These systems operate through allostatic regulation – the process by which the body achieves stability through physiological change – allowing adaptation to environmental demands by adjusting cardiovascular, metabolic and immune function (McEwen, 2007, 2017; Morris, 2016).

Under healthy conditions, allostatic regulation helps the organism return to baseline after a stressor (McEwen, 2007; Morris, 2016). When stress responses become excessive or chronic, however, this regulation becomes impaired (McEwen, 2007, 2017). Dysregulation of the HPA-axis can lead to sustained cortisol elevations and persistent sympathetic activation increases cardiovascular strain by keeping up heart rate and blood pressure (Chrousous, 2009; Ulrich-Lai & Herman, 2009). Over time, this prolonged activation of the two systems accumulates into allostatic load, eventually shifting the stress response from adaptive to maladaptive and causing physiological as well as psychological impairments (McEwen, 2007, 2017).

On the physiological level, prolonged stress increases the risk of developing cardiovascular disease, including hypertension, atherosclerosis and arrythmias, as well as metabolic syndrome, obesity and insulin resistance (Chrousos, 2009; Kivimäki & Steptoe, 2018). Chronic stress also suppresses immune function, reducing resistance to infections and slowing wound healing (Kiecolt-Glaser et al., 2002; Segerstrom & Miller, 2004). On the psychological level, long-term stress exposure and maladaptive stress responses are associated with increased risk of anxiety and depression, impaired executive function and attention, as well as sleep disturbances, all of which can exacerbate cognitive and emotional dysfunction

(Hammen, 2005; Kiecolt-Glaser et al., 2020; McEwen, 2007; Meerlo et al., 2008). Sustained cortisol elevations can also impair hippocampal function, affecting memory and learning (Lupien et al., 2009).

Giving the negative impacts of stress on our health, various interventions have been developed to reduce stress and improve stress-coping (Kiecolt-Glaser et al., 2020). Stress measures are generally divided into physiological and psychological indices. Physiological measures include endocrine markers (e.g., salivary, serum or hair cortisol) and autonomic markers (e.g. heart rate, blood pressure, skin conductance) (Kim et al., 2018; Stalder et al., 2017). Psychological measures assess subjective appraisal, such as the widely used Perceived Stress Scale (PSS; Cohen et al., 1983). Some interventions, such as Cognitive Behavioral Therapy (CBT) or mindfulness-based programs, have shown promising effects in reducing both self-reported stress and physiological stress (Kiecolt-Glaser et al., 2020; Morton et al., 2020). However, these interventions are usually time-consuming and not easily accessible, underscoring the need for stress-reducing strategies that could be more readily incorporated into daily life.

2.2 Stress-reduction through social touch

"Social touch" refers to the affiliative skin-to-skin contact between individuals, i.e., physical touch provided by and to others (Elias & Abdus-Saboor, 2022; von Au et al., 2024). Touch is the first sense to develop in humans and thereby our fundamental source of contact with the external world (Gallace & Spence, 2010). The skin, our medium of touch, is also the largest sensory organ. Over recent decades, physical touch has been increasingly examined in empirical studies, with findings revealing its importance for our well-being (Gallace & Spence, 2010).

Physical touch is crucial not only for communication and the construction of interpersonal relationships, but also for our physical and emotional well-being (Gallace & Spence, 2010). A recent meta-analysis by Packheiser et al. (2024) showed that touch received from others significantly impacts physical and mental health, independently of age, sex, clinical status or type of touch. Physiologically, small to moderate effects include decreases in heart rate, blood pressure, and cortisol-levels, as well as improved mobility. In newborns, parental touch is also linked to better weight gain. Psychologically, effects appear strongest, with moderate to large reductions of trait and state anxiety, depression, fatigue and pain. However, these effects seem to depend on the perceived pleasantness: only touch that is

perceived positively and not as threatening promotes positive outcomes (Eckstein et al., 2020).

Most research on interpersonal touch derives from parent-infant interactions, romantic relationships, and therapeutic applications like massage therapy (Field, 2019). Stress-reducing effects have been primarily investigated in social touch forms such as hugging, hand-holding, and gentle stroking typically delivered by partners or family members, but also by strangers (Field, 2019). For instance, Ditzen et al. (2007) found that women who received a shoulder and neck massage prior to exposure to a standardized laboratory stressor (TSST) exhibited lower cortisol and heart rate responses compared to those that received verbal social support or no support. In general, higher levels of intimacy (e.g., more frequent hugs between partners) correlate with lower levels of cortisol, heart rate, and blood pressure (Ditzen et al., 2008; Light et al., 2005). Massage interventions also reduce perceived stress, pain, fatigue and anxiety, in non-clinical but especially in clinical settings (Eckstein et al., 2020). For example, hand massages have been shown to reduce anxiety levels in patients awaiting ambulatory surgery (Brand et al., 2013) and classical massage has been shown to reduce subjective stress and anxiety as well as cortisol levels in women with a breast cancer diagnose (Listing et al., 2010). Together, these findings support the notion that physical touch serves as a “stress buffer” (Morrison, 2016).

Different mechanisms have been proposed to explain these effects. Most prominent is the idea that physical touch communicates proximity, positive affiliation and safety, decreasing HPA-axis- and sympathetic activity and increasing release of oxytocin, thereby supporting allostatic regulation (Gallace & Spence, 2010; Morrison, 2016). Inhibition of the stress systems seems to occur via the Prefrontal Cortex (PFC), insula, and amygdala, a network involved in both top-down and bottom-up emotion processes (Eckstein et al., 2020). Studies show that the anxiolytic as well as the analgesic effects of social touch are largely mediated by a release of oxytocin from the paraventricular nucleus (PVN) of the hypothalamus, which is involved in an inhibition of HPA-axis activity and a modulation of the endogenous opioid system responsible for pain (Elias & Abdus-Saboor, 2022). Oxytocin also seems to moderate the hedonic experience of touch (Morrison, 2016). Furthermore, given the rewarding function of touch, an involvement of the dopaminergic system has been recently discussed (Elias & Abdus-Saboor, 2022).

Among different types of primary sensory neurons involved in touch, one system of nerve fibers called C-tactile afferents (CTs) seems to be particularly important regarding its pleasant and rewarding sensation (Pawling et al., 2017; von Mohr et al., 2018). CTs are unmyelinated afferent neurons and low-threshold mechanoreceptors primarily found in the hairy skin that respond optimally to slow, gentle touch typical for caressing (Field, 2019; Pawling et al., 2017). Touch at appropriate velocity correlates positively with both explicit as well as implicit measures of pleasantness (Pawling et al., 2017). CTs project to regions such as the insula, which is involved in the communication of safety by regulation of the amygdala, thereby dampening the stress response (Eckstein et al., 2020). Further support comes from neuro-imaging studies showing an activation of brain regions associated with hedonic experience, downregulation of the stress-response pathways, and oxytocin release (von Au et al., 2024). These effects have been shown to occur not only in human-to-human interactions but also in human-to-animal and even human-to-robot interactions (Eckstein et al., 2020).

In addition to dynamic, CT-optimal touch, research has shown that also static touch contributes to emotional regulation (Elias & Abdus-Saboor, 2022). While static touch may not optimally stimulate CT afferents, sustained contact in human-to-human interactions – such as holding hands or a light, supportive hug– activates pressure-sensitive mechanoreceptors and provides proprioceptive feedback, which can enhance body awareness and convey safety (von Mohr & Fotopoulou, 2018). Such contact has been shown to buffer stress, reduce physiological arousal, and support affective regulation, however, induces less hedonic pleasure as CT-optimal dynamic touch (Ali et al., 2023; Elias & Abdus-Saboor, 2022). Moreover, some studies support a possible role of CTs also in static touch (Ali et al., 2023). Evidence from self-administered touch indicates that similar mechanisms may operate during static self-touch, such as placing a hand on one’s chest, which can produce calming effects (Dreisörner et al., 2021), possibly by increasing interoceptive awareness as well as emotional regulation and mindfulness (Price et al., 2019).

Taken together, these findings suggest that different forms of touch effectively serve as stress-buffers (Field, 2019; von Mohr et al., 2018). Although the underlying mechanisms might differ, stress-reducing effects appear to occur universally across different agents, including the self (Dreisörner et al., 2021; Eckstein et al., 2020; von Au et al., 2024).

2.3 Stress-reduction through self-touch

While social touch is associated with a range of health benefits, a lack of social touch has been linked to impaired emotional, social and physiological well-being (Gallace & Spence, 2010; von Mohr et al., 2021). For instance, touch deprivation correlates with increased levels of anxiety and loneliness, which are associated with higher psychological and physiological stress (Schneider et al., 2023; von Mohr et al., 2021). Since social touch is not always available – whether temporarily or in more extreme scenarios such as during the COVID-19 pandemic – researchers have increasingly turned to self-touch as a possible stress-reducing mechanism (e.g., Dreisörner et al., 2021).

Self-touch refers to touch delivered from and to oneself (von Au et al., 2024). Spontaneous self-touch is very common in everyday life, and its frequency increases under stress (Grunwald et al., 2014). It appears to serve as a subconscious self-regulation- and thereby stress-reducing strategy. For instance, Grunwald et al. (2014), using electroencephalography (EEG) measures, showed a positive correlation between spontaneous facial self-touch gestures (sFSTG) during a stress-task and cortical activation in regions involved in emotion and working memory processes, indicating a regulatory function. Similarly, other studies have suggested that sFSTG help sustain attention and avoid distraction in cognitively and emotionally demanding tasks (Müller et al., 2019; Spille et al., 2022).

Like social touch, self-touch seems to exert analgesic effects (Hogendoorn et al., 2015). Together with the finding that positive effects of touch arise irrespectively of the agent (Eckstein et al., 2020), this indicates that self-touch may achieve effects comparable to those of social touch. However, underlying mechanisms might differ. Neural activation patterns suggest that self-touch is linked to greater activation in frontal brain regions such as the Orbitofrontal Cortex (OFC) and dorsolateral Prefrontal Cortex (dlPFC), which are involved in self-focused processes, cognitive control, and stimulus-independent thought (von Au et al., 2024). In contrast, social touch, has been associated with relative deactivation in these regions, a pattern thought to reflect reduced internal focus and greater hedonic experience (von Au et al., 2024). In conclusion, these findings suggest that self-touch may buffer stress by facilitating disengagement from external stressors and activating internally oriented processes (e.g., planning, brainstorming, or mind-wandering), whereas social touch supports coping by directing attention outward and enhancing hedonic experience.

Neff & Germer (2019) have recommended self-soothing touch in moments of struggle as simple and immediate way to redirect attention from negative thoughts and emotions toward our bodies, while also signaling safety and care to oneself. Compared to spontaneous self-touch gestures, research on deliberate use of self-touch for stress reduction is still limited, though. One of the first empirical investigations was conducted by Dreisörner et al. (2021), who compared self-touch, social touch, and no touch in the context of the Trier Social Stress Test (TSST; Kirschbaum et al., 1993). Before the task, participants either received a hug from another person (social touch condition), applied self-soothing touch (self-touch condition), or built a paper plane (control condition). Participants in the self-touch condition were free to choose position and kind of touch, with most participants placing one hand on the chest and one on the abdomen. Results showed significantly lower cortisol responses in both touch conditions compared to the control condition, though no significant differences in heart rate or self-reported stress were found.

Taken together, current evidence suggests that self-touch can buffer stress in ways comparable to social touch. Still, findings remain mixed, particularly regarding subjective versus physiological stress measures. To better understand and establish self-touch as a stress-reducing tool in the future, it is essential to understand the mechanisms underlying its effectiveness. Like social touch, self-touch seems to downregulate HPA-axis and sympathetic activtiy, as reductions of stress markers such as cortisol indicate (e.g., Dreisörner et al., 2021). However, more research is needed to investigate whether stress reductions primarily stem from attentional distraction (von Au et al., 2024), stimulation of specific mechanoreceptors in the skin (Eckstein et al., 2020), or the communication of safety (Gallace & Spence, 2010). Unlike social touch, self-touch naturally cannot serve as a cue for social support, but it may nonetheless signal safety through processes of mindfulness or self-compassion (Dreisörner et al., 2021; von Au et al., 2024).

2.4 Mindfulness

Findings by von Au et al. (2024) suggest that beyond the tactile stimulation itself, stress-buffering effects may also arise from a state of mindfulness promoted by touch. Mindfulness is a concept rooted in Buddhist tradition, where it is embedded in an ethical, spiritual framework, aimed at insight and liberation from suffering through present-moment awareness (Gethin, 2011). Contemporary psychology, however, has

adopted a definition largely detached from these ethical roots (Kabat-Zinn, 1990). Within this context, mindfulness is defined as a state of purposeful, non-judgmental awareness of the present moment. It involves an accepting attitude towards the here and now without judging or reacting to but just observing what is present.

