

Self-compassion

- Relationship with mindfulness, emotional stress symptoms and
psychophysiological flexibility

Julie Lillebostad Svendsen

Thesis for the degree of Philosophiae Doctor (PhD)
University of Bergen, Norway
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UNIVERSITY OF BERGEN



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Julie Lillebostad Svendsen

Abstract

How we relate to ourselves when facing negative emotions may impact on our psychological health. Drawn from Buddhist psychology, self-compassion involves treating oneself kindly in times of suffering and remembering that failure and imperfection is part of the shared human condition. Converging evidence shows higher levels of dispositional self-compassion to associate with lower levels of self-reported emotional stress symptoms, such as depressive symptoms, anxiety symptoms and rumination. Self-compassion is suggested to be closely related to mindfulness, another Buddhist concept, and is proposed as a key mechanism explaining why individuals who are mindful tend to be less depressed. Less research has examined how self-compassion relates to psychophysiological functioning, for instance by using biomarkers of autonomic flexibility such as vagally mediated heart rate variability. The purpose of this thesis was thus to examine how self-compassion relates to emotional stress symptoms, mindfulness, and psychophysiological flexibility as indexed by vagally mediated heart rate variability in healthy adults. The overall hypothesis was that self-compassion would specifically protect against emotional stress symptoms.

In the first paper, we examined whether self-compassion could explain the well-established link between high levels of mindfulness and lower levels of depressive symptoms. We also included rumination, as a hypothesized counterpart to self-compassion, as another potential mediator of the mindfulness-depressive symptoms relationship. Our main hypothesis was thus that higher levels of self-compassion and lower levels of rumination would mediate the relationship between higher levels of mindfulness and lower levels of depressive symptoms. The sample consisted of 277 healthy university students. They filled out the “Five Facet Mindfulness Questionnaire” (FFMQ), “Self-Compassion Scale” (SCS), Rumination subscale of the “Reflection Rumination Questionnaire” (RRQ), and the Depression subscale of the “Symptom Checklist-90 Revised” (SCL-90-R-dep). The results were consistent with our hypothesis, showing that both higher levels of self-compassion and lower levels of rumination mediated the relationship between mindfulness and

depressive symptoms. The results suggest that mindfulness may exert its effect on reduced depressive symptoms both through promoting a compassionate way of relating to oneself, as well as reducing the tendency to ruminate about negative thoughts and feelings.

In the second paper, we examined whether dispositional self-compassion is associated with vagally mediated heart rate variability (vmHRV), a proposed biomarker of autonomic flexibility. We had four hypotheses. First, we expected that higher levels of dispositional self-compassion would positively associate with higher levels of vmHRV measured during a five-minute resting condition. Second, we expected that the relationship between dispositional self-compassion and vmHRV would persist even when controlling for trait anxiety and rumination. Third, to validate that the proposed relation between higher self-compassion and higher vmHRV was representative of participants' everyday lives, we expected that higher levels of self-compassion would associate with higher levels of a 24-hour measure of vmHRV in a subsample of the participants. Finally, we expected to replicate previous study findings that self-compassion associates with lower trait anxiety and rumination. The sample consisted of 53 healthy university students. They completed the SCS, FFMQ, the rumination subscale of the RRQ, and the trait subscale of the "State-Trait Anxiety Inventory" (STAI). In addition, their heart rate variability was measured during a five-minute resting electrocardiogram, and the subsample (N=26) wore heartrate monitors for 24 hours. The results supported our hypotheses, showing that higher dispositional self-compassion positively related with higher resting and 24-hour vmHRV. This relation was found to persist when controlling for trait anxiety and rumination. Further, dispositional self-compassion also inversely related to trait anxiety and rumination. The results suggest that individuals with high tendencies to treat themselves compassionately are better able to physiologically adapt emotional responses.

In the third paper, we aimed to disentangle the effects of dispositional self-compassion and mindfulness on vmHRV. Drawing from previous study findings that self-compassion exceeds mindfulness in predicting self-reported outcome measures such as depressive symptoms and anxiety symptoms, we hypothesized that self-

compassion would explain variance in vmHRV beyond mindfulness. We also expected to replicate the previous study findings using self-reported outcome measures of trait anxiety and rumination. The sample was identical to the one used in paper II and consisted of 53 healthy university students who completed the SCS, FFMQ, the rumination subscale of the RRQ, and the trait subscale of the STAI. Resting vmHRV was measured during a five-minute resting electrocardiogram. The results were consistent with our hypotheses, indicating that dispositional self-compassion predicted variance in vmHRV beyond what was predicted by mindfulness. Self-compassion also predicted variance above mindfulness in trait anxiety and rumination. This suggests that being more self-compassionate relates to better psychophysiological regulation above and beyond the effects of being mindful, pointing to self-compassion as an important buffer against psychophysiological stress reactivity.

Together, the findings support the emerging picture of self-compassion as a healthy way of self-responding, facilitating psychological and physiological functioning.

List of publications

Paper I

Svendsen, J. L., Kvervenes, K. V., Wiker, A. S., & Dundas, I. (2016): Mechanisms of mindfulness: Rumination and self-compassion, *Nordic psychology*, 69. doi:10.1080/19012276.2016.1171730

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Paper III

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Abbreviations

BMI - Body Mass Index

ECG - Electrocardiogram

FFMQ - Five Facet Mindfulness Questionnaire

HF-HRV - High frequency Heart Rate Variability

MBCT - Mindfulness-Based Cognitive Therapy

MBSR - Mindfulness-Based Stress Reduction

MSC - Mindful Self-Compassion

RRQ-Rum - Rumination subscale of Reflection Rumination Questionnaire

RMSSD - Root mean square of successive differences between normal heartbeats

SCS - Self-Compassion Scale

vmHRV - Vagally mediated heart rate variability (throughout the thesis used to refer to the five-minute resting condition)

24-h vmHRV - 24 hour vagally mediated heart rate variability (throughout the thesis used to refer to the 24-hour condition)

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1. Introduction

“there is you and you.

this is a relationship.

this is the most important relationship.”

— *Nayyirah Waheed*

1.1 Purpose and scope of the dissertation

Ranging from mild stress and discomfort in everyday life to more severe life crises such as personal loss or disease, experiencing suffering is an inevitable part of being human. Self-compassion denotes a particular way of relating to oneself in such challenging moments (Neff, 2003b). Instead of instinctively fighting or suppressing negative emotions, criticizing oneself when things go wrong, one tries to open for and accept the difficult emotions, and extend kindness to oneself. This compassionate way of relating to oneself is suggested to lead to more adaptive and flexible emotion regulation (Neff, 2003a), as evidenced in reduced symptoms of depression, anxiety, and rumination. Further, it is suggested to relate to the ability to be mindful of present moment activities. As most research on self-compassion has focused on self-reported outcome measures, there is a need for research on how self-compassion relates to psychophysiological functioning (e.g. Barnard & Curry, 2011).

The purpose of this thesis was thus to investigate how self-compassion relates with emotional stress symptoms (i.e. depressive symptoms, anxiety symptoms and rumination), mindfulness, and psychophysiological flexibility as indexed by vagally mediated heart rate variability (vmHRV). The overall hypothesis was that being high in self-compassion would specifically protect against emotional stress symptoms. This we wanted to examine through answering three main questions: 1) May dispositional self-compassion and its counterpart, rumination, mediate the well-established relationship between mindfulness and reduced depressive symptoms? 2) Is higher levels of dispositional self-compassion related to psychophysiological

flexibility as measured with higher vagally mediated heartrate variability (vmHRV), in addition to lower anxiety and rumination? 3) Is dispositional self-compassion a stronger predictor of higher vmHRV than mindfulness? These hypotheses are respectively investigated in the three papers constituting the thesis (see table 1 for summary of the papers).

In the following sections, key areas in the scientific literature on self-compassion will be reviewed. This includes definitions and measurement of self-compassion, and previous research findings on how self-compassion relates with emotional stress symptoms, mindfulness, and vagally mediated heart rate variability.

Table 1: Overview of thesis and research papers

Thesis aim	To investigate how dispositional self-compassion relates to dispositional mindfulness, self-reported emotional distress and psychophysiological flexibility		
Main research question	<i>How does dispositional self-compassion relate to mindfulness, self-reported depressive symptoms, anxiety symptoms, and negative rumination, and vmHRV?</i>		
	Paper 1	Paper 2	Paper 3
Title	Mechanisms of mindfulness: Rumination and self-compassion	Trait Self-Compassion Reflects Emotional Flexibility Through an Association with High Vagally Mediated Heart Rate Variability	Dispositional self-compassion: Associations with psychophysiological flexibility beyond mindfulness
Research question	1) Does higher levels of self-compassion and lower levels of rumination mediate the relation between mindfulness and depressive symptoms? 2) Does self-compassion explain variance beyond rumination?	1) Is there a relation between self-compassion and vmHRV, resting and 24 h? 2) If so, does it sustain when controlling for anxiety and rumination? 3) Is there an inverse relation between self-compassion and self-reported anxiety and rumination?	1) Is self-compassion a stronger predictor than mindfulness of vmHRV? 2) Is self-compassion a stronger predictor than mindfulness of self-reported anxiety and rumination?
Design	Cross-sectional	Cross-sectional	Cross-sectional
Sample	N= 277, students	N= 53, students	
Data material	Self-reports	Self-reports, heart-rate variability measures	Self-reports, heart-rate variability measure

Independent variables	Dispositional mindfulness (FFMQ), self-compassion (SCS), rumination (RRQ-rum; the two latter proposed mediators)	Dispositional self-compassion (SCS)	Dispositional self-compassion (SCS), mindfulness (FFMQ)
Dependent variables	Depressive symptoms (SCL-90)	VmHRV during rest and 24 h, anxiety (STAI-T), rumination (RRQ-rum)	VmHRV during rest, dispositional trait anxiety (STAI-T), rumination (RRQ-rum)
Analysis	Bivariate correlational analyses, mediation analysis	Bivariate and partial correlational analyses, hierarchical regression analyses	Bivariate correlational analyses, hierarchical regression analyses

1.2 Self-compassion

1.2.1 Defining self-compassion

Self-compassion is a relatively new concept in Western psychology (Neff, 2003a, 2003b). It is related to the general concept of compassion, a word originating from Latin “compati”, meaning “to suffer with” (Strauss et al., 2016). Several definitions of the concept of compassion exists (e.g. Feldman & Kuyken, 2011; Gilbert, 2005; Goetz, Keltner, & Simon-Thomas, 2010; Strauss et al., 2016). Although they differ in some respects, there seems to be a broad consensus that compassion means feeling for a person who is suffering and being motivated to act to help ease the suffering (Strauss et al., 2016).