Mindfulness is considered an innate quality of mind as it is essentially awareness itself, yet it is a quality that can be intentionally cultivated through practice (Kabat-Zinn, 2015). This awareness can be directed inward or outward – toward inner states such as thoughts, emotions and bodily sensations, or toward sensory information about our environment (Bishop et al., 2004). Psychological mindfulness practice aims to improve the ability to intentionally focus attention on these present-moment experiences, thereby supporting emotional regulation and stress reduction (Shapiro et al., 2006). Empirical research supports this view, showing that mindfulness practice can reduce stress and improve both physical and mental health, including symptoms of depression and anxiety, while fostering overall well-being by enhancing emotion processing (Sayers et al., 2015).

Mindfulness-based interventions (MBIs) encompass a variety of practices that can be categorized as formal (e.g., meditation, breathing exercises, mindful movement) or informal (mindfulness in daily activities) (Zhang et al., 2021). While some MBIs focus purely on mental techniques, others integrate self-soothing touch such as placing a hand on the heart or the face (Smeets et al., 2014). Such forms of self-touch in MBIs have shown to promote a sense of safety and enhance self-regulation, thereby reducing stress (Neff & Germer, 2013).

Beyond long-term improvements in well-being, mindfulness has also been shown to reduce stress reactivity to acute stressors, leading to the formulation of the *mindfulness stress-buffering hypothesis* (Creswell & Lindsay, 2014). It proposes that mindfulness buffers against stress via both top-down pathways, as in altering stress appraisal, and bottom-up pathways, as in attenuating physiological stress response. Supporting this, Morton et al. (2020) conducted a meta-analysis of 12 studies using the TSST to examine the stress-buffering effects of MBIs. Program durations ranged from one day to six months and contained around eight sessions. Studies included self-report as well as physiological (neuroendocrine, cardiovascular, inflammatory) measures. Buffering effects were found at both levels, although effects were strongest for self-reported stress, with seven out of ten studies showing significantly reduced stress reactivity following an MBI.

Because of these positive effects, MBIs have been increasingly implemented to reduce stress and improve well-being, with Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1990) being the most widely applied program (Davis et al., 2024). However, when practicing mindfulness, some facets of it seem to play a bigger role than others. In a longitudinal study, Davis et al. (2024) examined the development of different mindfulness facets during MBSR and identified self-compassion as the most prominent mechanism of change in outcomes such as depression, anxiety and stress. This aligns with findings indicating that self-compassion may serve as an underlying mechanism of stress-reduction through self-touch (Susman et al., 2024), suggesting self-compassion as a key mechanism in both the stress-buffering effects of mindfulness and self-touch.

2.5 Self-Compassion

Self-compassion can be defined as compassion directed inward, where one relates to oneself as the object of concern and care in the face of suffering (Neff, 2003b). It can be conceptualized as a personality trait (trait self-compassion) or a current state (state self-compassion) (Neff, 2003a, 2003b; Miyagawa & Neff, 2023). It is closely related to mindfulness: self-compassion can be seen as one aspect of mindfulness, while at the same time mindfulness constitutes one of three components of self-compassion, together with self-kindness and common humanity (Neff & Dahm, 2015). Thereby, being self-compassionate in the face of suffering means (a) treating oneself with kindness rather than harsh self-criticism, (b) recognizing suffering as part of the shared human experience, and (c) accepting painful thoughts and feelings instead of refusing or over-identifying with them (Neff, 2003a).

Although mindfulness and self-compassion are interdependent, the two are regarded as distinct constructs (Neff & Germer, 2013). In the context of stress particularly: Mindfulness allows individuals to recognize moments of stress with awareness, whereas self-compassion enables them to respond to that stress with warmth and care (Neff, 2003a, 2003b; Neff & Germer, 2019). Importantly, self-compassion differs also from self-pity, where one gets immersed in their own problems. In comparison, self-compassion is about an enhanced feeling of interconnectedness, recognizing imperfection as part of human cognition and maintaining perspective on one’s own emotional experience instead of getting swept away by it (Neff, 2003a). This capacity might explain why self-compassionate

individuals cope better with stress (Neff & Germer, 2013). Indeed, research shows that self-compassion is linked to less rumination and fear of failure as well as greater willingness to acknowledge negative emotions, all of which are associated with better stress coping and overall psychological health (Neff, 2003a). For example, Neff et al. (2015) found that self-compassionate individuals coped better with life stressors such as academic failure.

Additionally to MBIs such as MBSR, programs have been developed that specifically target the cultivation of self-compassion, most prominently the 8-week Mindful Self-Compassion (MSC) program by Neff & Germer (2013). During the program, participants meet for 2.5 hours per week, learning different kinds of formal practices (e.g., loving-kindness meditation) and informal practices (e.g., self-compassionate letter writing, soothing touch) alongside a half-day silent meditation retreat (Germer & Neff, 2013). Additionally, participants are encouraged to practice individually for about 40 minutes daily. Neff & Germer (2013) tested the effectiveness of the program in two studies, with results showing significant increases in life-satisfaction as well as decreases in depression, anxiety and stress. Another study even suggests self-compassion as a stronger predictor of psychopathology (depression, anxiety, worry) and quality of life than mindfulness itself, explaining up to ten times more variance in those outcomes (van Dam et al., 2011).

Beyond the more evident connection between self-compassion and mindfulness, self-compassion is also related to self-soothing touch. Theoretical models of Compassion-Focused Therapy (CFT) suggest that activating the parasympathetic “soothing system” through compassionate attention and self-touch can downregulate threat responses and promote emotional regulation (Gilbert, 2014, 2020). In line with that, self-soothing touch is embedded in loving-kindness and compassion-based programs like the MSC, where it serves as a therapeutic element (Neff & Germer, 2013). According to Neff & Germer (2019), self-touch is an expression of self-compassion, thereby proposing “compassionate touch” practices, such as placing the hands over the heart, holding one’s shoulders, or cradling the face, as simple ways to calm oneself in difficult moments.

While MSC includes such practices, self-touch has not yet been studied as an isolated variable within the program (Neff & Germer, 2019). However, empirical support stems from a recent study by Susman et al. (2024), showing that daily micropractice of self-compassionate touch (≤ 20 seconds/day) increased self-

compassion over one month, as well as positive affect. Importantly, increases in self-compassion co-occurred with reductions in stress and psychopathology.

Taken together, theory and empirical evidence suggest that state self-compassion could be a mechanism (mediator) through which mindfulness and self-touch translate into improved affect, or trait self-compassion could moderate practice outcomes by influencing how individuals apply mindfulness or self-soothing skills.

2.5.1 Self-compassion as a mediator in stress-buffering effects

Given the centrality of self-compassion in both mindfulness and self-soothing touch interventions, it has been proposed that changes in self-compassion may serve as a key mechanism through which these practices exert their beneficial effects (e.g. Gu et al. 2015). Brief mindfulness or self-soothing touch practices may first increase state self-compassion, which may in turn mediate reductions in physiological and emotional stress responses.

Apart from indirect evidence from studies that show positive effects of self-compassion practices on perceived stress after an eight-week MSC program (Neff & Germer, 2013) or on stress-reactivity during the TSST (Pace et al., 2009), some direct evidence supports this mediating role. Arch et al. (2014) for example found that a brief self-compassion training (SCT) lead to higher trait and state self-compassion during TSST recovery, co-occuring with diminished physiological stress and subjective anxiety responses, though mediation was not tested directly. Davis et al. (2024) directly tested mediation effects, but in a longitudinal study of an eight-week MBSR program and found that increases in self-compassion mediated decreases in depression and anxiety. Although reductions in perceived stress were primarily accounted for by improvements in mindfulness and emotion regulation, these findings suggest that mindfulness training fosters emotional well-being by cultivating a more compassionate stance toward oneself. Complementary evidence from a systematic review of mediation studies (Gu et al., 2015) also identifies self-compassion as a potential mechanism of change in mindfulness-based programs, though empirical support was still limited at that time.

Emerging evidence also indicates that self-touch may exert its stress-reducing effects through increases in self-compassion. For example, the previously mentioned study of Susman et al. (2024), showing increases in state self-compassion through brief daily self-touch practices, co-occurring with reductions in stress and negative affect, support the idea of self-compassion as an underlying mechanism of the

stress-reducing effects of self-touch. However, empirical research directly examining mediation effects through self-compassion on stress-reactivity in self-touch contexts is still scarce.

2.5.2 Self-compassion as a moderator in stress-buffering effects

At the same time, there is reason to assume that self-compassion may not only mediate but also moderate the effectiveness of brief mindfulness or self-soothing touch interventions. Conceptually, individuals high in trait self-compassion may benefit more strongly because they are generally more inclined to engage with practices in a self-kind, accepting, and emotionally aware manner – qualities that may enable better access to an intervention's stress-buffering components, such as attending to one's own internal experiences (Feldman & Kuyken, 2019; Neff, 2003a, 2003b). In other words, increased acceptance and self-kindness as well as reduced over-identification regarding negative emotions associated with dispositional self-compassion may amplify effects of mindfulness or self-touch interventions by facilitating deeper engagement with the exercises, thereby leading to stronger effects on stress responses (Neff, 2003a, 2003b).

Supportive, though indirect evidence comes from empirical studies. For example, Inwood & Ferrari (2018) reported that trait self-compassion functions as a protective or resilience factor, particularly under high-stress conditions. They showed that self-compassion supports emotion regulation and coping, suggesting that individuals high in self-compassion better access self-regulatory processes, which may facilitate engagement with contemplative or self-regulatory practices. Similarly, the previously mentioned study by Arch et al. (2014) showed that higher trait self-compassion after a brief self-compassion training co-occurred with dampened physiological stress response as well as reduced subjective anxiety as a response to the TSST, consistent with the idea that trait self-compassion enhances adaptive engagement with stress and emotion-regulation processes.

Together, these findings indicate that individuals high in trait self-compassion may be better equipped to utilize brief mindfulness or self-soothing touch interventions effectively. However, direct empirical tests of trait self-compassion as a moderator in the context of mindfulness and self-touch interventions are scarce and results are mixed. For instance, Arch et al. (2016) found that while higher trait self-compassion predicted lower perceived stress during the TSST among conditions, it

did not significantly moderate the effectiveness of a self-compassion training (SCT) in reducing stress responses to the task.

Taken together, these considerations suggest that both mindfulness and self-soothing touch serve as stress buffers in stressful situations (e.g., Dreisörner et al., 2021), but the specific role of self-compassion remains insufficiently explored. While some evidence points to self-compassion as a particularly important mechanism in mindfulness interventions (Davis et al., 2024; Gu et al., 2015) and as a personal trait influencing how individuals respond to such interventions (Inwood & Ferrari, 2018), even less is known about its role in self-soothing touch or the combination of mindfulness and self-soothing touch. Moreover, most evidence comes from longitudinal or correlational designs, which may be different from acute stress dynamics, and finally, studies directly testing moderation or mediation effects are scarce.

Accordingly, the present study investigates these potential mechanisms, assessing whether state and trait self-compassion mediate or moderate the stress-buffering effects of brief mindfulness and self-soothing-touch interventions in an acute stress context.

3 Research question and hypotheses

Based on the theoretical framework and previous findings, the present study addresses the following research question.

3.1 Research question

Does the stress-buffering effect of different intervention conditions – mindfulness-only (mind-only), self-soothing touch-only (touch-only), and combined mindful self-soothing touch (mind-touch) – depend on individuals' trait self-compassion and on state self-compassion induced by the interventions?

3.2 Hypotheses

H1 (Moderation). Trait self-compassion moderates the relationship between condition and change in subjective momentary stress (Δ*stress*) following the stress task (TSST). Specifically, participants of the mind-only, the touch-only and the mind-touch touch conditions will exhibit a smaller increase in subjective momentary stress compared to the control condition when they score higher in trait self-compassion.

H2 (Mediation). State self-compassion mediates the relationship between condition and change in subjective momentary stress (Δ*stress*) following the stress

task (TSST). Specifically, participants of the mind-only, the touch-only and the mind-touch conditions will exhibit higher scores in state self-compassion, which will in turn predict a smaller increase in subjective momentary stress compared to the control condition.

4 Methods

The research question was investigated as part of a larger study on mindfulness and self-soothing touch (Mind-Touch Study). The sampling strategy, inclusion and exclusion criteria, and study procedure followed those of the overarching study and are described below, as well as the sample used for the current analyses.

4.1 Participants

In the overall study, a sample of 140 participants was aimed for. This decision was based on a power analysis using G*Power, which indicated a minimum sample size of N = 128 for a small estimated effect size (f = .10), desired power of .80, and significance level of α = .05, drawing on data of an earlier study by Dreisörner et al. (2021). To account for potential dropouts, the planned sample size was increased to N = 140.

Participants were recruited through posters distributed around the facilities of the University of Vienna, and via social media. The study was advertised under the title *“Studie zu Bewerbungssituationen”* [Study about job application situations]. To achieve the study’s aims, the use of deception was necessary. All participants provided written informed consent prior to participation. The study was approved by the Ethics Committee of the University of Vienna, and participants were reminded of their rights during the debriefing, when they were fully informed about the actual research objectives. Each participant received €50 as compensation, as indicated on the invitation posters.