Self-compassion can be understood as directing the same qualities inward: feeling for oneself when one suffers and being motivated to reduce the pain. A pioneer in the field of self-compassion within western psychology, Kristin Neff, defines self-compassion as “being touched by and open to one’s own suffering, not avoiding or disconnecting from it, generating the desire to alleviate one’s suffering and to heal oneself with kindness”(Neff, 2003b, p. 87). She (Neff, 2003b) notes that people often are more compassionate toward others than toward themselves and emphasizes the importance of giving oneself the same support, understanding and kindness in times of hardship, as one would give to a friend.

Inspired by Buddhist psychology, Neff (Neff, 2003a, 2003b) defines self-compassion in terms of three bipolar components, each of which can be beneficial in reducing emotional stress symptoms. The first, self-kindness versus self-judgment, refers to treating oneself in a supportive, reassuring, gentle, and understanding way in times of personal failure or difficulty, instead of being critical and judgmental toward oneself. The second, common humanity versus isolation, entails recognizing that difficulties are part of the shared human experience rather than feeling isolated and alone in suffering. Finally, mindfulness versus over-identification relates to holding painful thoughts and feelings in balanced awareness instead of over-identifying, suppressing or becoming emotionally overwhelmed by them. Over-identification thus refers to being engaged in negative thoughts and feelings with little awareness of being engaged, much like watching a movie while forgetting that it is only a movie (Germer & Barnhofer, 2017). The three components reflect different dimensions of the self-to-self relation; how individuals emotionally respond to their suffering (by being kind and understanding versus cold and critical toward themselves), cognitively understand their suffering (by remembering that suffering is part of the common humanity, versus feeling isolated and abnormal), and pay attention to their suffering (with mindful awareness, versus overidentification; Neff, 2016a).

Table 2**Overview of the components of self-compassion**

Components of self-compassion		
Self-kindness	Self-kindness versus self-judgment	The ability to treat oneself kindly when challenged by personal failure or suffering versus criticizing or judging oneself for one's suffering
Common humanity	Common humanity versus isolation	Recognizing that suffering is universal and part of being human versus feeling isolated and alone in suffering
Mindfulness	Mindfulness versus overidentification	Holding the experience of suffering in non-judgmental awareness versus overidentifying with the feelings of suffering

Thus, rather than referring to a general *evaluation* of the self, self-compassion represents a way of *relating* to oneself (Neff & Davidson, 2016). This distinguishes self-compassion from the concept of global self-esteem, which can be defined as a general positive or negative orientation toward the self (Rosenberg, 1965). As opposed to attitudes of high self-esteem, self-compassionate attitudes are not depended on coming off positively in comparison to other individuals or satisfying given standards (Neff, 2003b). It has thus been suggested as a healthier attitude toward the self than self-esteem (Leary, Tate, Allen, Adams, & Hancock, 2007; Neff, 2003b), and associated with less potential negative side effects such as narcissism and contingent self-worth (Crocker & Park, 2004). To further clarify the concept of self-compassion, Neff (Neff, 2003b) also emphasizes the distinctions between self-compassion and self-pity. Whereas self-pity involves exaggerating own problems, self-compassion represents a more balanced awareness of one's challenges, acknowledging that other individuals also suffer.

An alternative model has been provided by Paul Gilbert (Gilbert, 2009, 2005). His theory is framed by evolutionary psychology and attachment theory and focuses on capacities for soothing and care evolved to increase survival. He defines compassion “a sensitivity to suffering in self and others with a commitment to try to alleviate and prevent it” (Gilbert, 2017, p. 11). Gilbert emphasizes the role of secure attachment relationships forming a basis for the development of self-compassion (Gilbert & Procter, 2006), in which securely attached children internalize the way their parents treat them and develop the ability to treat themselves in the same manner. He proposes that compassion is a motivational system designed to regulate negative emotions and suggests that it is accompanied by a specific physiological activation pattern. He distinguishes between the threat system active in times of perceived danger, the drive system active when seeking out resources, and the contentment and safeness system active when one feels safe. When one of the systems is active, it is described to inhibit the other ones. Hence, activation of the contentment system may reduce stress activation associated with the threat system. Importantly, it is suggested that the three systems may be activated through self-

performed actions in much the same way as actions performed by others. Thus, one may activate one's own contentment-system through being self-compassionate.

The models of Neff and Gilbert appear to be complementary rather than contradictory. They seem to share a common understanding of self-compassion as a healthy attitude toward oneself in times of personal distress or suffering, facilitating adaptive emotion regulation through self-soothing. Moreover, both appear to understand self-compassion as a multidimensional construct, including aspects such as acknowledging and recognizing suffering, having a sense of non-judgment, and being motivated to try to alleviate the suffering. However, Gilbert focuses more on competencies related to being compassionate, such as empathy, sympathy, and distress tolerance, whereas Neff places a greater emphasis on the three elements of self-kindness, common humanity and mindfulness (Gilbert, 2017). In this thesis, a broad understanding of self-compassion will be applied covering elements from both theories.

1.2.2 Measuring self-compassion

Operationalizing self-compassion as a construct is necessary for researchers to be able to study it. Predominantly, self-compassion has been measured with self-report scales. The most commonly used self-report scale is the self-compassion scale developed by Kristin Neff (SCS; Neff, 2003a). This was the first operationalization of self-compassion to be developed and was validated in a student sample. In a series of studies to confirm the three-factor structure postulated by Neff (2003b), consisting of self-kindness versus self-judgment, common humanity versus isolation, and mindfulness versus over-identification, Neff (2003a) did not find support for this three-component solution, but rather for a six-factor solution consisting of self-kindness, self-judgment, common humanity, isolation, mindfulness, and over identification. The sum of the six subscales (when reverse coding the negative subscales) reflects the individual's overall level of self-compassion. Neff (2003a) argues that this six-factor solution, although unexpected, is explainable, because having high levels on one subscale (e.g. self-kindness) does not necessarily mean that one has low levels on the hypothesized counterpart (e.g. self-judgment). In other

words, one may refrain from judging oneself without taking active step towards self-kindness. Or, one may tend to criticize oneself, but still also often extend kindness toward oneself. All items focus on how one treats oneself in times of suffering, such as when faced with life challenges, perceived failure or inadequacy, or difficult emotions. To date, there has not been established clinical norms for the SCS, and most of the research has been done on non-clinical samples (Finlay-Jones, 2017). Although the SCS has recently been subjected to psychometric criticism (e.g. Costa, Maroco, Pinto-Gouveia, Ferreira, & Castilho, 2016; Lopez et al., 2015; Muris, Otgaar, & Petrocchi, 2016; M. Williams, Dalgleish, Karl, & Kuyken, 2014), it has been identified as the strongest measure currently available to measure self-compassion (Strauss et al., 2016). Most studies on self-compassion have used the total score as an indicator of self-compassion (Lopez et al., 2015), in correspondence with the original intentions when the scale was designed (Neff, 2003a).

An alternative and less used self-report instrument of self-compassion is Paul Gilbert's Forms of self-criticizing and reassuring scale (FSCRS; Gilbert, Clarke, Hempel, Miles, & Irons, 2004), measuring self-reassurance and two forms of self-criticism. However, this scale does not compute a total self-compassion score. Rather it provides three subscale scores, measuring self-reassurance, self-criticism, and self-hate.

1.2.3 Self-compassion as a disposition, state, and trained ability

Self-compassion can be regarded as a disposition, state, or trained ability.

Dispositional self-compassion may be understood as individuals' general tendency to treat themselves compassionately in everyday life. The SCS is designed to measure such general tendencies (Neff, Whittaker, & Karl, 2017), and much of the research has indeed used participants without any formal compassion training. Individual differences in self-compassion may stem from different sources, such as early experiences with significant others in childhood (e.g. Barlow, Turow, & Gerhart, 2017; Vettese, Dyer, Li, & Wekerle, 2011), or cultural norms (Neff, Pisitsungkagarn, & Hsieh, 2008). An alternative term, used interchangeably with "dispositional" in the literature, is "trait" self-compassion.

State self-compassion may be understood as how compassionate one feels toward oneself in the present moment and has been subject to less research attention than dispositional self-compassion. Some researchers (e.g. Arch et al., 2014) have modified the SCS to measure states instead of dispositions, by rephrasing the parts of the items referring to general tendencies with words referring to current experience (e.g., “In response to my performance, I am being tough on myself” rather than the original “When times are really difficult, I tend to be tough on myself”). In this way, they were able to measure changes in state self-compassion in response to a brief self-compassion induction in an experimental paradigm.

Although individuals may naturally differ in their abilities and habits to be self-compassionate in daily life, self-compassion is also thought to be a skill that can be learned (Neff & Germer, 2013). Both Kristin Neff (Mindful Self-Compassion; Neff & Germer, 2013) and Paul Gilbert (Compassion Focused therapy; Gilbert, 2009) have developed training programs aimed at increasing self-compassion levels. Several studies indicate that these programs are effective in increasing individuals’ self-compassion. For example, Neff and Germer (2013) found that upon completion of the MSC course participants had significantly higher levels of self-compassion, mindfulness, happiness and life satisfaction, and lower levels of depression, anxiety and stress as compared to the control group.

The understandings of self-compassion as a disposition, state, and trained ability do not seem to mutually exclude each other but may rather be understood to operate together. For instance, a person’s dispositional levels of self-compassion may influence the number of compassionate states entered during a day and may perhaps also influence the person’s susceptibility to increase his or her levels of self-compassion through training.