At the time of analysis, 136 participants had been tested. Data from one participant could not be used due to a procedural error, resulting in a final sample of N = 135 included in the analysis. Participants were predominantly students, with a mean age of 23.15 years. The sample was representative with respect to gender, comprising 73 females (54.1%), 60 males (44.5%), 1 diverse (0.7%), and 1 not specified (0.7%).

4.1.1 Inclusion- and Exclusion criteria

Participants were healthy, German-speaking individuals aged 18-35, with a BMI between 18 and 25 kg/m² and no severe or chronic physical illness. Exclusion criteria included regular smoking (> 5 cigarettes per week), alcohol abuse (≥ 15 alcoholic beverages per week for men or ≥ 8 for women), other types of substance abuse within the past two years, and current medication affecting hormone levels. Participants currently affected by any psychological disorder, those with an eating disorder within the past five years, or with a lifetime prevalence of an affective or anxiety disorder, social phobia, or psychosis were also excluded.

Additional exclusion criteria applied specifically to female participants to control for factors potentially influencing cortisol levels. Female participants were required not to be pregnant, breastfeeding, or using hormonal contraceptives. Furthermore, they were tested universally during the follicular phase of the menstrual cycle. Finally, participants with regular mindfulness practice or experience with the Trier Social Stress Test (TSST; Kirschbaum et al., 1993) were excluded.

4.2 Study design

The overarching study was a randomized controlled trial with one between-subject factor (condition) and one within-subject factor (repeated measures of stress at eight timepoints) as independent variables. Subjective momentary stress, momentary salivary cortisol and momentary heart rate were examined as the dependent variables. The present work focuses specifically on subjective momentary stress. More precisely, the analyses examine how stress reactivity to a stress task (Δ*stress*) between two timepoints differs between conditions, moderated by trait self-compassion (Hypothesis 1) or mediated by state self-compassion (Hypothesis 2). Accordingly, the design for the current analyses includes one between-subject factor (condition) as the independent variable, change in subjective momentary stress (Δ*stress*) as the dependent variable and trait- or state self-compassion as moderator or mediator variables, respectively.

4.2.1 Experimental variables and measurements

Subjective momentary stress was assessed using a unipolar visual analog scale (VAS) ranging from 0 (*kein Stress* [no stress]) to 100 (*maximaler Stress* [maximum stress]). Of eight total stress assessments in the study, three were relevant for the present analysis (see Figure 1 in the Procedure section): T0 (before the intervention), T1 (after the intervention, before the TSST), and T2 (immediately after

the TSST). The outcome variable ∆*stress* was defined as the difference between T1 and T2 (∆*stress* = T2 – T1), thereby the change in stress from before to after the stress task. T0 was included as a covariate, since pre-intervention stress levels were expected to influence the effectiveness of the intervention and thereby stress reactivity. The independent variable was the condition, which comprised four groups (see next section for details).

The moderator variable, trait self-compassion (trait SC), was assessed using the German short form of the Self-Compassion Scale (SCS-D-Kurzform; Hupfield & Ruffieux, 2011). This instrument is a validated translation of the English short form (SCS-SF; Raes et al., 2011), which is based on the original scale developed by Neff (2003b). The SCS-D measures six aspects of self-compassion (self-kindness, self-judgment, common humanity, isolation, mindfulness, over-identification) across 12 items. Participants responded on a 5-point Likert scale from 1 (*fast nie* [almost never]) to 5 (*fast immer* [almost always]). In the analysis, the total score was used. The full questionnaire is provided in Appendix A.

The mediator variable, state self-compassion (state SC), was assessed with a single item (“Ich habe gerade hohes Selbstmitgefühl” [I currently have high self-compassion]), rated on a 5-point Likert scale (Zhang et al., 2022). The response options were: 1 = *stimme nicht zu* [strongly disagree], 2 = *stimme eher nicht zu* [disagree somewhat], 3 = *weder noch* [neither agree nor disagree], 4 = *stimme eher zu* [agree somewhat], and 5 = *stimme zu* [strongly agree].

4.2.2 Conditions

Note that throughout this paper, the terms “condition” and “group” are used interchangeably to refer to the four intervention arms. There were three experimental and one control condition, characterized by the specific intervention that participants received. Participants were randomly assigned to one of the four conditions (1:1:1:1), using block randomization (block size = 10; 14 blocks). Of the 135 participants included in the analysis, 34 were in the control condition, 35 in the touch-only condition, and 33 in both the mind-only and the mind-touch conditions. All interventions were completed in a seated position and lasted 2 minutes. Touch was applied in a form of static self-touch. Instructions were given in a standardized way (see Appendix B for full instructions).

In the self-soothing touch only (touch-only) condition, participants were instructed to place their right hand over their heart and their left hand on their abdomen. No additional mindfulness instructions were given.

In the mindfulness only (mind-only) condition, participants were guided to focus on their breathing. No additional self-soothing touch instructions were given.

In the mindful self-soothing touch (mind-touch) condition, participants received a combined intervention of mindfulness and self-soothing touch. They were instructed to place their right hand over their heart and their left hand on their abdomen. Then they were guided to notice the warmth and pressure of their hands on their bodies.

In the control condition, participants were instructed to build a paper plane to account for effects of time.

4.2.3 Trier Social Stress Test (TSST)

As a stress-inducing task, the Trier Social Stress Test (TSST; Kirschbaum et al., 1993) was administered. The TSST is a widely used and standardized paradigm to induce stress in laboratory settings, combining two kinds of stressors: social evaluation and uncontrollability. It is referred to as the gold standard to induce stress in laboratory settings and is used in most prior research on the given topic (Morton et al., 2020). The procedure consists of two phases.

In the first phase, participants are instructed to prepare a five-minute speech for a job-interview for their dream job which they would later present in front of a committee. They are asked to focus on personal strengths and suitability for the position. Participants are also informed that they would later receive a second task from the committee and that their performance would be recorded. Participants get five minutes to prepare for the speech, during which the experimenter leaves the room.

In the second phase, participants deliver their speech in front of a committee consisting of two trained confederates. After five minutes, the speech is interrupted, and participants are assigned the second task: counting backwards from 2043 in steps of 17. Errors result in restarting the task from the beginning. Throughout both tasks, the confederates are instructed to maintain neutral facial expressions, providing no positive feedback or reassurance to the participants. Additional stress is induced by a sterile-looking environment: confederates are dressed in laboratory

coats and bright unnatural light is used. With the speech and arithmetic task lasting 5 minutes each, the duration of the TSST is ten minutes in total.

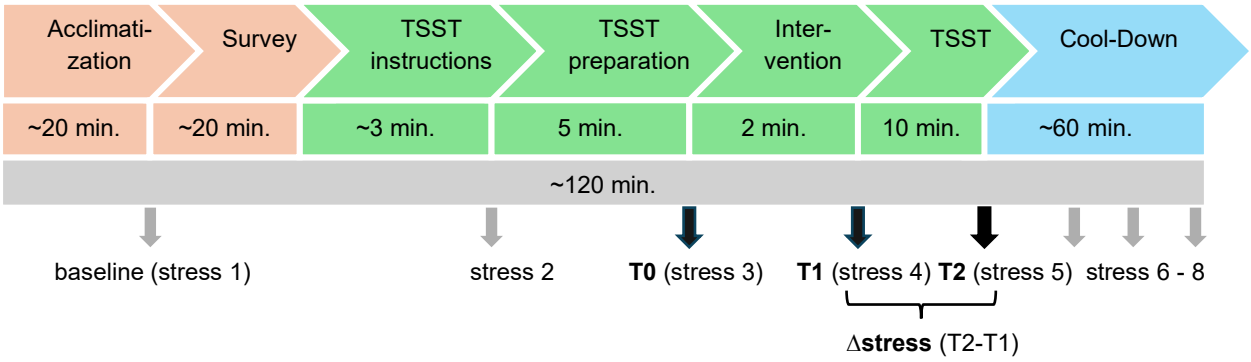
4.3 Procedure

Participants who completed the online screening and met the abovementioned inclusion- and exclusion criteria were contacted by a member of the study. During this telephone screening, additional eligibility criteria were checked, and an appointment for the testing was scheduled. Participants were instructed to follow a checklist of behaviors (e.g. regarding physical activity, eating and drinking) for the last 24 hours prior to testing, to control for factors influencing cortisol levels. An initial email confirmed the appointment details and included the checklist, followed by a reminder email approximately two days before the appointment.

The experiment was conducted in the laboratory facilities of the Biomedical University of Vienna (Campus Vienna Biocenter 2). Testing sessions took place twice per day at regular times (12:30-14:30 / 15:00-17:00), to control for baseline cortisol differences due to diurnal fluctuations. Each session lasted approximately 120 minutes per participant. Figure 1 illustrates the experimental procedure, including the points of measurement of subjective momentary stress.

Figure 1

Experiment procedure including measurements of subjective momentary stress



The procedure of the experiment can be roughly divided into three phases: *Acclimatization and preparation, intervention and stress task* and *cool-down*.

During the *acclimatization and preparation phase*, participants were welcomed by the experimenter and taken to a waiting room for a ten-minute acclimatization period to control for baseline stress differences. Afterwards, participants were escorted to the testing room, where they read and signed the written consent, put on a belt with a Movisens detector that was used to measure heart rate variability, and

completed a screening questionnaire to confirm compliance with the behavioral checklist and test eligibility. Next, participants completed a computer questionnaire assessing baseline subjective momentary stress (stress 1), demographic and health data and exploratory variables including trait self-compassion (Neff, 2003b). Finally, the procedure for saliva sampling was explained, and the first saliva sample was collected.

The *intervention and stress-task phase* started with the instructions for the TSST. Prior to the five-minute preparation time for the speech, stress 2 was assessed, and a second saliva sample was collected. After preparation, participants provided another stress rating (stress 3; T1). Participants then received the intervention according to their assigned experimental condition, presented as a "supporting measure". They therefore drew one of four manipulated lots, indicating the intervention that they would receive. While the experiment conductor was not blinded, TSST confederates were. After the intervention, participants rated stress again (stress 4) as well as state self-compassion. Also, another saliva sample was taken. They then proceeded to the second part of the TSST: the speech and arithmetical task, which took place in a different room.

After the TSST, the *cool-down phase* followed. Participants returned to the testing room and provided another stress rating (stress 5) and saliva sample. They then remained in the testing room for approximately 50 minutes, during which three additional stress ratings (stress 6-8) and saliva samples were collected at 10, 15 and 15 minutes, respectively. At the end of the study, participants were debriefed by the experiment conductor.

4.4 Analysis

All analyses were conducted using *IBM SPSS Statistics for Windows, Version 29.0* (IBM Corp.). For the first hypothesis, a multiple regression analysis was performed to test whether trait self-compassion (trait SC) moderated the effect of the intervention on Δ*stress*. The independent variable (condition) was multicategorical and therefore dummy-coded using indicator coding (Darlington & Hayes, 2017). In indicator coding, all categories are compared with a reference category (Darlington & Hayes, 2017). Here, the control group served as the reference. This resulted in three dummy variables (X1, X2, X3), comparing the control group to the touch-only (X1), mind-only (X2) and mind-touch (X3) conditions. The main analysis was conducted using the PROCESS macro for SPSS (Hayes, 2022). Mean centering was applied

only to continuous variables that define products, as centering dummy-coded variables distorts their meaning (Hayes, 2022). To check assumptions, the model was replicated in a linear regression analysis with all eight predictors, including manually calculated mean-centered moderator and interactions terms.

For the second hypothesis, a multiple regression analysis was performed to examine whether state self-compassion induced through the interventions mediated the effect of the interventions on Δ*stress*. Again, indicator coding was applied, creating three dummy variables comparing the control group to the touch-only (X1), mind-only (X2) and mind-touch (X3) conditions. Because the independent variable was dummy-coded and no interactions were modeled, no mean-centering was applied (Hayes, 2022). As in the moderator analysis, the main model was estimated using PROCESS, and assumption were tested by replicating the model in a linear regression analysis.

In addition to the confirmatory analyses, an exploratory one-way analysis of variance (ANOVA) was conducted to examine the short-term effects of the interventions. Specifically, changes in stress from pre-intervention (T0) to post-intervention (T1) were compared across conditions.

5 Results

The following section reports the results of all analyses, including assumption checks.

5.1 Descriptive statistics

Table 1 summarizes the key descriptive statistics. Means and standard deviations of subjective momentary stress are reported for pre-intervention stress (T0), post-intervention stress (T1), and stress after the TSST (T2), as well as for change in stress between T1 and T2 (Δ*stress*). Additionally, the table includes mean values of state self-compassion (state SC) for each condition. Figure 1 additionally illustrates changes in stress between T0, T1 and T2 graphically.

Table 1

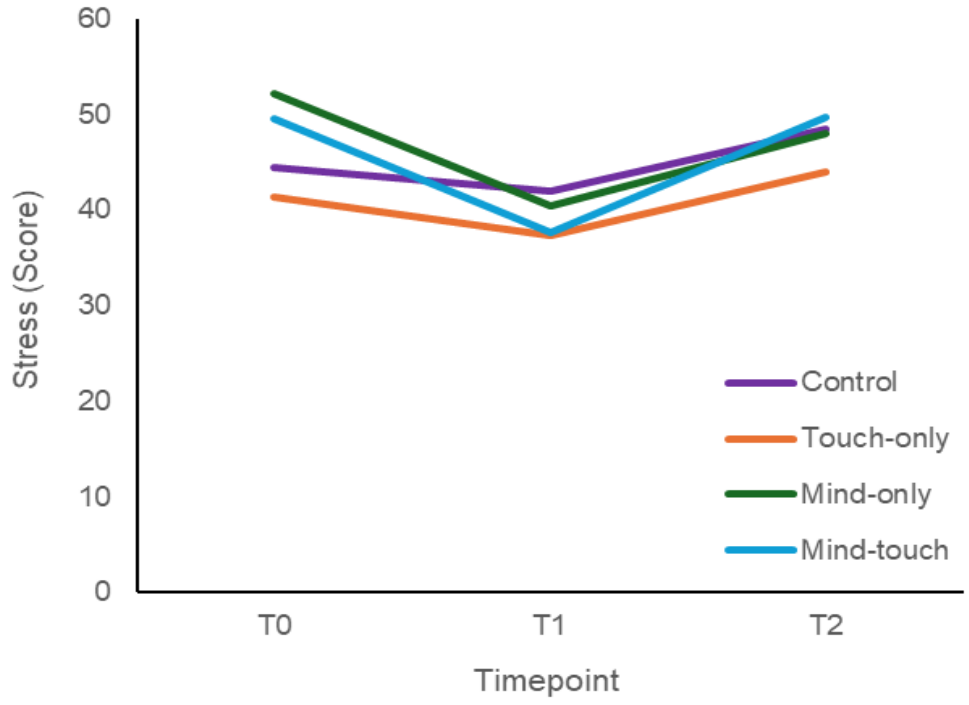
Descriptive statistics of stress and state self-compassion by condition

Condition	T0 *M (SD)*	T1 *M (SD)*	T2 *M (SD)*	Δ*stress* *M (SD)*	state SC *M (SD)*
Control	44.47 (3.51)	42.00 (3.95)	48.53 (5.35)	6.53 (5.14)	3.26 (1.14)
Touch-only	41.34 (3.40)	37.31 (2.58)	43.94 (4.44)	6.63 (3.75)	3.40 (1.04)
Mind-only	52.24 (3.90)	40.64 (3.82)	48.09 (4.94)	7.45 (5.35)	3.45 (0.79)
Mind-touch	49.52 (4.55)	37.73 (3.75)	49.79 (4.90)	12.06 (3.63)	3.76 (0.83)

Note. T0 = pre-intervention stress, T1 = post-intervention stress, T2 = stress after TSST, Δ*stress* = T2 – T1; SC = self-compassion, *M* = mean, *SD* = standard deviation.

Figure 2

Changes in stress between T0 and T2



Note. T0 = pre-intervention stress, T1 = post-intervention stress, T2 = stress after TSST.

5.2 Randomization

To verify the success of randomization before conducting the main analyses, it was examined whether conditions differed in gender, age, baseline stress, and trait self-compassion.

Gender distribution was tested using a Chi-Square test. Because only one participant identified as non-binary and one did not state their gender, these categories were excluded due to low cell counts. The Chi-Square test indicated that the distribution of gender (male vs. female) did not differ significantly across the four conditions, $\chi^2(3, N = 133) = 2.74$, $p = .433$.

Age differences were assessed with a one-way ANOVA, which revealed no significant differences between conditions, $F(3, 131) = 1.79$, $p = .151$. Levene's test and the Shapiro-Wilk test indicated violations of homogeneity of variance and normality in the control and the touch-only conditions. As a robust alternative, a Kruskal-Wallis-test was conducted, which also showed no significant differences, $H(3) = 3.34$, $p = .339$.

Baseline stress levels (stress 1) were examined with a one-way ANOVA, which showed no significant group differences, $F(3, 131) = 0.928$, $p = .429$. Shapiro-Wilk tests and histograms indicated positively skewed distributions in all conditions, but a Kruskal-Wallis test again confirmed the ANOVA results, $H(3) = 3.66$, $p = .301$.

Differences in trait self-compassion between the conditions were tested in a one-way ANOVA, which also revealed no significant group differences, $F(3, 131) = 0.21$, $p = .892$.

Taken together, these results suggest that randomization was successful: the conditions did not differ significantly in gender, age, baseline stress, or trait self-compassion.

5.3 Manipulation check

Further, it was examined whether the experimental manipulation of mindfulness was successful – that is, whether mindfulness-related interventions induced a state of mindfulness, more so than the other two conditions. After the interventions, state mindfulness was assessed in two items (Item 1 = "Ich bin jetzt gerade auf den gegenwärtigen Moment fokussiert" [Right now, I am focused on the present moment]; Item 2 = "Ich bin jetzt gerade in der Lage, die Gedanken und Gefühle, die ich habe, zu akzeptieren." [Right now, I am able to accept my thoughts and feelings]).

Boxplots showed that scores on both items were strongly skewed toward the upper end of the scale, with limited variability across groups. Accordingly, Kruskal-Wallis tests revealed no significant group differences for Item 1, $H(3) = 0.22$, $p = .974$, with similarly high values in the control ($M = 4.06$, $SD = 0.13$), touch-only ($M = 4.00$, $SD = 0.16$), mind-only ($M = 4.15$, $SD = 0.12$) and mind-touch ($M = 4.03$, $SD = 0.15$) conditions. Likewise, no significant group differences were found for Item 2, $H(3) = 1.29$, $p = .731$, with similarly high means in the control ($M = 4.00$, $SD = 0.158$), touch-only ($M = 4.09$, $SD = 0.13$), mind-only ($M = 4.12$, $SD = 0.17$) and mind-touch ($M = 4$, $SD = 0.14$) conditions.

5.4 Moderator analysis

5.4.1 Assumptions testing – moderator analysis

Assumptions testing for the moderator analysis revealed three outliers. Two exceeded the Mahalanobis critical value of $\chi^2(8) > 26.12$, calculated for $\alpha = .001$, as recommended in the literature (Field, 2018; Tabachnik & Fidell, 2019). The third did not exceed the Mahalanobis threshold but showed a large negative standardized residual (ZRE = -2.42) and a moderate Cook's distance (0.16). Closer inspection revealed an unusually high negative Δ*stress* value for this participant, who belonged to the control group (Δ*stress* = -43, compared to the control group mean of 6.5). Sensitivity analysis indicated substantial influence on overall model fit and interaction effects when the three cases were included. For robustness, all three outliers were excluded, resulting in a sample of N = 132. As this exclusion strategy was not preregistered, however, results for both the outlier-excluded sample and the original sample (N = 135) are reported in Appendix C.

After outlier exclusion, assumptions were reassessed. Normality was examined through a P-P-Plot and a histogram of standardized residuals, both of which indicated an accurate distribution. Additionally, a Shapiro-Wilk test was conducted that showed no significant results, $W(132) = .99$, $p = .505$, supporting normality of residuals across all four groups. Linearity was assessed via a scatterplot of standardized predicted values against standardized (studentized) residuals, which showed no deviations from linearity. Partial regression plots further confirmed linear relationships with the outcome variable for all predictors, indicating homoscedasticity. Multicollinearity indicators were beneath acceptable limits for all variables (Variance Inflation Factors [VIFs] = 1.1-4.8 and Tolerance = .2-.9). Given the experimental design, independence of errors was assumed.

5.4.2 Results – moderator analysis

The overall multiple regression model was not statistically significant, $F(8, 123) = 1.47$, $p = .175$, with predictors accounting for 10% of variance in $\Delta stress$, ($R^2 = 0.10$). None of the main effects of condition were significant. The main effect of trait self-compassion on $\Delta stress$ was significant, $B = -22.13$, $p = .038$. The covariate, stress at T0, also significantly predicted $\Delta stress$, $B = -2.38$, $p = .014$, such that lower levels of stress before the intervention were associated with larger increases in stress.

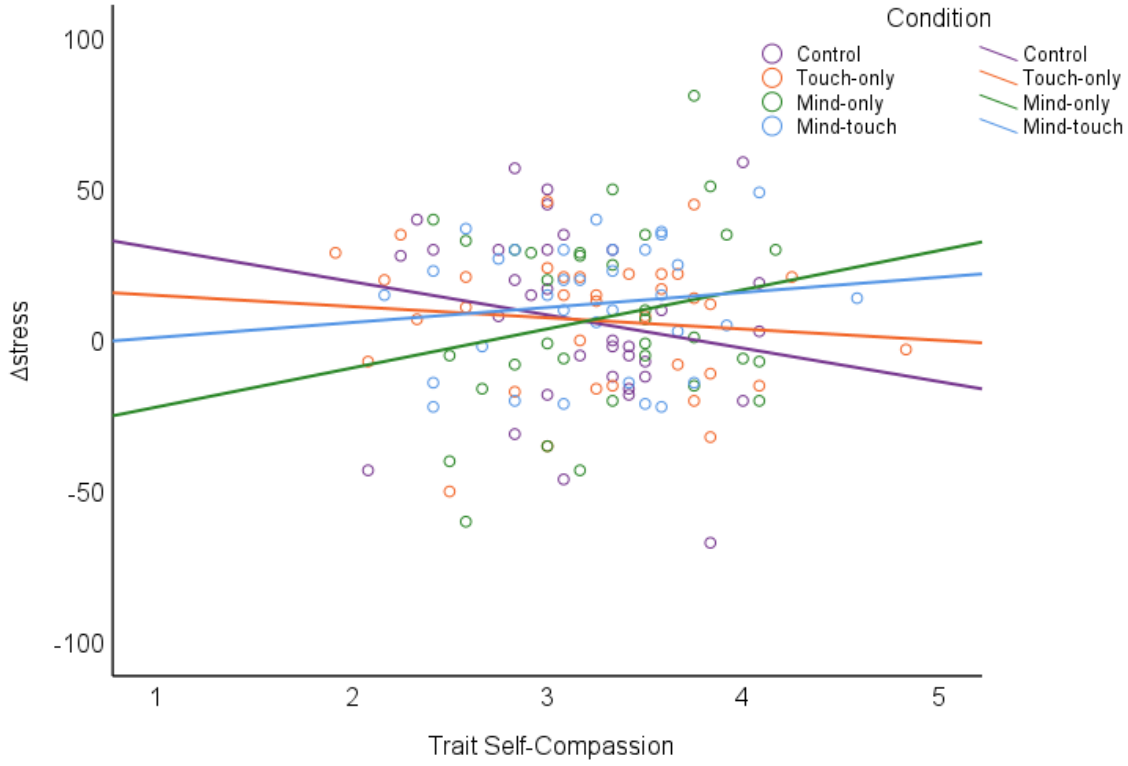
The following interactions were tested: *X1* x *trait SC* (touch-only x trait self-compassion), *X2* x *trait SC* (mind-only x trait self-compassion) and *X3* x *trait SC* (mind-touch x trait self-compassion). Two interactions were statistically significant: *X2* x *trait SC, B* = 32.61, $p = .029$, and *X3* x *trait SC, B* = 27.76, $p = .044$. Figure 3 illustrates these interactions, showing a positive direction for the mindfulness-only (X2) and the mindful-touch (X3) conditions, indicating that in these groups, increases in stress ($\Delta stress$) were higher for people who scored higher in trait self-compassion. In contrast, in the touch-only group as well as the control group, $\Delta stress$ decreased with higher trait self-compassion, although these interactions were not significant. For a better overview, the full moderation model, including direct and indirect effects, is illustrated again in Figure 4.

Despite individual significant effects, the overall interaction effect (i.e. test of highest-order unconditional interaction) was not statistically significant, $F(3, 123) = 2.00$, $p = .111$, $\Delta R^2 = 0.054$. A detailed summary of the regression results, including standard errors, t-values and confidence intervals, is presented Appendix C (Table C1).

Taken together, Hypothesis 1 was not supported by the present data. Participants with higher trait self-compassion did not show smaller increases in stress in the three experimental conditions compared to the control condition.