1.2.4 Self-compassion as a protective factor against depressive symptoms, anxiety symptoms and rumination

Defining depressive symptoms, anxiety symptoms, and rumination

Depressive symptoms include low mood, low energy levels, low self-worth, loss of interest or feelings of pleasure, feelings of hopelessness, disturbed sleep, loss of

sexual interest, and suicidal thoughts (American Psychiatric Association, 2000). Anxiety symptoms comprises feelings of tension, nervousness, or restlessness, worried thoughts, and physical changes such as increased heart rate and blood pressure (American Psychiatric Association, 2000). Studies using dimensional measures have shown that depressive symptoms vary in the general population, indicating that they have dispositional attributes and may vary between individuals in a trait-like manner (e.g. Schrader, 1994). Likewise, trait anxiety has been defined as relatively stable individual differences in the tendency to experience anxiety and perceive stressful situations as threatening (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).

Rumination may be defined as efforts to regulate negative emotions or mood through repetitively directing attention towards negative emotions as well as possible causes and consequences of the emotions (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). It is broadly understood as a way of responding to a perceived discrepancy between one's current status and target status and is viewed as a stable individual trait (Smith & Alloy, 2009). Two subtypes of rumination have been identified (Treyner, Gonzalez, & Nolen-Hoeksema, 2003). The first, reflection, entails emotionally neutral pondering, in which one purposely turns inward to engage in cognitive problem-solving. This can be argued to be a more adaptive form of rumination. The second type, termed brooding, reflects moody pondering, where one passively compares one's current situation with an unachieved standard. This brooding subtype represents the more maladaptive form (e.g. Burwell & Shirk, 2007; Treyner et al., 2003). Although individuals often have the impression that it may help them deal with difficult emotions and situations, research indicates that it to the contrary serves to exasperate and prolong negative mood (Nolen-Hoeksema, Morrow, & Fredrickson, 1993). Such rumination typically involves self-critical thoughts, which is proposed as a trans-diagnostic factor in emotional distress and is found to be an important vulnerability factor to depressive symptoms and anxiety symptoms (e.g. Barcaccia et al., 2019; Blatt, Quinlan, Chevron, McDonald, & Zuroff, 1982; Blatt & Zuroff, 1992; Rimes & Watkins, 2005; see also A. M. Werner, Tibubos, Rohrmann, & Reiss, 2019 for a recent review).

Self-compassion appears to represent an opposite way of relating to difficulties compared to brooding rumination. Whereas brooding rumination typically is a habitual and automatic pattern, self-compassion involves a mindful presence and a tendency to refrain from overidentifying with negative thoughts and emotions. When faced with challenges, individuals with a high tendency to ruminate may react with an immediate attempt to solve the problem to reduce the discrepancy between current and target state, whereas an individual high in self-compassion may rather acknowledge and accept the uncomfortable emotion before habitually reacting. Likewise, whereas rumination involves evaluation and judging oneself against given standards, self-compassion entails a non-judgmental stance toward oneself. Also, rumination is often self-critical in nature, while self-compassion represents low self-criticism. Moreover, whereas rumination entails cognitive aspects of pain, for example thinking “why can I never get it right?”, self-compassion broadens the focus to include emotional and bodily aspects of pain, such as allowing uncomfortable bodily sensations to enter awareness, rather giving rise to questions like “what do I need?”. Thus, whereas rumination represents a maladaptive emotion regulation strategy (Nolen-Hoeksema, 1991), self-compassion may have protective effects, which we will further address in the next section.

Self-compassion as a protective factor

Self-compassion is suggested to be an adaptive emotion regulation strategy (Diedrich, Grant, Hofmann, Hiller, & Berking, 2014; Gilbert & Procter, 2006; Neff, 2003b; Neff, Hsieh, & Dejitterat, 2005) buffering against depressive symptoms, anxiety symptoms and brooding rumination. Emotion regulation refers to the process of shaping which emotions one has, when they occur, and how one expresses or experiences the emotions (Gross, 1998, 2014). When experiencing a negative event, such as feeling hurt or having failed, individuals high in self-compassion are expected to respond to difficulties by allowing uncomfortable thought and emotions to enter awareness, holding them with acceptance and mindfulness. They may then have more resources available to reflect and view the experience in the light of common humanity, contextualizing the failure in context of broader human experience rather

than merely in terms of their own personal narrative. This may make them feel more connected to others in times of failure (Neff, 2003b). Likewise, individuals with high habitual tendencies to be self-compassionate may have higher access to active self-soothing strategies. Such acts of self-kindness may take many forms, for instance reassuring and supportive self-talk, or generating feelings of support, understanding, and warmth toward oneself in moments of personal inadequacy. It may also take the form of actions, such as engaging in physical activity, or talking to a good friend (Neff & Germer, 2013). In this way, individuals high in self-compassion may be more efficient in activating their own safe and contentment system and deactivate the threat system associated with continuous self-criticism (Gilbert, 2009). Holding difficult emotions in mindful awareness, painful feelings are not avoided or pondered about, but are instead approached with kindness, gentleness and a sense of common humanity. In this way negative emotions may be transformed into more positive ones (Neff, 2003b).

Indeed, one of the most consistent findings in the self-compassion literature is that higher levels of self-compassion associate with lower levels of self-reported depressive symptoms, anxiety symptoms and a lower tendency to ruminate. A meta-analysis including 20 studies (MacBeth & Gumley, 2012) found a large effect size when examining the relation between self-compassion and symptoms of depression and anxiety. Regarding depressive symptoms in particular, several cross-sectional studies have found higher levels of dispositional self-compassion to relate with lower levels of depressive symptoms in nonclinical (e.g. Brenner, Heath, Vogel, & Crede, 2017; Neff, 2003a; Neff et al., 2008; Raes, 2010; Woodruff et al., 2014) and clinical samples (A. M. Bakker, Cox, Hubley, & Owens, 2019; Krieger, Altenstein, Baettig, Doerig, & Holtforth, 2013; Van Dam, Sheppard, Forsyth, & Earleywine, 2011). In a longitudinal study using a nonclinical sample, Raes (2011) found that higher levels of dispositional self-compassion predicted lower increases or greater reductions in depressive symptoms five months later. This indicates that self-compassion prospectively protects against depressive symptoms, rather than merely being influenced by pre-existing depression levels. Similar findings have been reported using a clinical sample of depressed patients (Krieger, Berger, & Holtforth, 2016).

Krieger, Berger, and Holtforth, (2016) found that level of self-compassion predicted later level of depressive symptoms, but level of depressive symptoms did not predict later level of self-compassion.

In relation to anxiety symptoms, cross-sectional studies have found dispositional self-compassion to relate to lower levels of anxiety symptoms in nonclinical (e.g. Leary et al., 2007; Neff, 2003b; Neff, Kirkpatrick, & Rude, 2007; Raes, 2010) and clinical samples of individuals with generalized anxiety disorder (Roemer et al., 2009) and mixed depressive and anxiety symptoms (Van Dam et al., 2011). Neff, Kirkpatrick and Rude (2007) found that high levels of dispositional self-compassion protected against anxiety symptoms in a laboratory setting where participants were asked to consider their greatest weakness. Similarly, Leary and colleagues (2007) found that individuals with higher dispositional self-compassion had less anxiety symptoms when they were asked to think about their difficulties in life. Self-compassion is also found to associate with less self-presentation concerns (Long & Neff, 2018). Moreover, lengthier self-compassion intervention programs, such as the MSC, has also been found to lead to reduced levels of anxiety symptoms (Neff & Germer, 2013). In a recent study using a clinical sample, Harwood and Kocovski (2017) induced higher self-compassion levels through a self-compassion writing task and found that individuals with social anxiety experienced less anxiety before a speech task as compared to control groups who did not perform the self-compassion writing task.

Regarding rumination, cross-sectional studies have found higher levels of dispositional self-compassion to inversely relate to rumination in nonclinical samples (Neff, 2003a; Neff et al., 2007; Neff & Vonk, 2009; Raes, 2010), and depressed outpatient samples (Krieger et al., 2013). Dispositional self-compassion has also been found to associate with less negative rumination after receiving negative feed-back (Blackie & Kocovski, 2019). In an intervention study with a nonclinical sample (Neff et al., 2007), participants received help in finding their inner self-compassionate voice through the Gestalt two-chair technique. Results showed that increases in self-compassion after the intervention related to reduced rumination one month later.

Together these findings indicate that self-compassion protects against emotional distress such as depressive, anxiety and rumination symptoms.

1.3 Self-compassion and mindfulness

Like self-compassion, mindfulness originates from Buddhist psychology, and the two concepts are closely related (e.g. Baer, 2010; Neff, 2003b; Radhakrishnan & Moore, 1957). In the following sections, mindfulness definitions will be reviewed, as well as similarities and differences between self-compassion and mindfulness. Further, research examining self-compassion and rumination as mediators of the relation between mindfulness and depressive symptoms will be reviewed.

1.3.1 Defining and measuring mindfulness

Bishop and colleagues (2004) have provided an influential operational definition of mindfulness. They propose that mindfulness consists of two components, of which the first is self-regulation of attention. This comprises the ability to intentionally direct attention to the present moment, sustain attention, and switch it back to the present moment whenever it wanders off from the present moment into thoughts about the past or future. In this way, mindfulness involves a direct and concrete experience of events in the body and mind, rather than an indirect and abstract experience of events through thinking about them. This is thought to lead to a de-centered perspective on thoughts and emotions, in which they are viewed as fluctuating and subjective rather than permanent and objective reflections of reality. The second component has to do with *how* one relates to whatever is present; with the attitudinal qualities of curiosity, experiential openness, and acceptance. Acceptance is in this context defined as being experientially open to present moment reality (Roemer & Orsillo, 2002), rather than passively resigning or giving up the possibility of change.