Figure 3

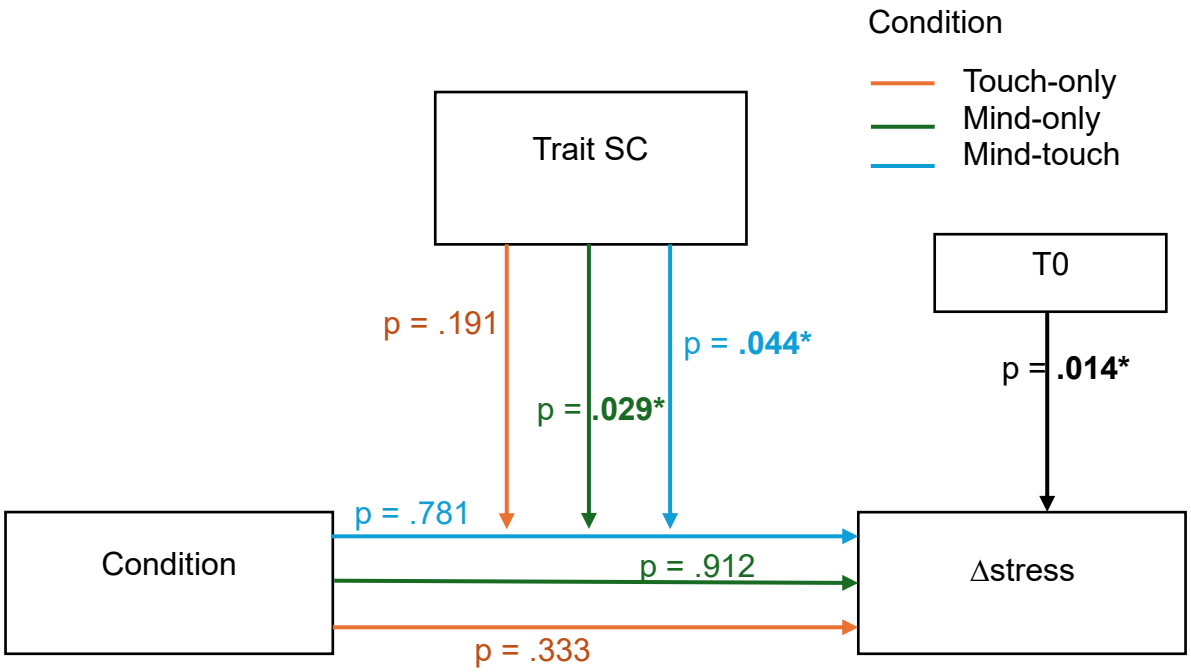
Interactions between trait self-compassion and ∆stress in each condition



Note. ∆*stress* = change in subjective momentary stress between T1 (post-intervention) and T2 (post-TSST) (T2-T1).

Figure 4

Illustration of moderator analysis



Note. Moderator effects through Trait SC represent interactions, Trait SC = state self-compassion, Δ*stress* = change in subjective momentary stress between T1 (post-intervention) and T2 (post-TSST), T0 = pre-intervention stress (covariate).
** p < .05*

5.5 Mediator analysis

5.5.1 Assumptions testing – mediator analysis

Normality of the data was assumed after inspection of P-P-Plots of standardized residuals, the histogram of standardized residuals, and a Shapiro-Wilk test, $W(135) = 0.99$, $p = .558$. Scatterplots of standardized predicted values and standardized residuals indicated linearity of the data. Partial regression plots suggested homoscedasticity, and no signs of multicollinearity were found (VIFs < 1.6 and Tolerance = .65-.97). No outliers were detected, as values were below calculated cutoffs for Cook's distance (< 1), Mahalanobis (< 26.12), leverage (h < 0.20) as well as standard deviations for residuals < |3|.

5.5.2 Results – mediator analysis

The overall model testing the total effect (path *c*) of X (intervention) on Y (Δ*stress*) was not significant, $F(3, 130)$, $p = .533$, $R^2 = .01$. Similarly, the regression model testing the direct effect (path *c'*) was also not significant, $F(3, 130) = .735$, $p =$

.533, R^2 = .01. Relative direct effects were -0.533, p = .931, for the touch-only condition, 2.661, p = .707, for the mind-only condition, and 6.775, p = .270, for the mind-touch condition. No significant indirect effects were found. Relative indirect effects were -0.044, 95% CI [-1.446, 1.462] for the touch-only condition, -0.058 95% CI [-1.468, 1.530] for the mind-only condition, and -0.155, 95% CI [-2.874, 2.388] for the mind-touch condition.

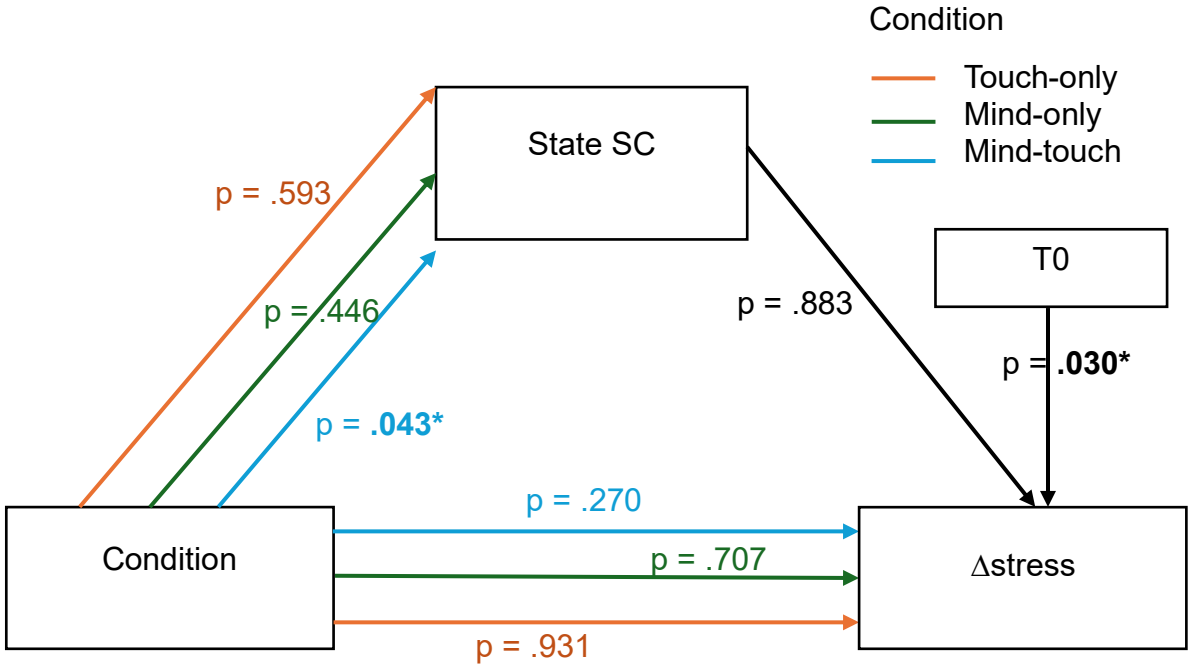
The indirect effect (*a x b*) can be broken down in paths *a* and *b*. The overall model testing path *a*, the relationship between the predictors and the mediator, was not significant, $F(4, 130) = 1.29$, p = .280, R^2 = .04. Only the mindful-touch condition (X3) showed a significant relationship with the mediator, with higher rates of state self-compassion compared to the control group, B = 0.488, p = .043. The relationship between state self-compassion and Δ*stress* (path *b*) was negative, indicating that higher rates of state self-compassion were associated with lower increases in subjective momentary stress, although this effect was not significant, B = -.32, p = .880, with a standardized coefficient indicating a negligible effect, β = –.01 (Cohen, 1988). Stress immediately prior to the intervention (T0) was included as a covariate and was significant, B = -0.22, p = .030. Figure 5 gives an illustration of the mediator model, summarizing p-values of individual paths a, b, and c' for all conditions.

Overall, including state self-compassion as a mediator, $F(5, 129) = 1.31$, p = .266, R^2 = .04 compared to the model without the mediator, $F(4, 130) = 1.60$, p = .179, R^2 = .04, did not improve model fit ($\Delta R^2 = 0$). Detailed regression results are provided in Appendix D (Table D1), along with a summary of total, direct and indirect effects (Table D2).

Taken together, Hypothesis 2 was not supported by the present data. Participants in the three experimental conditions did not show smaller increases in stress, mediated by higher intervention-induced state self-compassion, compared to the control condition.

Figure 5

Illustration of mediator analysis



Note. State SC = state self-compassion, Δ*stress* = change in subjective momentary stress between T1 (post-intervention) and T2 (post-TSST), T0 = pre-intervention stress (covariate), Condition → State SC = path *a*, state SC → Δstress = path *b*, Condition → Δstress = path *c'*.

** p < .05*

5.6 Exploratory analysis - Short-term intervention effects

As an additional exploratory analysis, short-term effects of the interventions were examined, defined as the immediate stress reduction achieved through them. A difference score was calculated to indicate change in stress from pre-intervention (T0) to post-intervention (T1). Table 2 presents descriptive statistics of these difference scores (T1-T0) for all conditions.

Table 2

Short term intervention effects (T1-T0) of each condition

Condition	*M* (*T1-T0*)	*SD*	95% CI	
			LL	UL
Control	-2.47	1.80	-6.03	1.08
Touch-only	-4.03	1.77	-7.53	-0.53
Mind-only	-11.61	1.82	-15.21	-8.00
Mind-touch	-11.79	1.82	-15.40	-8.20

Note. T1-T0 = change in stress from pre- to post-intervention, *M* = mean, *SD* = standard deviation, CI = confidence interval, LL = lower limit, UL = upper limit.

A one-way ANOVA was conducted to compare the difference scores across the four intervention conditions. The analysis revealed a significant effect, $F(3, 131) = 7.43$, $p < .001$, $f = .41$. Results of Tukey post-hoc tests are summarized in Table 3. Both the mind-only and mind-touch conditions showed significantly greater stress reduction compared to the control condition. The touch-only group did not differ significantly from the control group. Additionally, the mind-only and mind-touch conditions showed significantly greater stress reductions than the touch-only condition.

Assumption checks for the ANOVA indicated homoscedasticity (Levene's test). A Shapiro-Wilk test showed mild deviations from normality in the touch-only condition, $W(35) = .905$, $p = .006$, and the mind touch condition, $W(33) = .932$, $p = .04$. Therefore, a Kruskal-Wallis test was conducted as a robust alternative. The findings were largely consistent with the ANOVA results, except that the mind-only versus touch-only comparison was not significant, $H(3) = 29.84$, $p = .09$.

Table 3

Pairwise comparisons (Tukey HSD)

Comparison (I–J)	Mean Difference	*p*	95% CI		Cohen's *d*
			LL	UL	
Control – Touch-only	1.56	.926	–5.00	8.12	0.15
Control – Mind-only	9.14	.003*	2.48	15.80	0.93
Control – Mind-touch	9.32	.002*	2.66	15.98	0.95
Touch-only – Mind-only	7.58	.018*	0.96	14.19	0.68
Touch-only – Mind-touch	7.76	.014*	1.15	14.37	0.70
Mind-only – Mind-touch	0.18	1.000	–6.53	6.89	0.02

Note. Comparisons are expressed as Group I minus Group J (e.g., Control – Touch-only), CI = confidence interval, LL = lower limit, UL = upper limit.

* $p < .05$

6 Discussion

The present thesis examined whether the effects of a mindfulness, a self-soothing touch or a combined mindful self-soothing touch intervention on the change in subjective momentary stress (∆*stress*) following a stress-task (TSST) depend on levels of trait self-compassion as well as intervention-induced state self-compassion. It was first hypothesized that trait self-compassion would moderate the relationship between condition and ∆*stress*, such that participants with higher trait self-compassion would show smaller increases in stress in all three experimental conditions compared to the control condition. This hypothesis was not supported. Although a significant moderation effect was observed in the mindfulness and the mindful self-soothing touch conditions, the effect was contrary to expectations, with participants higher in trait self-compassion exhibiting larger increases in stress compared to the control group. For the touch-only condition, the moderation effect was in the expected direction but not significant. Second, it was hypothesized that state self-compassion would mediate the relationship between condition and ∆*stress*, such that higher state self-compassion would be associated with smaller increases in stress in the experimental conditions compared to the control condition. This hypothesis was not supported either. Neither the mediation effects nor the overall model were significant. The only significant effect was a higher level of state self-compassion for participants in the mind-touch condition. The relationship between

state self-compassion and ∆*stress* followed the expected tendency, with higher state self-compassion associated with smaller increases in stress, but this effect was not statistically significant. In addition to the confirmatory analyses, an exploratory analysis was conducted that revealed short-term stress-reducing effects of the interventions in the mind-only and the mind-touch conditions. In those conditions, stress after the intervention was significantly reduced compared to the control condition. Taken together, these results indicate that interventions achieved short-term stress-reducing effects in the mindfulness-related conditions, but buffering effects in the TSST as well as moderator and mediator effects through self-compassion remain uncertain. The following section will discuss these findings in more detail.

6.1 Main effects of intervention on stress-reactivity

The multiple regression analyses conducted revealed no significant differences in stress increase between T1 and T2 when comparing the experimental groups to the control group. Thereby, consistently no main or direct effects were found. This suggests that none of the interventions significantly buffered stress reactivity to the TSST compared to the control condition. Descriptively, all three experimental groups reported higher stress increases following the stress task than the control group. Participants in the touch-only condition showed stress responses most similar to the control group, followed by the mindfulness condition, while the mind-touch condition reported the largest stress increases. These findings are surprising given that both touch and mindfulness that have repeatedly been shown to buffer stress in previoius research (Dreisörner et al., 2021; Morton et al., 2020).