Mindfulness theorists differ in their focus on this second component of attitudes. For instance, Brown and Ryan (2003) do not include an attitudinal component in their definition, exclusively emphasizing the dimension of present

moment attention. They define mindfulness as “the state of being attentive to and aware of what is taking place in the present” (Brown & Ryan, 2003, p. 822). In the other end, Kabat-Zinn (e.g. 1990) places great emphasis on such attitudinal qualities such as non-judging, acceptance, and patience. He defines mindfulness as “paying attention in a particular way; on purpose, in the present moment, and non-judgmentally” (Kabat-Zinn, 1994, p. 4). In fact, he proposes that mindfulness might as well be called “heartfulness”, as it entails being present with an attitudinal quality of care and concern. Likewise, Shapiro and colleagues (2006) emphasize the “heart”-qualities embedded in mindfulness, such as patience, not striving, kindness, and compassion.

Like self-compassion, mindfulness may also be understood as a disposition, state, and trained ability. Dispositional mindfulness, the tendency to be mindful in daily life (Brown & Ryan, 2004), is proposed to be a universal human capacity (e.g. Kabat-Zinn, 1990; Shapiro, Siegel, & Neff, 2018; M. Williams, Teasdale, Segal, & Kabat-Zinn, 2010). In line with this, studies have shown level of mindfulness to vary among individuals in the general population irrespective of mindfulness practice (Brown, Ryan, & Creswell, 2007). Dispositional mindfulness has also been shown to significantly correlate with emotional well-being (Branstrom, Duncan, & Moskowitz, 2011; Kong, Wang, & Zhao, 2014; Malinowski & Lim, 2015). Several authors have noted that it is important to measure dispositional mindfulness in relation to studies on the effects of mindfulness interventions, as pre-existing levels may influence effects of mindfulness training (e.g. Tang, Holzel, & Posner, 2016; Wheeler, Arnkoff, & Glass, 2016). The majority of the research on mindfulness has been focused on effects of mindfulness meditation training (Shapiro, Astin, Bishop, & Cordova, 2005). Examples of mindfulness interventions are Mindfulness-based Stress Reduction (MBSR; Kabat-Zinn, 1982, 1990), and Mindfulness-based Cognitive Therapy (MBCT; Segal, Teasdale, & Williams, 2002). Such interventions have been shown to improve health and reduce emotional stress symptoms (de Vibe et al., 2017; Kuyken et al., 2008), and to increase dispositional levels of mindfulness (e.g. Keng, Smoski, Robins, Ekblad, & Brantley, 2012). A related way to view mindfulness, is as a temporary state. Bishop and colleagues (2004) regard mindfulness as closer to a

state than a disposition, as the mindful state ceases when attention is no longer directed to present moment experience. However, frequently entering a mindful state is thus thought to increase the habitual tendency to be mindful in everyday life, i.e. dispositional mindfulness.

Mindfulness has predominantly been measured with self-report instruments. Most self-report scales developed to measure mindfulness focus on dispositional levels, such as the Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) and the Mindful Awareness Attention Scale (MAAS; Brown & Ryan, 2003). The FFMQ was developed through factor analysis of the combined pool of items in five different mindfulness instruments. It distinguishes five mindful components: observing, describing, acting with awareness, non-judgment and non-reactivity to inner experiences. “Observing” refers to the tendency to notice and be present with external and internal experience, “describing” taps the ability to label inner experience, and “acting with awareness“ reflects the tendency to focus attention on current activities. “Non-judgment” refers to the ability to relate to thoughts and feelings without evaluating them, and “non-reactivity to inner experiences“ entails the ability not to react to experiences in an automatic and reactive manner. The FFMQ thus measures both attention and attitude components of mindfulness. In contrast, reflecting the unidimensional definition of Brown and Ryan (2003), the MAAS is predominantly focused on the attention component, measuring the absence of mindless and automated behavior. Thus, the FFMQ may be argued to be a broader measure of mindfulness the MAAS.

Similarities and differences between self-compassion and mindfulness

The extent to which self-compassion and mindfulness are similar versus different concepts depends on how one defines the two constructs. Using the mindfulness definition by Brown and Ryan (2003), the difference between the two concepts seems clear, since mindfulness is understood as attention and awareness in the present moment as opposed to self-compassion which also involves caring for oneself. When employing mindfulness definitions including and emphasizing the attitudinal component, however, the distinctiveness may seem less profound, and mindfulness

and self-compassion may seem to overlap to a great extent. This is because both concepts include awareness of and approaching experience as it is, with attitudes of acceptance and non-judgment. Rather than fighting or suppressing experience, both emphasizes a befriending of negative emotions, leading to an increased ability to meet and accept feelings that may otherwise be suppressed or give rise to rumination, experiential avoidance or shame. Indeed, as conceptualized by Neff (2003a) mindfulness is even an integral part of self-compassion, and as conceptualized by Shapiro (2006), compassion is also an inherent part of mindfulness.

Nonetheless, mindfulness and self-compassion are proposed to reflect distinct constructs (Baer, 2010; Bishop et al., 2004; Boellinghaus, Jones, & Hutton, 2014; Germer & Barnhofer, 2017; Neff & Dahm, 2015). Stressing the importance of distinguishing between the operational features and the potential benefits of mindfulness, Bishop and colleagues (2004) argue that self-compassion is not part of the general mindfulness construct, but rather a likely *outcome* of practicing mindfulness. When becoming more mindful of one's experiences it may be easier to detect when one needs self-compassion. Likewise, Neff and Dahm (2015) identifies several ways in which self-compassion may be distinguished from the general concept of mindfulness. First, self-compassion is narrower in scope than mindfulness, as it focuses exclusively on situations of suffering. Correspondingly, the type of mindfulness that is part of Neff's self-compassion definition refers to balanced awareness of *negative* feelings and thoughts, in contrast to general mindfulness which may be applied to both positive, neutral and negative situations. For instance, one may be mindful of eating a raisin, however it does not make sense to give oneself-compassion for eating a raisin (unless for instance one has had a highly negative experience related to eating raisins; Neff & Dahm, 2015). Second, self-compassion and mindfulness differ in their respective targets. The target of self-compassion is the *person* who struggles, whereas the target of mindfulness is the *experience* the person has, i.e. the thoughts, feelings and emotions arising from moment to moment. Whereas one can be mindful of a difficult emotion, one cannot be compassionate toward an emotion, - only toward a person or a self (Germer & Barnhofer, 2017). Third, self-compassion explicitly focuses on common humanity, the active

remembrance that making mistakes, being imperfect, and having negative emotions are normal and something everyone experiences from time to time (Neff & Dahm, 2015). Finally, and importantly, self-compassion adds an extra element of intentional self-soothing actions. Thus, self-compassion more than mindfulness focuses on the motivation to act to ease suffering. Important to note, is that one does not soothe oneself in order to feel better, but because one feels bad (Neff & Germer, 2013).

1.3.2 The relation between mindfulness and depressive symptoms

It seems well established that mindfulness relates to lower levels of depressive symptoms (e.g. K. Bakker & Moulding, 2012; S. M. Barnes & Lynn, 2010; Deng, Li, & Tang, 2014; Jimenez, Niles, & Park, 2010; Kuyken et al., 2008; Kuyken et al., 2010). For instance, a recent meta-analysis (Tomlinson, Yousaf, Vitterso, & Jones, 2018) included 21 studies focusing on dispositional mindfulness, predominantly in nonclinical samples. All 21 studies found that dispositional mindfulness was inversely related to depressive symptoms, and Tomlinson et al (2018) conclude that the relationship seems consistent. The relation between higher dispositional mindfulness and lower depressive symptoms has been shown both using cross-sectional (e.g. Baer et al., 2006; Brown & Ryan, 2003), and longitudinal (e.g. S. M. Barnes & Lynn, 2010) designs. For instance, Barnes and Lynn (2010) found that students scoring higher on mindfulness as measured by the FFMQ at the start of the semester were less likely to develop depressive symptoms at the end of the semester. Similarly, Barnhofer, Duggan, & Griffith (2011), found that dispositional mindfulness protected against the negative effects of neuroticism in a community sample. They found that neuroticism was significantly related to depression in participants reporting to have low to medium levels of dispositional mindfulness, but not in those reporting to have high levels of mindfulness.

In keeping with this, empirical evidence links training in mindfulness to reduced depressive symptoms. Although recently a critical meta-analysis concluded that mindfulness-based interventions only have weak effects on common psychiatric disorders (Hedman-Lagerlof, Hedman-Lagerlof, & Ost, 2018), several other meta-

analyses and review studies conclude that mindfulness-based interventions such as MBSR and MBCT are effective in reducing depressive symptoms in non-clinical (Khoury, Sharma, Rush, & Fournier, 2015) and clinical samples (Goyal et al., 2014; Hofmann, Sawyer, Witt, & Oh, 2010; Strauss, Cavanagh, Oliver, & Pettman, 2014; Wang et al., 2018). For instance, Hoffman et al (2010) performed a meta-analysis based on 39 studies using clinical samples and found that mindfulness-based interventions were moderately effective in reducing depressive symptoms. Thus, the overall picture seems to be that mindfulness, both as a dispositional tendency, and to certain degree as an intervention, relates to a lower degree of depressive symptoms.

Less is known about the mechanisms explaining the inverse relationship between mindfulness and depressive symptoms. Self-compassion is one interesting candidate, and several researchers have suggested that self-compassion is a key mechanism through which mindfulness-based interventions improve well-being (Baer, 2010; Holzel et al., 2011; Kuyken et al., 2010). Moreover, rumination, as the theoretical antidote to self-compassion is another likely mediator candidate. The next section will review previous research findings on this topic.

1.3.3 Self-compassion as a potential mediator to the effects of mindfulness

A mediator is a variable that may account for the relationship between an independent and dependent variable (Baron & Kenny, 1986; Kazdin, 2007). The notion of self-compassion as a mediator of mindfulness is in line with the traditional Buddhist view that mindfulness naturally gives rise to compassion (Hollis-Walker & Colosimo, 2011; Radhakrishnan & Moore, 1957). Neff postulates that mindfulness is a prerequisite to self-compassion, as “we can't heal what we can't feel” (Neff, 2011, p. 80). Thus, a person who is deeply caught up in the storyline of self-critical thinking may not have the perspective needed to notice that he or she is suffering, for example through noticing signs of bodily tension and thus may not have access to self-compassion. He or she may instead continue ruminating about own failure, rather

than taking the mindful perspective to notice signs of distress such as tense shoulders, rapid heart rate, superficial breath, or feelings of anger, sadness or fear.

Indeed, the notion that self-compassion may be facilitated by mindfulness is supported by the high correlation found between the two constructs (e.g. Hollis-Walker & Colosimo, 2011; Keng et al., 2012; Van Dam et al., 2011), and research showing that changes in mindfulness predicts changes in self-compassion (e.g. Birnie, Speca, & Carlson, 2010). Most research on mindfulness mediators has been done in the context of mindfulness-based interventions. In a key study, Kuyken and colleagues (2010) examined the effect of MBCT versus maintenance antidepressant medication on relapse in depressive symptoms. The study aimed to examine whether self-compassion and mindfulness would mediate the link between MBCT participation and reduced depressive symptoms at 15 months follow-up. Further, another study purpose was to examine whether reduced reactivity, as measured one month after the MBCT intervention, had the expected beneficial effects in reducing depressive symptoms. Reactivity was here operationalized as increases in dysfunctional thoughts after a sad mood induction in which participants were asked to rehearse a sad memory whilst listening to sad music. The results showed that both self-compassion and mindfulness mediated the association between MBCT and reduced relapse in depressive symptoms. Interestingly, results also showed that increased self-compassion (but not mindfulness) decoupled the link between reactivity and depressive relapse. This indicates that self-compassion is an important mechanism through which MBCT works in reducing susceptibility to depressive symptoms.

Increased self-compassion has also been found to mediate the effects of MBI's on outcome measures other than depression, such as stress (Shapiro et al., 2005), worry (Keng et al., 2012), compassion for others (Yip, Mak, Chio, & Law, 2017), and well-being (Evans, Wyka, Blaha, & Allen, 2018). Together these studies support the idea that self-compassion may serve as a mediator to the effects of mindfulness on depressive symptoms.

1.3.4 Rumination as a potential mediator to the effects of mindfulness

Rumination is another proposed mediator of the relationship between mindfulness and reduced depressive symptoms. The notion of reduced rumination representing a mediator between mindfulness and depressive symptoms is in line with the theoretical premise of MBCT (M. Williams, Teasdale, Segal, & Kabat-Zinn, 2007). It is suggested that sad mood becomes associated with negative ruminative thinking, particularly in individuals with a history of depression. Thus, even brief periods of low mood are proposed to automatically trigger negative, ruminative, self-evaluative thinking, leading to a vicious circle which may result in depressive relapse.

Several studies support the mediating effect of rumination in the relationship between mindfulness and depressive symptoms (Coffey & Hartman, 2008; Desrosiers, Vine, Klemanski, & Nolen-Hoeksema, 2013; Heeren & Philippot, 2011; Jain et al., 2007; Labelle, Campbell, & Carlson, 2010; van Aalderen et al., 2012). Two cross-sectional studies (Alleva, Roelofs, Voncken, Meevissen, & Alberts, 2014; Coffey & Hartman, 2008) using student samples, found that lower levels of rumination mediated the relationship between higher dispositional mindfulness and lower depressive symptoms. This has also been shown in a clinical sample (Desrosiers et al., 2013). In individuals suffering from depressive and anxiety symptoms, Desrosiers and colleagues (2013) found that rumination mediated the relation between higher levels of mindfulness and lower depressive symptoms.

Likewise, studies focusing on mindfulness interventions rather than dispositional mindfulness have generally supported the role of reduced rumination in mediating the effects on reduced depressive symptoms, (e.g. Heeren & Philippot, 2011; Jain et al., 2007; Labelle et al., 2010; van Aalderen et al., 2012). For example, Labelle and colleagues (2010) found that reduced rumination mediated the impact of MBSR participation on reduced symptoms of depression in a sample of cancer patients. Similarly, van Aalderen and colleagues (2012) found that changes in rumination mediated the effects of MBCT participation on reduced symptoms of depression in a sample of currently depressed patients. It should however be noted that one study (Kearns et al., 2016) did not find support for this relation, reporting

that reduced levels of rumination did not mediate the relation between MBCT participation and reduced depressive symptoms.

In summary, there are indications that both higher levels of self-compassion and lower levels of rumination may explain the link between mindfulness and depressive symptoms.

1.4 Self-compassion and vagally mediated heart-rate variability

Thus far, we have seen that dispositional self-compassion relates to reduced self-reported depressive symptoms, anxiety symptoms and rumination, as well as increased levels of mindfulness. However, there is a gap in the research literature regarding how dispositional self-compassion relates to the ability to physiologically adapt emotional responses.

One proposed psychophysiological measure of emotion regulation is heart rate variability (HRV; Appelhans & Luecken, 2006; Porges, 2007; Thayer & Lane, 2000). In the following I will define HRV and its measurement, describe how self-compassion may be linked to higher HRV, and finally discuss the relation between self-compassion, mindfulness and HRV.

1.4.1 Defining and measuring vagally mediated HRV

HRV can be defined as the variation in time intervals between subsequent heartbeats (Shaffer & Ginsberg, 2017). This variability is suggested to be modulated through the output of the autonomic nervous system (ANS) on the sinoatrial node (i.e. pacemaker) of the heart (Appelhans & Luecken, 2006; Thayer & Lane, 2000). The ANS consists of a sympathetic branch, increasing heart rate and mobilizing the organism when needed (e.g. in times of perceived threat), and a parasympathetic branch reducing heart rate and allowing for rest in times of perceived safety. Importantly, the parasympathetic branch, through the 10th cranial nerve termed the

vagus nerve, has a shorter latency of response (i.e. in terms of milliseconds), than the sympathetic fibers (in terms of seconds; Appelhans & Luecken, 2006). Thus, faster moment-to-moment adjustments in autonomic function (i.e., high variability) seem to be primarily reflective of the withdrawal or addition of vagal influence. Due to this important function of the vagus nerve in increasing HRV, it is often referred to as vagally mediated heart rate variability (vmHRV), and I will use this term in the remainder of this thesis.

High vmHRV is suggested to index an increased flexibility in the up- and down regulation of emotional arousal according to situational demands (Beauchaine & Thayer, 2015; Holzman & Bridgett, 2017; Porges, 2007; Thayer & Lane, 2000, 2009). High vmHRV relates to feelings of calm and safety, and to an increased ability to self-soothe when stressed (Porges, 2007; Thayer, Ahs, Fredrikson, Sollers, & Wager, 2012). In contrast, low vmHRV is proposed to reflect a reduced capacity to flexibly adapt to stress and situational demands and is found to associate with higher levels of symptoms of depression (Kemp et al., 2010), anxiety (Chalmers, Quintana, Abbott, & Kemp, 2014) and brooding rumination (Carnevali, Thayer, Brosschot, & Ottaviani, 2018; D. P. Williams et al., 2015; D. P. Williams et al., 2017). Lower levels of vmHRV has also been shown to represent a risk factor for cardiovascular disease and mortality (Thayer & Lane, 2007).

There are two major theories linking high vmHRV to flexible emotional responding (Appelhans & Luecken, 2006). The Polyvagal theory (Porges, 2007) distinguishes three neural circuits: the phylogenetically old unmyelinated vagus, the sympathetic-adrenal system, and the phylogenetically recent myelinated vagus. The two first-mentioned are described to be active in threatening situations; the unmyelinated vagus enabling simple immobilization (for example freezing) behavior, and the sympathetic-adrenal system enabling mobilization (e.g. fight/flight). In contrast, the myelinated vagus is suggested to facilitate a calm state, and to enable regulated responding (e.g. self-soothing and the inhibition of emotional arousal). The ability of the myelinated vagus nerve to rapidly withdraw its inhibiting effect allows for rapid engagement and disengagement according to inner and outer situations, without the metabolic high cost of activating the sympathetic nervous system. Porges

(2017) postulates that this circuit is the physiological basis for feelings of compassion for self and others.

The neurovisceral model (Thayer & Lane, 2000; 2009) postulates that vmHRV is a peripheral correlate of the ability of the brain's integrative system for emotion regulation to modulate emotional responses in accordance with the demands of a given situation. A cluster of central nervous system structures termed the central autonomic network (CAN; Berntson et al., 1997) is suggested to modulate the activity of the vagus nerve. This happens through inhibition processes, in which the prefrontal cortex has inhibitory control over subcortical structures like the amygdala (Beauchaine & Thayer, 2015). In turn, the amygdala has inhibitory control over the vagus nerve, so that amygdala-mediated inhibition of the vagus nerve leads to increase in heart rate. High levels of vmHRV is thus suggested to indicate the prefrontal cortex' ability to inhibit amygdala activation and reinstate vagal control over heart rate. And contrary, low levels of vmHRV should indicate a reduced capacity of the prefrontal cortex to inhibit amygdala activation, leading to reduced autonomic flexibility. As such, the theory suggests that individuals with high vmHRV should have a well-functioning capacity of the prefrontal cortex to control central and peripheral functioning, resulting in more adaptive emotion regulation.

VmHRV is typically measured using electrocardiogram (ECG) equipment. The ECG provides inter-beat intervals, and one heartbeat is registered through the main components of Q, R and S. The R spike is the most visibly detectable (see figure 2). It represents the depolarization of the heart's ventricles and is used to assess the inter-beat interval (Laborde, Mosley, & Thayer, 2017). Thus, the inter-beat intervals are usually referred to as "R-R intervals", or - to illuminate that they are normal heartbeats - "normal to normal (N-N) intervals". Resting vmHRV is measured during short-term periods in which an individual is seated or lying down, asked to breathe normally, and relax with eyes open (Quintana, Alvares, & Heathers, 2016). This is proposed to derive tonic vmHRV levels, and vmHRV is indeed proposed as a trait or dispositional measure (Thayer & Lane, 2000). VmHRV may also be measured for a longer period of time (typically 24 hours), using ambulatory equipment.