6.1.1 Measurement considerations

One possible explanation for the missing main effects may be the use of a subjective stress measure. Research has repeatedly shown a discrepancy between subjective (psychological) and objective (physiological) stress indices, such as salivary cortisol or heart rate variability (HRV) (Campbell & Ehlert, 2012; Ditzen et al., 2007; Dreisörner et al., 2021; Heinrichs et al., 2002). Subjective ratings often remain unchanged, even when physiological measures show significant variation. For example, Ditzen et al. (2007) found that physical touch from a partner significantly reduced cortisol responses to a stress task, but not self-reported stress. A similar pattern was reported in the study by Dreisörner et al. (2021), who found that self-soothing touch reduced cortisol but not self-reported stress as a response to the

TSST. Also Hellhammer & Schubert (2012) found no correlation between physiological and subjective measures of stress both before and after the TSST. This suggests that the interventions in our study may have reduced physiological stress responses without reaching conscious awareness of the participants (Ditzen et al. 2007).

6.1.2 Intervention intensity

Another explanation for the missing main effects might be that the interventions were too brief to act as stress buffers. Exploratory analyses of short-term effects showed that mindfulness and mindful self-soothing touch reduced stress levels prior to the TSST, more so than the control intervention. This indicates that both interventions functioned as *proactive* stress buffers, reducing anticipatory stress (Engert et al., 2013). However, these effects rapidly diminished once participants were exposed to the TSST, suggesting that the interventions did not serve as effective *reactive* stress buffers. Given that the TSST is a robustly strong stressor (Man et al., 2023), a single two-minute intervention may have been insufficient to withstand its effects (see also Figure 2 illustrating these dynamics).

Mindfulness and the emotional regulation achieved through it are generally understood as skills that need to be trained (Kabat-Zinn, 2015). Mindfulness-based programs usually span several weeks, like the MBSR with a duration of 8 weeks, including weekly 2.5-hour sessions, a full day silent retreat and daily 45-minute home practice (Kabat-Zinn, 1990). Also, single sessions within different MBIs typically last at least 5 minutes, compared to 2 minutes in our study (Morton et al. 2020). Research shows that positive mental health outcomes, such as reductions in depression, stress and anxiety, increase with both the quality and duration of mindfulness practice (Goldberg et al., 2019).

Similarly, studies examining mindfulness or self-compassion in acute stress situations usually include more than one training session. For example, Arch et al. (2014) tested effects of brief self-compassion training (SCT) where participants first followed a 10-minute self-focused loving kindness meditation, followed by three days of home-practice before undergoing the TSST. The authors found reduced physiological stress responses and state anxiety compared to controls, as well as increased state and trait self-compassion. Other studies even used the full 8-week MBSR program before testing stress reactivity to the TSST (e.g. Nyklíček et al., 2013).

Also self-soothing touch could require practice to reliably buffer stress in acute stress situations. A recent meta-analysis of social touch interventions revealed a median touch duration across studies of 20 minutes, with an average of four sessions at 2.3-day intervals (Packheiser et al., 2024). Their results indicated that mental health benefits of social touch of different forms increase with repetition. Given the parallels between social and self-touch (Eckstein et al., 2020), similar mechanisms might apply. Susman et al. (2024) supported this idea, showing positive effects of self-guided micropractice of self-compassionate touch on perceived stress, but only for participants engaging in near-daily practice. More frequent practice promoted greater benefits and also stronger habit-formation, suggesting that self-compassionate touch relies on practice and habit. This aligns with research about spontaneous self-touch, which appears to regulate emotion most effectively among individuals who touch themselves frequently (Spille et al, 2022).

Taken together, the findings suggest that our study may have required longer and repeated practice sessions to observe significant stress-buffering effects in any of the experimental conditions.

6.1.3 Social touch versus self-touch

Evidence for the effects of self-touch on the reactivity to acute stressors is still limited. Our hypotheses about the effectiveness of self-soothing touch were grounded in the well-documented stress-buffering effects of social touch, and in findings that spontaneous self-touch gestures as well serve self-regulatory functions (Grunwald et al., 2014; Field, 2019). Despite the similarities between social touch and self-touch mentioned, differences between the two could explain missing main effects in the present study.

Compared to social touch, self-soothing touch lacks the component of social support, and may therefore communicate less safety (Eckstein et al., 2020). Moreover, interpersonal touch seems to be perceived as more pleasant than self-touch (Guest et al., 2008), which may limit the latter’s efficacy. Neuroimaging evidence further suggests divergent mechanisms: social touch deactivates brain regions involved in self-related processes, while self-touch activates them (von Au et al., 2024). This implies that social touch may function as a distractor, orienting individuals outward, whereas self-touch heightens self-focus, including attention to stress-related thoughts and emotions. In the context of an acute stressor, this self-focus may undermine the buffering potential of self-touch.

6.2 Short term stress-reducing effects

While the main analyses revealed no overall stress-buffering effects of the experimental interventions, the exploratory analysis showed significant short-term stress-reducing effects for the mind-only and the mind-touch interventions. As mentioned in the previous section, this indicates that, while none of the interventions served as reactive stress-buffers, the mindfulness-related conditions effectively served as proactive stress-buffers, reducing anticipatory stress (Engert et al., 2013). This is in line with previous research showing reductions of anticipatory stress through brief mindfulness interventions (Colgary et al., 2020). The touch-only intervention, however, was less effective than both the combined intervention and the mind-only interventions in reducing stress, and not more effective than the control intervention. This suggests that mindfulness was likely the driving factor behind these short-term stress-reducing effects.

While mindfulness – at least in short-term practice – appears to operate via top-down processes, reducing stress through emotional regulation (Chiesa & Jakobsen, 2013), self-soothing touch seems to act via bottom-up processes, directly regulating sensory-affective experiences (Spille et al., 2022). Combining the two was suggested as a way to engage both pathways (Kirschner et al., 2019), although in our study a combination of the two practices only achieved additional benefits compared to self-touch alone, but not compared to mindfulness alone.

Research further indicates that mindfulness helps bring attention to the present moment, fostering a nonjudgmental, accepting attitude towards personal thoughts and feelings (Kabat-Zinn, 1990). Self-touch appears to increase self-focused processes as well, but while some studies suggest attentional and emotional regulation through self-touch (Spille et al., 2022), others suggest a distraction from the present moment (von Au et al., 2024). This indicates that mindfulness and self-soothing touch may rely on partly different mechanisms, which could explain why mindfulness-related interventions functioned better as proactive stress-buffers than self-touch in our study. However, these mechanisms remain unclear and require further research.

Finally, it is important to mention that the manipulation check indicated relatively high levels of intervention-induced state-mindfulness, with no significant differences between conditions ($M > 4$ among all conditions and both items). Rather than reflecting equally mindfulness-inducing interventions, this pattern likely resulted

from limited sensitivity of the two items, as the strong skew toward the upper end of the scale suggested possible ceiling effects. Consequently, the interpretability of the measure is restricted.

6.3 The role of self-compassion in the stress-buffering effect

6.3.1 Moderation through trait self-compassion

The overall moderation model was not significant, with a small-to-medium effect size (Cohen, 1988). This is consistent with Arch et al. (2016), who reported no moderating role of trait self-compassion in the effectiveness of a brief self-compassion meditation training on physiological stress response and state anxiety during the TSST. However, simple interaction tests for the mindfulness-only and mindful self-soothing touch conditions reached significance. Given the weak overall model fit and small effect sizes, suggesting that the interactions did not explain a significant amount of variance in the outcome, the following interpretations should be regarded with caution, though.

In the touch-only condition, the moderating effect of trait self-compassion was not significant, but the direction was as hypothesized: higher trait self-compassion was associated with smaller increases in stress during the TSST. This effect was, however, comparable to slightly weaker than in the control group. By contrast, simple interaction effects in the mind-only and mind-touch conditions were significant, suggesting that only in the mindfulness-related conditions the effectiveness of the interventions depended on participants' levels of trait self-compassion. Unexpectedly, these effects were in the opposite direction to what had been hypothesized. Participants with higher trait self-compassion that received a mindfulness or a mindful self-soothing touch intervention reacted more sensitively to the TSST, exhibiting greater increases in stress. This is contrary to findings that generally indicate a positive relationship between trait self-compassion and stress coping (Arch et al., 2014; Neff, 2003a; Neff et al. 2015).

Although previous research generally suggests a stress-buffering effect of self-compassion, the present results raise the possibility that, in the context of mindfulness interventions, self-compassion may heighten vulnerability to acute stressors. People high in self-compassion are more attuned to their emotional state and more willing to confront negative thoughts and feeling (Feldman & Kuyken, 2019; Neff, 2003a). A mindfulness intervention specifically directs attention to such inner experiences as part of present-moment awareness (Bishop et al., 2004). In this

way, mindfulness may further amplify awareness of emotional processing, making stress-responses more noticeable for self-compassionate individuals. This opens the possibility that participants in our study may not have been more stressed physiologically, but more consciously aware of their internal distress. For these individuals, a neutral task (such as building a paper plane in the control condition) or a self-touch exercise may have buffered stress better by providing distraction rather than heightened awareness of both the stressor and their internal distress.

This interpretation is consistent with research showing that mindfulness increases interoceptive awareness but does not automatically foster non-reactivity or acceptance. For example, Bornemann et al. (2015) found that mindfulness enhances sensitivity to bodily sensations without necessarily enhancing non-worrying. This suggests that mindfulness interventions need a component of affective training additionally to training of interoceptive awareness. Consistent with that, Joshi et al. (2021) suggest that increased interoceptive awareness may exacerbate emotional distress on the short term when not combined with an accepting, non-reactive attentional style. In programs such as the MBSR, participants are taught non-judgmental and accepting attitudes toward present-moment sensations, which facilitate long-term emotion regulation and stress reduction (Kabatt-Zinn, 1990; Bishop et al., 2004). By contrast, the brief mindfulness intervention in the present study did not emphasize acceptance and hence might have heightened awareness of personal distress.

These interpretations remain speculative, especially given the weakness of the moderation effects. Furthermore, the present analyses focused on stress reactivity, while recovery during the cool-down phase was not examined. It is possible that highly self-compassionate participants showed stronger immediate stress reactivity but also faster recovery after the stressor. Research indicates that self-compassion is associated with aspects of emotional regulation such as reduced rumination and lower self-criticism (Ferrari et al., 2018; Leary et al., 2007), both of which seem to buffer a prolonged stress-response after a stressor, meaning quicker emotional recovery (Leary et al., 2007).

Finally, power considerations further help explaining the present findings. A post hoc power analysis for the interaction block (three interaction terms) indicated achieved power of 0.63 (ΔR^2 = 0.05, f^2 = 0.060, N = 132, α = .05), which falls below the conventional .80 threshold. In line with that, a sensitivity analysis showed that, with

N = 132, α = .05, three tested predictors, and eight total predictors, the study could reliably detect effects of $f^2 = 0.085$ or larger, corresponding to a minimum detectable ΔR^2 of 0.08. This indicates that the study was underpowered to reliably detect a moderator block of the observed effect size.

6.3.2 Mediation through state self-compassion

The second hypothesis proposed that the experimental interventions would induce a state of self-compassion that in turn would buffer the stress response to the TSST. This was not supported by our results. The mediation analysis did not reach statistical significance, and the overall model accounted for only a small proportion of variance ($R^2 = 0.04$), suggesting that any effects are likely to be small in magnitude (Cohen, 1988).

Few studies have examined self-compassion as a mediator within mindfulness-based programs. Kuyken et al. (2010) found that reduction in depressive symptoms and risk of relapse for participants receiving Mindfulness-Based Cognitive Therapy (MBCT) was mediated by self-compassion. Similarly, Davis et al. (2024) and Gu et al. (2015) previously identified self-compassion as a mediator of mental-health improvements in mindfulness-programs. Among self-touch interventions, the study of Susman et al., (2024) previously showed that brief daily self-touch practices increased state self-compassion over one month, co-occurring with reductions in stress and negative affect.

However, a systematic review and meta-analysis by Golden et al., (2021) exploring self-compassion as a mechanism of change in mindfulness-bases programs showed mixed or non-significant mediation effects in some studies (e.g., Bergen-Cico & Cheon, 2014) as well as methodological limitations. Empirical research on mediation effects in self-touch contexts is even more scarce. In addition to the scarcity and heterogeneity in findings (Golden et al., 2021), differences in study design make it hard to relate our findings to previous research. Whereas the studies mentioned used multiple-week interventions and looked at long-term health outcomes, our study tested effects of a single-session intervention in buffering stress response to an acute stressor. Luo et al. (2018) for example used cold pain exposure and reported lower physiological stress (higher HRV) and reduced pain ratings as a response for individuals undergoing a compassionate self-talk protocol. However, no other studies so far have directly investigated mediator effects on stress reactivity in an acute stress context like the TSST.

Although path *a* for the combined intervention (X3) reached significance, the relative indirect effects (*a x b*) for all three experimental conditions remained non-significant. This suggests that state self-compassion played a negligible role in mediating the relationship between condition and change in subjective momentary stress. The lack of mediation may be a result of inconsistent mediation – opposing directions of paths *a* and *b,* meaning that condition was positively correlated with state self-compassion, while state self-compassion was negatively correlated with ∆*stress*. More probably however, it was due to the weakness of the two paths, particularly path *b*, which was close to zero and thereby negligible (Cohen, 1988).