Alternatively, it is possible to measure how participants' vmHRV is affected by stimuli, such as stressful tasks like having to give a speech - termed phasic vmHRV.

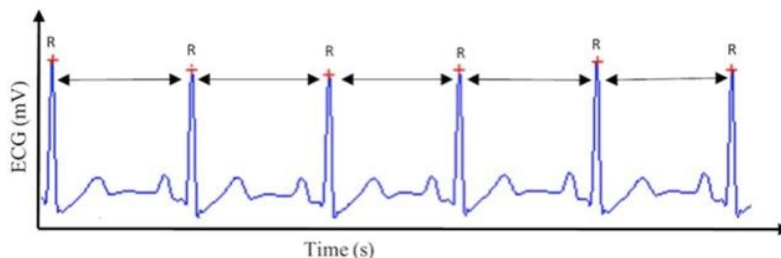


Figure 2: Illustration of the R-R interval (interbeat interval) extracted from the electrocardiogram signal. VmHRV is calculated based on the R-R intervals. Adapted from Laborde et al. (2017) with permission.

Several different components may be calculated from the ECG matrix (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). The most broadly recognized measures suggested to reflect vagal (i.e. parasympathetic) activity are the root mean square of successive differences (RMSSD) between normal heartbeats, and the high frequency (HF; Task force, 1996). RMSSD is a time domain measure, which means that it is based on differences between inter-beat intervals. HF is a frequency domain method, in which a power spectrum density (PSD) estimate is calculated for the NN interval. Three main spectral components are distinguished: very low-frequency (VLF; 0-0.04 Hz), low-frequency (LF; 0.04-0.15), and high-frequency (HF; 0.15-0.4 Hz) components.

1.4.2 The relation between self-compassion and vmHRV

Self-compassion is proposed to stimulate physiological systems associated with stress reduction and feelings of safeness and contentment (Gilbert, 2009). Treating oneself in a caring, supportive, and reassuring way is proposed to have similar physiological effects as early attachment experiences of being soothed by a significant caregiver

(Gilbert, 2009). It is suggested to down-regulate activity in the threat protection system, associated with continual self-criticism and hyperactivity of the sympathetic nervous system activity. Moreover, being self-compassionate is thought to activate or increase access to the soothing and contentment system, promoting a calm physiological state of reduced sympathetic arousal and enhanced parasympathetic activity. As increased vmHRV is suggested to be an indicator of parasympathetic activity and effective emotion regulation (Thayer & Lane, 2000), and the ability to self-soothe when stressed (Porges, 2007), self-compassion is likely to associate with increased vmHRV.

Indeed, research evidence indicates that self-compassion training associates with increased vmHRV (Arch et al., 2014; Kok et al., 2013; Rockliff, Gilbert, McEwan, Lightman, & Glover, 2008). One study (Arch et al., 2014), employing a female student sample, investigated the effect of a brief self-compassion intervention (45 minutes total over the course of five days) on participants' reactions to a social stress test. They found that participants in the experimental group had a lower reduction in vmHRV both before and after the social stress test as compared to the control group. Similar findings were obtained by (Kok et al., 2013) in a sample of University employees. The experimental group attended a longer course in lovingkindness meditation, consisting of one-hour sessions over the course of six weeks. Lovingkindness meditation is a contemplative practice focusing on self-generating feelings of compassion, love and goodwill toward oneself and others, often through rehearsing sentences such as "may I be safe, may I be peaceful". Results showed that the instrumental group had significantly increased levels of resting vmHRV levels post intervention as compared to the waiting list control group. A less straightforward result was obtained by Rockliff and colleagues (2008), using a student sample. Participants were asked to imagine receiving compassion. The results showed that some participants responded with increased vmHRV, as expected, however others showed a more threat-like response of reduced vmHRV. The authors speculate that this was due to some participants having high levels of self-criticism and insecure attachment styles, thus reacting to the compassionate imagery by a

threat response instead of soothing, which was supported in that participants responding with reduced vmHRV also had an increase in cortisol levels.

No previous study had investigated the relation between dispositional self-compassion and vmHRV, however dispositional self-compassion has been found to relate to biological markers of stress regulation other than vmHRV. For instance, higher dispositional self-compassion is shown to associate with lower levels of stress-induced blood inflammation (Breines et al., 2014), lower salivary alpha amylase concentration (Breines et al., 2015) in community samples, and immunological markers and blood sugar control in diabetic patients (Friis, Johnson, Cutfield, & Consedine, 2015). Together with the studies of trained self-compassion relating to vmHRV, these studies point to the likelihood of dispositional self-compassion associating with vmHRV.

1.4.3 Self-compassion, mindfulness, and vmHRV

The relation between mindfulness and vmHRV

More studies have examined the relationship between mindfulness and vmHRV than that of self-compassion and vmHRV. Interestingly though, the findings for the relation between dispositional mindfulness and vmHRV seem inconsistent, with one study (Prazak et al., 2012) reporting a positive association between higher levels of mindfulness and higher levels of vmHRV, whereas others failed to find a significant association (Brzozowski, Gillespie, Dixon, & Mitchell, 2018), or found a positive association only for certain subsets of participants (Fogarty et al., 2015; Mankus, Aldao, Kerns, Mayville, & Mennin, 2013). Mankus and colleagues (2013) found a positive association only for individuals high in anxiety (but not for those low in anxiety), and Fogarty and colleagues (2015) found an association only in men after a stress reduction task (but not in women). Finally, Kadziolka, Di Pierdomenico and Miller (2016) found the FFMQ subscales of “Observe” and “Acting with awareness” to relate to higher vmHRV, however these authors did not report the relation between vmHRV and the other FFMQ subscale scores nor the total FFMQ score.

Interestingly, findings seem to be more consistent when measuring effects of mindfulness training on vmHRV, instead of measuring dispositional levels of mindfulness. The majority of the studies have reported a positive relation between mindfulness training and increased levels of HRV (e.g. Azam et al., 2015; Delgado-Pastor, Perakakis, Subramanya, Telles, & Vila, 2013; Ditto, Eclache, & Goldman, 2006; Joo, Lee, Chung, & Shin, 2010; Krygier et al., 2013; May et al., 2016; Nijjar et al., 2014; Shearer, Hunt, Chowdhury, & Nicol, 2016; Takahashi et al., 2005; Tang et al., 2009; Watford & Stafford, 2015), however one study (Nyklicek, Mommersteeg, Van Beugen, Ramakers, & Van Boxtel, 2013) did not find an effect of mindfulness training on vmHRV. As mindfulness training has been shown to increase also self-compassion levels (Kuyken et al., 2010), however, these findings cannot necessarily be interpreted as to signify that mindfulness in itself relates to higher vmHRV.

May self-compassion provide additional protection against emotional stress symptoms beyond mindfulness?

In recent years there has been an increased interest in disentangling the effects of self-compassion and mindfulness on emotional distress (e.g. Van Dam et al., 2011). Given the previously described differences between self-compassion and mindfulness, Neff and Dahm (2015) argue that self-compassion may explain aspects of emotional distress beyond mindfulness. Indeed, dispositional self-compassion is found to associate with self-reported emotional distress and well-being in a higher degree than dispositional mindfulness (e.g. Baer, Lykins, & Peters, 2012; Beshai, Prentice, & Huang, 2018; Dahm et al., 2015; Van Dam et al., 2011; Woodruff et al., 2014; Woods & Proeve, 2014). In one study (Van Dam et al., 2011), self-compassion was found to account for ten times more unique variance in depressive symptoms, anxiety symptoms, worry, and quality of life than mindfulness as measured by the MAAS. Woodruff and colleagues (2014) aimed to replicate these findings using the FFMQ, since it is reckoned as a more comprehensive measure of mindfulness. Despite the added breath of the FFMQ compared to the MAAS, self-compassion was still a stronger predictor than mindfulness, indicating that the predictive superiority of self-compassion over mindfulness cannot be explained by weaknesses specific to the MAAS alone. Furthermore, dispositional self-compassion is found to be a stronger

predictor than mindfulness of self-reported shame proneness (Woods & Proeve, 2014), psychological well-being (Baer et al., 2012; Hollis-Walker & Colosimo, 2011), and traumatic stress symptoms (Dahm et al., 2015). Moreover, in a recent study (Beshai et al 2017), dispositional self-compassion associated more than dispositional mindfulness with lower depressive cognitions in response to a sad mood induction, and better abilities in spontaneous mood recovery. Moreover, in the previously described study by Kuyken and colleagues (2010), self-compassion was found more than mindfulness to act as a modulator of the toxic relationship between cognitive reactivity and relapse often seen in depressed patients.

Together these studies indicate that self-compassion may explain additional variance beyond mindfulness on self-reported outcome measures. It is thus possible that self-compassion also may explain additional variance in the ability to flexibly adjust physiological responses, as measured by vmHRV.

1.5 General summary

In summary, dispositional self-compassion has been found to relate with reduced symptoms of depression, anxiety and rumination, and increased mindfulness. Further, training in self-compassion has been found to relate with increased vmHRV.

However, we have identified three gaps in the current literature. First, the role of dispositional self-compassion as a mediator to the effects of dispositional mindfulness on reduced symptoms has not been examined. Second, no previous studies have examined the relation between dispositional self-compassion and vmHRV. Third, no previous studies have disentangled the effects of dispositional self-compassion and mindfulness on vmHRV.

2. Aims

The overall aim of this thesis was to examine how dispositional self-compassion relates with emotional stress symptoms (i.e. depressive symptoms, anxiety symptoms, and rumination), mindfulness and psychophysiological flexibility. Based on theory and previous study findings reviewed in the introduction, we predicted that higher levels of dispositional self-compassion would specifically protect against emotional stress symptoms.

2.1 Research questions and hypotheses for paper I

As reviewed in the introduction, much research has shown dispositional mindfulness to be inversely related to depressive symptoms, but there was scarce evidence on potential mediators of the relationship. The purpose of paper I was thus to investigate whether higher levels of self-compassion and lower levels of rumination could mediate the relationship, using a sample of healthy adults. The first hypothesis was that both self-compassion and rumination would be significant mediators of the relationship, and the second hypothesis was that self-compassion would explain variance beyond what could be explained by rumination.

2.2 Research questions and hypotheses for paper II

A large body of evidence indicates that dispositional self-compassion associates with better self-reported emotion regulation outcomes, such as reduced symptoms of depression and anxiety. However, there was a gap in the research literature regarding whether dispositional self-compassion associates with the psychophysiological measure of emotion regulation vagally mediated heart-rate variability (vmHRV). We thus aimed to examine the relation between dispositional self-compassion and vmHRV in a sample of healthy adults. We had four hypotheses. First, we predicted that self-compassion would associate with increased vmHRV measured during a 5-

minute resting condition. Second, we expected that the association between dispositional self-compassion and vmHRV would persist even when controlling for trait anxiety and rumination. Third, in order to ecologically validate the findings, we predicted that the relation between dispositional self-compassion and vmHRV would persist in a subsample wearing heartrate monitors for 24 hours. Finally, we expected to replicate previous study findings that self-compassion would associate with lower self-reported trait anxiety and rumination.

2.3 Research questions and hypotheses for paper III

Previous research has examined the relation between trained self-compassion and vmHRV, and between dispositional and trained mindfulness and vmHRV, generally reporting positive associations. Researchers have also compared dispositional self-compassion and mindfulness on diverse self-report outcomes of emotional distress, consistently finding that self-compassion exceeds mindfulness in explaining such self-report outcomes. Despite these lines of research, we were unable to identify any studies comparing dispositional self-compassion and mindfulness on vmHRV.

In this paper, we therefore wanted to expand previous research by adding the psychophysiological measure of vmHRV as an outcome measure. Our first hypothesis was that dispositional self-compassion would explain variance beyond that which could be explained by mindfulness on vmHRV. Further, we aimed to replicate previous findings using the self-report measures of trait anxiety and rumination as outcome measures.

3. Methods

3.1 Methods and procedures paper I

3.1.1 Participants paper I

We gathered the data used in this paper during the spring of 2012. In order to increase the sample's heterogeneity and gender distribution, we invited undergraduate students from three different fields of study - psychology, medicine and engineering, to participate in the study. The sample consisted of 155 women and 116 men ($N = 277$, mean age = 22.9, $SD = 3.55$). Psychology undergraduate students constituted 53% of the sample, medical undergraduate students constituted 22%, and engineering undergraduate students constituted 25% of the sample. Of a total of 309 questionnaires, 282 were returned (response rate: 91.3%). Five cases were excluded as they did not reach the criteria of having answered 80% of all scales, thus the sample consisted of 277 students.

3.1.2 Procedure and measurements paper I

Questionnaire packages were administered to undergraduate psychology and medical students at the University of Bergen, and engineering students at Bergen University College. Participants received the questionnaires at the beginning of a lecture and completed them during a 15-minute break. The questionnaire package consisted of the Five Facet Mindfulness Questionnaire (FFMQ), the Self-Compassion Scale (SCS), the Rumination subscale of the Reflection-Rumination questionnaire (RRQ-RUM) and the Depression subscale of the Symptom Checklist-90 revised (SCL-90-R).

Measures

Five Facet Mindfulness Questionnaire (FFMQ)

The FFMQ (Baer et al., 2006) was used to measure levels of dispositional mindfulness. As previously described, this scale consists of 39 items measuring five

mindfulness skills; observing (e.g. “When I’m walking, I deliberately notice the sensations of my body moving”), describing (e.g. “It’s hard for me to find the words to describe what I’m thinking”; reverse scored item), acting with awareness (e.g. “When I do things, my mind wanders off and I’m easily distracted”; reverse scored item), non-judging of inner experiences (e.g. “I tell myself that I shouldn’t be thinking the way I’m thinking”; reverse scored item), and non-reactivity to inner experiences (e.g. “I watch my feelings without getting lost in them”). Each item is rated on a five-point likert-type scale ranging from one (“never or very rarely true”) to five (“very often or always true”). The FFMQ has been shown to have high construct validity (Baer et al., 2006; Baer et al., 2008). The five subscales are shown to be internally consistent, with alpha coefficients ranging from .76 to .91 (Baer et al., 2006). In the present study we used a Norwegian translation of the scale (Dundas, Vollestad, Binder, & Sivertsen, 2013), and the Cronbach’s alpha for the total FFMQ was .82, indicating adequate internal consistency.

Self-Compassion Scale (SCS)

The SCS (Neff, 2003a) was used to measure levels of dispositional self-compassion. It consists of 26 items measuring the previously described components of self-kindness (e.g. “I’m kind to myself when I’m experiencing suffering”), common humanity (e.g. “When I feel inadequate in some way, I try to remind myself that feelings of inadequacy are shared by most people”), mindfulness (e.g. “When something upsets me I try to keep my emotions in balance”), self-judgment (e.g. “I’m disapproving and judgmental about my own flaws and inadequacies”), isolation (e.g. “When I think about my inadequacies, it tends to make me feel more separate and cut off from the rest of the world”), and overidentification (e.g. “When something painful happens I tend to blow the incident out of proportion”). Items are rated on a five-point Likert -type scale ranging from 1 (“almost never”) to 5 (“almost always”). High scores on the positive subscales and low scores on the negative subscales reflect an overall high level of dispositional self-compassion. The SCS has shown good reliability and cross-cultural validity (Neff et al., 2008). In the present study we used a Norwegian translation of the self-compassion scale (Dundas, Svendsen, Wiker,

Granli, & Schanche, 2016), and the Cronbach's alpha for the total SCS was .91, indicating good internal consistency.

Rumination subscale of the Reflection-Rumination questionnaire (RRQ-RUM)

The rumination subscale of the RRQ (Trapnell & Campbell, 1999) was used to measure levels of dispositional brooding rumination. The scale consists of 12 items, and examples of items are "I always seem to be "re-hashing" in my mind recent things I've said or done", "I tend to "ruminate" or dwell over things that happen to me for a really long time afterward", "I spend a great deal of time thinking back over my embarrassing or disappointing moments". Each item is rated on a five-point Likert -type scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). We used a Norwegian translation of the RRQ-Rum scale which has shown high internal reliability (Cronbach's alpha = .91; Verplanken, Friborg, Trafimow, Woolf, & Wang, 2007).

Depression subscale of the Symptom Checklist-90 revised (SCL-90-R)

The depression subscale of the SCL-90-R (Derogatis, Lipman, & Covi, 1973) was used to measure levels of depressive symptoms. It consists of 13 items reflecting several core symptoms of depression, including lack of energy, loss of interest, suicidal thoughts, feelings of loneliness, and feelings of hopelessness about the future. Each item is rated on a five-point Likert -type scale, ranging from 1 ("not at all") to 5 ("very much"), and respondents are asked to indicate how much they have been bothered by the symptoms during the past seven days.

3.1.3 Statistical analyses paper I

Bivariate correlational analyses were performed to show the relationship between levels of mindfulness, self-compassion, rumination and depressive symptoms. In order to test the hypothesis that levels of self-compassion and rumination mediated the relationship between levels of mindfulness and depressive symptoms, a bootstrapping procedure was conducted using the "Indirect" macro (Preacher &

Hayes, 2004) for SPSS. This macro was also used to test the second hypothesis that the level of self-compassion was a stronger mediator than the level of rumination, i.e. through obtaining a contrast effect obtained through subtracting the cross product of one path from the cross product of the other path. The bootstrapping procedure produces a confidence interval which is based on an empirically derived sampling distribution. Bootstrapping is regarded as superior to the Sobel test, as it does not impose the assumption of normality of the sampling distribution and enables inclusion of several mediators in the model.

3.1.4 Ethical considerations paper I

Informed consent was obtained from all participants. Participants were given written and oral information about the study and the study aims. Participants were informed that participation was voluntary and anonymous, and that they were free to resign at any point without consequences. They received no compensation for participating in the study. As no data contained identifying information, we received confirmation that neither the Regional Committee for Medical Research Ethics for Western Norway nor the Norwegian Data Inspectorate required notification of the study. All procedures were in accordance with the Helsinki declaration.

3.2 Methods and procedures paper II

3.2.1 Participants paper II

Data used in this paper was gathered during the fall and spring of 2014. Participants were recruited through internal announcements to the University of Bergen student population, to a pilot study for a larger randomized controlled study on the effects of mindfulness-based cognitive therapy. The pilot consisted of three 2,5 hour sessions and one all day-retreat, and data was gathered pre and post this intervention. Only the pre-data were used in the present thesis. Initially 56 participants were included,

however three participants were excluded from further analysis due to poor data quality on the five-minute resting vmHRV measurements. The final sample thus consisted of 53 participants (36 (68 %) female, mean age = 23.6 years, SD = 2.52).

A subsample of 34 of these participants wore 24-hour heart rate monitors, however eight were excluded from further analysis due to poor data quality. Thus, the subsample consisted of 26 participants. This subsample was representative of the main sample with respect to gender distribution, age range and BMI (16 (62 %) women; mean age = 23.85; SD = 2.72).

Exclusion criteria were heart conditions, previous formal experience with mindfulness, and severe psychiatric illness or usage of sedative or psychoactive medication.

3.2.2 Procedure and measurements paper II

In order to control for circadian effects, the data were collected in approximately the same time in the afternoon. Participants were asked not to drink caffeine, smoke or exercise six hours prior to the experiment. When arriving on the testing day, participants received detailed explanations of the tests they would undergo, but no information about our hypotheses. They were then asked to fill out a package of questionnaires, including the SCS, as well as information about age, gender and BMI. They were then asked, one at a time, to move to an experimental room where their heart rates were recorded with an electrocardiogram (ECG). Directly thereafter, the subsample selected for wearing 24-hour monitors had the monitors attached.