A look at the individual relationships between intervention, state self-compassion and ∆*stress* for each condition provides further insights. Correlations between condition and state self-compassion (path *a*) for example were not significant for the touch-only and the mind-only conditions, suggesting that the interventions in these conditions did not meaningfully increase state self-compassion compared to the control exercise. Average state self-compassion levels of 3.3 (control), 3.4 (touch-only) and 3.5 (mind-only) reflect only medium levels. In contrast, with an average of 3.8 the combined intervention yielded significantly higher state self-compassion. However, the difference compared to the control condition ($\Delta = 0.5$) remains small, so conclusions should be drawn cautiously.

One reason why only the combined intervention successfully promoted self-compassion could be that it closely resembled self-compassion exercises used in established programs. For example, “self-compassionate touch” in the study of Susman et al. (2024) involved placing one hand on the heart and one on the abdomen, as in our study. Participants were instructed to imagine a recent failure, notice emotions and bodily sensations arising with it, and to meet those feelings with warmth and kindness towards oneself, as if being their own friend. Instructions in our intervention did not explicitly include aspects of self-compassion but focused instead on mindfulness. Nevertheless, mindful self-soothing touch in our study may have most closely resembled the self-compassionate touch practice in Susman et al. (2024), which effectively increased self-compassion when practiced almost daily.

Pure self-soothing touch, in contrast, may not inherently induce self-compassion. Programs such as MSC typically include an introduction into self-compassion as a concept (Neff & Germer, 2013). Self-soothing touch techniques within those programs and techniques suggested for at-home training also explicitly

invite to cultivate self-compassion (Neff & Germer, 2013; Neff & Germer, 2019). For example, a supportive touch practice within a MSC program, as proposed by Neff & Germer (2019), invites participants to feel compassion with themselves by saying phrases to themselves like “May I be kind to myself” or “May I give myself the compassion I need”. This may explain why the self-soothing touch interventions in our study, which did not explicitly address self-compassion, did not significantly promote feelings of self-compassion.

Like self-soothing touch, also mindfulness may not automatically increase self-compassion. Although related, the two are regarded as distinct constructs (Neff & Germer, 2013). Research shows that programs explicitly targeting self-compassion like the MSC tend to produce stronger gains in self-compassion compared to classical mindfulness programs (e.g., MBSR) (Crego et al., 2025; Neff & Germer, 2013), However, other studies find comparable increases (Golden et al., 2020).

Another finding was that state self-compassion was negatively, though not significantly, correlated to $\Delta stress$, suggesting a trend for higher state self-compassion to buffer stress reactivity. This non-significant trend may have been influenced by using a difference score as the outcome variable. Difference scores show reduced reliability and statistical power, making it harder to detect an existing mediation effect (Cronbach & Furby, 1970; Rogosa & Willett, 1983). Also, detecting indirect effects generally requires larger sample sizes than direct effects (Fritz & MacKinnon, 2007). Finally, subjective measures of emotional experience are more susceptible to noise due to high inter-individual variability, increasing the risk of Type II errors (Kashdan & Rottenberg, 2010).

Finally, a post hoc power analysis based on the observed effect size (f^2 = .043, N = 135, α = .05) indicated that the study had limited statistical power (~40%). In line with this, a sensitivity analysis indicated that, with five predictors, the study could reliably detect effects of $f^2 \approx 0.10$ or larger. Together, these analyses highlight that smaller effects may have been missed, suggesting that a larger sample would have been needed to reliably detect them.

6.4 Limitations

In addition to the statistical considerations above, several limitations should be noted. As mentioned, with a sample size of N = 135, the study likely lacked sufficient power to detect moderator and mediator effects in multiple regression analyses. Furthermore, the sample was relatively homogenous – mainly students aged 20-25

years old – and multiple exclusion criteria were applied, reducing generalizability of our study.

Some limitations regard the measures used in the study. As noted earlier, using the VAS as a subjective measure of stress has advantages but also drawbacks. The VAS is widely used because of its simplicity in application and general reliability and validity (Lesage et al., 2012). However, it carries the risk of certain biases. For instance, ratings may be influenced by interindividual differences in interpreting the scale or by expectancy (demand) effects, meaning that participants may have rated stress higher simply because they assumed the task was designed to induce stress (Lesage et al., 2012; Hellhammer & Schubert, 2012). Furthermore, according to Hellhammer & Schubert (2012), stress ratings during the TSST are significantly higher than ratings right after the task, suggesting that post-stressor ratings, as used in our study, may not reliably capture stress reactivity.

Self-compassion as a trait was assessed through the SCS-D short form (Hupfeld & Ruffieux, 2011). As a German adaptation of the 12-item Self-Compassion Scale – Short Form (SCS-SF; Raes et al., 2011) it widely mirrors the original version, though including minor linguistic adaptations and item substitutions to improve psychometrics in German samples. This could potentially affect factor structure and cross-cultural comparability. Moreover, a recent large-scale study showed high reliability across gender and age for the SCS-SF, but only partial scalar invariance across countries (Swami et al., 2025). The authors recommended an adaptation to an 11-item, two-factor model (SCS-11). Thus, while use of the 12-item SCS-D short form may align with standard practice in German samples, it may not fully reflect emerging best practices for cross-cultural analyses.

State self-compassion was assessed using the single-item measure “I have high self-compassion” (Zhang et al., 2022), which has shown acceptable temporal stability and convergent validity, but cannot provide information on internal consistency or factorial structure. Because we used a German translation of this item, for which no psychometric evaluation is currently available, its reliability and validity in our sample remain uncertain. Moreover, several participants reported difficulties understanding the term self-compassion (*Selbstmitgefühl*), either during the assessment or in the debriefing, suggesting that participants’ understanding of the concept may have been limited, potentially biasing results.

Another limitation is that perceived pleasantness of the interventions was not assessed. Pleasantness is regarded an important factor in the stress-reducing effect of physical touch (Eckstein et al. 2020). Since it was not assessed in our study, it remains unclear whether the interventions were perceived as pleasant, leaving open the possibility that this could have influenced the results. In fact, the type of touch applied in our interventions may have influenced the hedonic experience. While dynamic stroking optimally stimulates CT-afferents and is strongly associated with hedonic pleasure and oxytocin release (Ali et al., 2023; von Au et al., 2024), static touch as applied in our study has been shown to buffer stress as well, but does not optimally engage CTs and its hedonic experience is rated as less high, or varies more depending on individual preferences (Ali et al., 2023).

In addition, our design did not control for motivational factors. Some participants may not have been fully engaged in the interventions, either due to individual situational factors or, since we excluded participants with prior mindfulness experience, because of a lack of interest in meditation practices alike. The remuneration of 50€ may also have been a stronger motivator than genuine interest in the study. Taken together, these factors could have led to low participant engagement, which is known to threaten the validity of experimental findings (Nichols & Edlund, 2015).

Finally, laboratory experiments are generally associated with limited ecological validity (Anderson & Bushman, 1997). The artificiality of the laboratory setting may have influenced both participants' responses to the stressor and their experience of the interventions. As a result, the outcomes may not adequately reflect stress reactivity in everyday life.

Taken together, these limitations highlight important challenges in studying stress-buffering interventions. At the same time, they point towards valuable opportunities for future research.

6.5 Future directions

Connecting to the limitations mentioned, some possibilities for future research can be mentioned.

Evidence of training effects suggest that future interventions may benefit from multiple in-lab sessions or multiple days of home-practice following an initial session before going through a stress test (Arch et al., 2014; Packheiser et al., 2024). Generally, looking at repeated practice will be an important direction for future

research. For single-session interventions, at least the intervention-stressor relationship should be adapted, either by increasing intervention duration and quality or by using a less severe stressor than the TSST.

To ensure intervention efficacy, future studies should also assess participants' motivational disposition and perceived pleasantness of the intervention. As hedonic experience has shown to be higher for dynamic forms of touch compared to static touch (Ali et al., 2023) and hedonic experience seems to be a primary contributor to the stress-reducing effects of touch (Eckstein et al., 2020), future research should further compare effectiveness of these different forms.

At-home practice may provide a more naturalistic setting, making participants feel less observed and enhancing participant engagement. However, studies often show that only a small percentage of participants remain engaged in home-practice (Parsons et al., 2017). If evidence increases that self-soothing touch and mindfulness profit from habitual practice, future research should try to identify perceived barriers to engagement. This knowledge could inform strategies such as mobile applications with reminders to support regular practice, benefiting both research compliance and public health outcomes.

The timing of stress measurement is another important consideration. As noted, stress assessed after a task may differ substantially from stress experienced during task performance, potentially misrepresenting stress reactivity (Hellhammer & Schubert, 2012). Future studies should therefore explore ways to capture perceived stress in real time, acknowledging the challenges of subjective measurement compared to physiological stress measures such as HRV. They should also investigate proactive versus reactive stress reactions. More generally, research should continue comparing psychological and physiological stress, as research indicates a divergence between the two measures (e.g., Ditzen et al., 2007).

Moreover, to better understand the role of self-compassion in the relationship between self-touch or mindfulness and stress reactivity, its assessment may need refinement, both as a trait and as a state variable. Further research on the SCS-D short version is warranted, potentially adapting it for better cross-cultural comparability (Swami et al., 2025). In addition, state self-compassion should ideally be measured with multiple items covering different facets and explicitly explaining the concept, thereby improving comprehension and measurement validity. For future studies, it may also be valuable to evaluate the mindfulness-inducing potential of

interventions. As the manipulation check in our analysis indicated ceiling effects for the two items assessing state mindfulness, future studies are advised to use a different measurement.

Finally, it is important to understand the mechanism behind mindfulness and self-soothing touch – the bottom-up and top-down mechanisms involved and how they might differ between mindfulness and self-soothing touch practices. This could also help understanding the role of self-compassion within their stress-buffering effects.

Overall, more research is needed on the effects of both mindfulness and self-soothing touch in acute stress situations and self-compassion as a mechanism.

7 Conclusion

The present study investigated the moderating and mediating role of self-compassion in the stress-buffering effects of mindfulness, self-soothing touch and mindful self-soothing touch. The results of our study do not allow for clear conclusions about the effectiveness of the interventions or of the role of self-compassion within these effects. Overall, no significant buffering effects were found across intervention conditions, nor were consistent moderation or mediation effects through self-compassion observed. Only isolated effects emerged, including an increase in state self-compassion through the mind-touch intervention and moderation by trait self-compassion in the two mindfulness-related conditions. However, exploratory analyses revealed short term stress-reducing effects in the mind-only and mind-touch conditions, suggesting that mindfulness may have been the driving source of these effects.

Taken together, these findings indicate that the mindfulness-related interventions reduced stress temporarily, but contrary to prior research, effects did not persist during the TSST. Apart from isolated effects, overall support for moderation or mediation effects through self-compassion was insufficient.

Possible explanations include differences between subjective and physiological stress measures, and methodological as well as statistical limitations. Most of all, it seems that both mindfulness and self-touch may rely on both quantity and quality of practice, with better outcomes when practicing repeatedly and with an explicit focus on acceptance and self-compassion. Therefore, the single-session two-

minute interventions in our study may have been insufficient to exert reliable stress-buffering effects.

Our results also suggested that the mind-touch intervention indeed promoted a stronger sense of self-compassion, but while this did not buffer stress increases during the TSST, results of the moderator analysis even raised the possibility that higher trait self-compassion could make more susceptible to stronger stress reactivity. However, no clear conclusions can be drawn as the role of self-compassion in the stress-buffering effects of mindfulness and self-touch remains insufficiently explored.

To investigate if, as hypothesized, self-compassion could instead act as a facilitator in mindfulness- and self-touch practices, interventions may need to be refined and self-compassion as a concept as well as its assessment should be further studied. Future research should also examine long-term, repeated applications of mindfulness and self-touch practices. Finally, studies should use larger samples to examine moderation and mediation effects and investigate how different top-down and bottom-up mechanisms contribute to stress reduction.

Despite the lack of significant effects, the study highlights the complexity of stress-buffering mechanisms and identifies key directions for advancing research on the interplay between mindfulness, self-soothing touch, and self-compassion in stress-reduction. Ultimately, this line of work could help inform the development of accessible and effective interventions to reduce stress in everyday life.

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List of Abbreviations

ACH	adrenocorticotropic hormone
APA	American Psychological Association
CBT	Cognitive Behavioral Therapy
CFT	Compassion-Focused Therapy
CRH	corticotropin-releasing hormone
CTs	C-tactile afferents
dlPFC	dorsolateral Prefrontal Cortex
EEG	electroencephalography
HPA	hypothalamic-pituitary-adrenal
HRV	heart rate variability
MBCT	Mindfulness-Based Cognitive Therapy
MBI	mindfulness-based intervention
MSC	Mindful Self-Compassion
MBSR	Mindfulness-Based Stress Reduction
OFC	Orbitofrontal Cortex
PFC	Prefrontal Cortex
PSS	Perceived Stress Scale
PVN	Paraventricular Nucleus
SAM	Sympathetic adreno-medullary
SC	self-compassion
SCS	Self-Compassion Scale
SCS-D	Self-Compassion Scale Deutsche Kurzform
SCS-SF	Self-Compassion Scale Short Form
sFST	spontaneous facial self-touch
TSST	Trier Social Stress Test
VAS	visual analog scale

Appendix A: Intervention instructions

Versuchsleitung (VL): “Jetzt werden Sie noch eine Unterstützungsmaßnahme erhalten. Ich bitte Sie, sich darauf einzulassen und teilzunehmen.
Um die Unterstützungsmaßnahme durchzuführen, ziehen Sie bitte nun einen Zettel aus dieser Box.”
[VP zieht Unterstützungsmaßnahme und liest sie vor]

Mindful self-soothing touch condition

VL spricht ruhig und klar und lässt ausreichend Pausen (min. 10 s) zwischen den Sätzen. VL zeigt die Maßnahmen auch vor.
VL: “Ich erkläre Ihnen nun die Unterstützungsmaßnahme und zeige Sie Ihnen auch vor. Bitte machen Sie mir nach.
Nehmen Sie eine bequeme Körperhaltung ein. Legen Sie Ihre linke Hand auf den Bauch und die rechte Hand auf die Brust, auf der Höhe Ihres Herzens.
Schließen Sie nun Ihre Augen.”
[VL stoppt die Zeit mit dem Handy]
[Pause]
VL: “Spüren Sie den Druck Ihrer Hände und die Wärme der Berührung.“
[Pause]
VL: “Spüren Sie, wo Ihre Hände Ihren Körper berühren.”
[Pause]
VL: “Fühlen Sie, wie sich für Sie die Berührung anfühlt.”
[Pause]
VL: “Wenn Sie abgelenkt sind, kehren Sie gedanklich wieder zu der Berührung zurück. Konzentrieren Sie sich ganz auf sich selbst und Ihre Berührung.”
[VL wartet bis 2 Minuten vergangen sind]
VL: “Bitte öffnen Sie nun Ihre Augen. Sie können die Hände wieder so legen, wie Sie möchten.”
[Pause]
VL: “Nun bitte ich Sie, den vorliegenden Fragebogen am Computer auszufüllen, dann machen wir mit dem Interview weiter.”
[VP füllt Fragebögen und Manipulationschecks aus]
VL: “Nun kommen Sie bitte mit."
[VL führt VP in den Interviewraum]

Self-soothing touch only condition

VL spricht ruhig und klar und lässt ausreichend Pausen zwischen den Sätzen. VL zeigt die Maßnahmen auch vor.
VL: “Ich erkläre Ihnen nun die Unterstützungsmaßnahme und zeige Sie Ihnen auch vor. Bitte machen Sie mir nach.
Nehmen Sie eine bequeme Körperhaltung ein. Legen Sie Ihre linke Hand auf den Bauch und die rechte Hand auf die Brust. Bitte halten Sie diese Position für eine Weile ein. Ich gebe Ihnen Bescheid, wenn wir weitermachen.”
Falls Nachfrage bzgl Augen schließen kommt: “Das überlasse ich Ihnen.”
[VL kontrolliert, ob die VP die demonstrierte Haltung eingenommen hat und beibehält]
[VL stellt kein Augenkontakt dar und richtet “Konzentration” auf das Manual/ Versuchsprotokoll vor sich auf den Tisch]
Falls Positionswechsel: “Bitte nehmen Sie wieder die demonstrierte Position ein.”
[VL stoppt die Zeit mit dem Handy]
[VL wartet bis 2 Minuten vergangen sind]
VL: “Sie können die Hände wieder so legen, wie Sie möchten.”
Pause.
VL: “Nun bitte ich Sie, den vorliegenden Fragebogen am Computer auszufüllen, dann machen wir mit dem Interview weiter."
[VP füllt Fragebogen und Manipulationscheck aus]
VL: “Nun kommen Sie bitte mit.”
[VL führt VP in den Interviewraum]

Mindfulness-only condition

VL spricht ruhig und klar und lässt ausreichend Pausen zwischen den Sätzen. VL zeigt die Maßnahmen auch vor.
VL: “Ich erkläre Ihnen nun die Unterstützungsmaßnahme und zeige Sie Ihnen auch vor. Bitte machen Sie mir nach. Legen Sie Ihre Arme so wie ich auf die Lehnen des Sessels.”
Schließen Sie nun Ihre Augen.”
[VL stoppt die Zeit mit dem Handy]
[Pause]
VL: “Atmen Sie ruhig ein und aus.“
[Pause]
VL: “Versuchen Sie ganz normal zu atmen. Spüren Sie Ihren Atem.”

[Pause]

VL: “Fühlen Sie, wie sich für Sie die Atmung anfühlt und wie Sie entspannen.”

[Pause]

VL: “Fühlen Sie, wie sich Ihre Brust durch Ihren Atem ganz natürlich hebt und senkt.”

[Pause]

VL: “Wenn Sie abgelenkt sind, kehren Sie gedanklich wieder zu Ihrer Atmung zurück. Konzentrieren Sie sich ganz auf sich selbst und Ihre Atmung.”

[VL wartet bis 2 Minuten vergangen sind]

VL: “Bitte öffnen Sie nun Ihre Augen.”

Control condition

[VL legt ein Blatt Papier für die VP auf den Tisch vor die VP]

VL: “Ich erkläre Ihnen nun die Unterstützungsmaßnahme. Nehmen Sie eine bequeme Körperhaltung ein.”

[VL gibt der VP ein Blatt Papier]

VL: “Bauen Sie nun aus diesem Blatt einen Papierflieger. Sie haben zwei Minuten Zeit. Das Ergebnis hat keine Auswirkungen auf das Interview.”

[VL stoppt die Zeit mit dem Handy]

[VL wartet bis 2 Minuten vergangen sind]

VL: “Die zwei Minuten sind jetzt um.”

Appendix B: SCS-D Short Form

This appendix reproduces the questionnaire assessing trait self-compassion in our study. Items used represent the German short form of the Self-Compassion Scale (SCS-D-Kurzform), as developed and validated by Hupfeld and Ruffieux (2011). The items are translated from the English short form of the Self-Compassion Scale by Raes et al. (2011), which is rooted in the original scale by Neff (2003). The German short form is freely available for research purposes.

Note: In the present study, the response options were adapted from the original scale (1 = *sehr selten*; 2 = *selten*; 3 = *gelegentlich*; 4 = *oft*; 5 = *sehr oft*) to the following: 1 = *fast nie*, 2 = *selten*, 3 = *weder noch*, 4 = *häufig*, 5 = *fast immer*

Instruction:

Jetzt geht es darum, wie du dich dir selbst gegenüber in schwierigen Situationen verhältst. Bitte lies dir jede Aussage sorgfältig durch, bevor du sie beantwortest. Dann kreuze an, wie oft du dich in der beschriebenen Weise verhältst.

(1 = fast nie; 2 = selten; 3 = weder noch; 4 = häufig; 5 = fast immer)

1 Wenn ich bei etwas versage, was mir wichtig ist, werde ich von Gefühlen der Unzulänglichkeit aufgezehrt.

2 Ich versuche verständnisvoll und geduldig gegenüber jenen Zügen meiner Persönlichkeit zu sein, die ich nicht mag.

3 Wenn etwas Unangenehmes passiert, versuche ich einen ausgewogenen Überblick über die Situation zu erlangen.

4 Wenn es mir schlecht geht, neige ich dazu zu glauben, dass die meisten anderen Menschen wahrscheinlich glücklicher sind als ich.

5 Ich versuche, meine Fehler als Teil der menschlichen Natur zu sehen.

6 Wenn ich eine sehr schwere Zeit durchmache, schenke ich mir selbst die Zuwendung und Einfühlsamkeit, die ich brauche.

7 Wenn mich etwas aufregt, versuche ich meine Gefühle im Gleichgewicht zu halten.

8 Wenn mir etwas für mich Wichtiges misslingt, glaube ich oft, dass nur ich allein versage.

9 Wenn ich mich niedergeschlagen fühle, neige ich dazu nur noch auf das zu achten, was nicht in Ordnung ist.

10 Wenn ich mich auf irgendeine Art unzulänglich fühle, versuche ich mich daran zu erinnern, dass die meisten Leute solche Gefühle der Unzulänglichkeit haben.

11 Ich missbillige und verurteile meine eigenen Fehler und Schwächen.

12 Ich bin intolerant und unduldsam gegenüber denjenigen Seiten meiner Persönlichkeit, die ich nicht mag.

Appendix C: Results of moderator analysis

Table C1

Multiple Regression Results for Moderation Model Predicting ∆stress with N = 132

Predictor	*B*	*SE*	*t*	*p*	95% CI	
					LL	UL
Constant	18.44	5.82	3.17	.002	6.92	29.95
X1	-1.63	5.84	-0.28	.781	-13.18	9.92
X2	0.76	6.88	0.11	.912	-12.85	14.32
X3	5.74	5.91	0.97	.333	-5.95	17.44
trait SC	-22.13	10.57	-2.09	.038	-43.05	-1.20
X1 × trait SC	16.34	12.44	1.31	.191	-8.28	40.97
X2 × trait SC	32.61	14.74	2.13	.029*	3.44	61.79
X3 × trait SC	27.76	13.65	2.03	.044*	0.74	54.78
T0	-0.24	0.10	-2.48	.014*	-0.43	-0.05

Note. These are the results for the sample excluding outliers. B = unstandardized regression coefficient, SE = standard error, CI = confidence interval, LL = lower level, UL = upper level, X1 = touch-only, X2 = mind-only, X3 = mind-touch, trait SC = trait self-compassion (moderator), T0 = stress prior intervention (covariate).

* $p < .05$

Table C2

Multiple Regression Results for Moderation Model Predicting ∆stress with N = 135

Predictor	*B*	*SE*	*t*	*p*	95% CI	
					LL	UL
Constant	15.9	6.02	2.65	.009	4.01	27.81
X1	.09	6.03	0.02	.988	-11.84	12.03
X2	2.8	7.08	0.39	.693	-11.21	16.8
X3	7.34	6.04	1.22	.226	-4.6	19.29
trait SC	-12.29	12.4	-0.99	.323	-36.79	12.2
X1 × trait SC	5.78	13.47	0.43	.669	-20.87	32.43
X2 × trait SC	22.91	16.07	1.43	.157	-8.89	54.71
X3 × trait SC	15.97	14.12	1.13	.260	-11.97	43.91
T0	-0.23	0.09	-2.35	.020*	-0.41	-0.04

Note. These are the results for the sample including outliers. B = unstandardized regression coefficient, SE = standard error, CI = confidence interval, LL = lower level, UL = upper level, X1 = touch-only, X2 = mind-only, X3 = mind-touch, trait SC = self-compassion (moderator), T0 = stress prior intervention (covariate).

* $p < .05$

Appendix D: Results of mediator analysis

Table D1

Multiple Regression Results for Mediation Model

Path	*B*	*SE*	*t*	*p*	95% CI	
					LL	UL
a1 (X1 → M)	0.14	0.26	0.54	.593	-0.37	0.65
a2 (X2 → M)	0.18	0.24	0.76	.446	-0.29	0.65
a3 (X3 → M)	0.49	0.24	2.04	.043*	0.02	0.96
b (M → Y)	-0.32	2.15	-0.15	.883	-4.56	3.93
c'1 (X1 → Y)	-0.53	6.12	-0.09	.931	-12.63	11.57
c'2 (X2 → Y)	2.66	7.08	0.38	.707	-11.34	16.66
c'3 (X3 → Y)	6.78	6.11	1.09	.270	-5.31	18.86
T0 → Y	-2.16	0.99	-2.19	.030*	-4.10	-0.21

Note. B = unstandardized regression coefficient, SE = standard error, CI = confidence interval, LL = lower level, UL = upper level, X1 = touch-only, X2 = mind-only, X3 = mind-touch, M = state self-compassion (mediator), Y = ∆Stress, T0 = stress prior intervention (covariate).

* $p < .05$

Table D2

Total, Direct, and Indirect Effects of Intervention on ∆Stress

Effect	*B*	*SE*	*t*	*p*	95% CI	
					LL	UL
Total effects						
X1	-0.58	6.16	-0.09	.926	-12.76	11.61
X2	2.60	7.15	0.36	.716	-11.55	16.75
X3	6.62	6.13	1.08	.282	-5.51	18.75
Direct effects						
X1	-0.53	6.12	-0.09	.931	-12.63	11.57
X2	2.66	7.08	0.38	.707	-11.34	16.66
X3	6.78	6.11	1.09	.270	-5.31	18.86
Indirect effects						
X1 → M → Y	-0.04	0.67	–	–	-1.45	1.46
X2 → M → Y	-0.06	0.67	–	–	-1.47	1.53
X3 → M → Y	-0.15	1.24	–	–	-2.87	2.39

Note. B = unstandardized regression coefficient, SE = standard error, CI = confidence interval, LL = lower level, UL = upper level, X1 = touch-only, X2 = mind-only, X3 = mind-touch, M = state self-compassion, Y = stress change (Δstress).