Measures

Levels of dispositional self-compassion were assessed using the Self-Compassion scale (SCS) and brooding rumination was assessed using the rumination subscale of the Rumination-Reflection Questionnaire (RRQ-Rum). Both these instruments are described under 3.1.2.

Trait scale of the State-Trait Anxiety Inventory (STAI)

The trait scale of the STAI (Spielberger et al., 1983) was used to measure levels of trait anxiety. The scale consists of 20 items. Examples of items are “I worry too much

over something that really doesn't matter" and "I have disturbing thoughts".

Items are rated on a four-point Likert -type scale ranging from 1 ("almost never") to 4 ("almost always").

The trait scale of the STAI has been shown to have excellent internal consistency (average $\alpha < .89$) and test-retest reliability (average $r = .88$; L. Barnes, Harp, & Jung, 2002).

VmHRV

In order to collect resting vmHRV data, we followed established recommendations for set up (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). The data was recorded using a lead-II ECG at a 1000 Hz sampling rate using a Biopac 4.0 BSL (Biopac Systems, Inc., Santa Barbara, CA). Resting vmHRV was collected during a five-minute resting period with the following instruction: "Give yourself some time to find a position that feels comfortable. See if you can breathe slowly, and relax as much as possible."

The data were first checked manually for artifacts (movement, extraordinary peaks, electrode noise) off-line, and were then subjected to analysis using Kubios version 2.0 (Tarvainen, Niskanen, Lipponen, Ranta-aho, & Karjalainen, 2014). The frequency band between 0.04 and 0.14 Hz was defined as low-frequency, and the band between 0.14-0.4 was defined as high frequency. We applied the root mean square of successive differences (RMSSD), which is considered a valid measure of vmHRV (Li et al., 2009; Thayer & Sternberg, 2006; D. P. Williams et al., 2015). RMSSD is reported to have high trait specificity (Bertsch, Hagemann, Naumann, Schachinger, & Schulz, 2012), implicating that a one-time assessment of RMSSD predominantly indicates a physiological trait measure (D. P. Williams et al., 2015).

To collect 24-hour inter-beat interval (IBI) data, Actiheart monitors (Cambridge Neurotechnology, Cambridge, UK) were used. Actiheart monitors has shown to produce reliable IBI data (Brage, Brage, Franks, Ekelund, & Wareham, 2005). Using two adhesive Ag/AgCl ECG electrodes (T815 Dia. 55), the monitor was placed horizontally below the apex of sternum, midway below the V1 and V2. The IBI data

was transferred to a computer using the Actiheart commercial software (Actiheart software 2.132). Noisy and missing data was edited using the manufacturer's algorithm (Cambridge Neurotechnology Ltd.; Brage et al. 2005). The data was then inspected manually, and remaining artifacts were removed. The data were subsequently analyzed using Kubios version 2.0 (Tarvainen et al., 2014), and RMSSD was calculated. Trend components were removed using the smoothness priors detrending method ($\lambda = 500$).

3.2.3 Statistical analyses paper II

VmHRV measures were log transformed in order to approximate a normal distribution. The data were statistically analyzed using the Statistical Package for the Social Sciences version 24.0.

A multiple hierarchical linear regression analysis was conducted to investigate the relation between dispositional self-compassion and resting vmHRV when controlling for the potential covariates of age, gender, and BMI. Thus, age, gender, and BMI were entered as covariates in the first step of the analysis, and the SCS total score was entered in the second step as a predictor (i.e. with *F* analysis of change in explained variance from step one to step two). In order to examine whether this relationship persisted when using two other 5 min resting vmHRV measures (HF and NN50), we repeated this procedure using HF and NN50 as outcome variables. HF refers to high-frequency variability, whereas NN50 refers to the number of pairs of successive NN intervals that differ by more than 50 ms.

In order to examine whether the relationship between dispositional self-compassion and vmHRV would persist also when controlling for trait-anxiety and rumination, residual scores of trait-anxiety and rumination (where the variance explained by the SCS total score had been extracted from the trait-anxiety and rumination scores in linear regression analyses) were added as covariates together with age, gender and BMI.

Pearson bivariate correlational coefficients were calculated to examine the relation between 5 min resting vmHRV, the total score of SCS, subscale scores of SCS, trait anxiety, and negative rumination, and 24 hours vmHRV.

In a partial correlation analysis, we examined the relation between dispositional self-compassion and 24-hour vmHRV when controlling for the covariates of age, gender, and BMI.

3.3 Methods and procedures Paper III

3.3.1 Participants paper III

The sample in Paper III was identical to the one used in Paper II, see the description under 3.1.1.

3.3.2 Procedure and measurement paper III

The procedure was identical to the one employed in Paper II. Measures used in the study were the FFMQ, the SCS, the Rumination Subscale of the RRQ, all of which are described under point 3.1.2, as well as the trait scale of the STAI described under point 3.2.2.

Resting vmHRV

The applied vmHRV measure was HF. HF is the most commonly used in previous research examining associations between self-compassion, mindfulness and vmHRV (Azam et al., 2015; Delgado-Pastor et al., 2013; Kok et al., 2013; Krygier et al., 2013; May et al., 2016; Nijjar et al., 2014; Nyklicek et al., 2013; Takahashi et al., 2005; Tang et al., 2009; Watford & Stafford, 2015) and is considered a valid measure of vmHRV (Li et al., 2009; Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996; Thayer & Sternberg, 2006; D. P. Williams et al., 2015).

3.3.3 Statistical analyses paper III

VmHRV measures were log transformed in order to approximate a normal distribution. The data were statistically analysed using the Statistical Package for the Social Sciences version 24.0.

Pearson bivariate correlational coefficients were calculated to examine the relationship between vmHRV, the SCS scores, and the FFMQ scores. Two linear hierarchical regression analyses were conducted in order to test the common and unique explained variance of the total scores of the FFMQ and the SCS on the level of vmHRV. To examine the unique explained variance of the FFMQ and the SCS, the first regression model had the FFMQ entered in the first step, and the SCS in the second step, whereas the second regression model had the SCS entered in the first step in the FFMQ in the second step (i.e., with *F* analysis of stepwise change in explained variance). In these two regression models, effects were adjusted for level of BMI and gender. The common and unique explained variance of the FFMQ and the SCS, respectively, were also examined with the outcome variables of self-reported levels of anxiety and rumination, presented in Supplemental Material.

3.3.4 Ethical considerations paper II and III

All participants completed written informed consent in accordance with the Helsinki declaration. The study protocol was approved by the Regional Committees for Medical and Health Research Ethics - South East Norway, Gullhaugveien 1-3, 0318 Oslo (study number 2014/148). Participants received oral and written information about the procedures they would undergo. They were informed that participation was anonymous and voluntary, and about the right to resign at any point without consequences. No monetary compensation was given for participation; however participants received a short mindfulness intervention consisting of three 2,5 hour sessions and one all-day silent retreat free of charge.

4. Results

4.1 Results paper I

Pearson bivariate correlations showed that higher levels of FFMQ were inversely correlated with higher scores on Depressive subscale of the SCL-90 ($p < .001$). Higher levels of FFMQ were inversely correlated with the proposed mediator of RRQ-rum ($p < .001$), and positively correlated with the other proposed mediator of SCS ($p < .001$). Higher levels of RRQ-rum were positively correlated with the Depressive subscale of the SCL-90 ($p < .001$), and higher levels of SCS were inversely correlated with the Depressive subscale of the SCL-90 ($p < .001$). The proposed mediators were inversely correlated ($p < .001$).

The results of the mediation analysis using bootstrapping were in accordance with our first hypothesis that both higher levels of SCS and lower levels of RRQ-rum mediated the relationship between mindfulness and depressive symptoms. Results also supported our second hypothesis that self-compassion would explain variance in depressive symptoms scores beyond that which could be explained by rumination. However, rumination could also explain variance in depression scores beyond that which could be explained by self-compassion, indicating that the past via rumination and self-compassion both contributed uniquely to predict depression scores. Results also indicated that none of the mediators were stronger than the other.

4.2 Results paper II

A multiple hierarchical linear regression analysis showed that the SCS total score significantly explained the variance in 5-min resting vmHRV (RMSSD) after controlling for the effects of age, gender and BMI. The SCS total score explained 12% of the variance in vmHRV after controlling for these three covariates and was the only significant contributor to explaining the variance. This was validated using

two other 5-min resting vmHRV-measures (HF and NN50, displayed in Supplementary data).

Second, we found that the SCS total score significantly explained vmHRV even when controlling for residual scores of trait anxiety and negative rumination in addition to the covariates of age, gender and BMI. The SCS total score explained 11% of the variance in vmHRV after controlling for the effects of these variables, and the SCS was the only significant contributor to explaining the variance in vmHRV.

Third, the relationship between the SCS total score and vmHRV was ecologically validated with a subsample wearing heartrate monitors for 24 hours. Controlling for the covariates of age, gender and BMI, the SCS total score significantly explained the variance in vmHRV in a partial correlation analysis.

Pearson bivariate correlation analyses showed that higher levels of the SCS total score significantly correlated with higher vmHRV. Lower levels of the negative SCS –subscales (self-judgment, isolation, and overidentification) correlated with higher vmHRV. The positive SCS-subscale self-kindness was marginally ($p=.06$) associated with vmHRV. Likewise, higher levels of trait anxiety marginally correlated with higher levels of vmHRV. Higher levels of rumination did not correlate with levels of vmHRV. The SCS total score correlated with the 24-hour vmHRV at the same level as it correlated with the five-minute resting vmHRV.

4.3 Results paper III

Pearson bivariate correlations showed that there was a significant relation between the total scores of the SCS and the FFMQ, as well as between the total scores of the SCS and the FFMQ and all SCS and FFMQ subscale scores. Only the SCS total scores, and not the FFMQ total score, related significantly to level of vmHRV (HF). Higher scores on the SCS subscale isolation related significantly to higher vmHRV, and the SCS subscale of self-judgment showed a trend to association with higher vmHRV ($p=.06$). None of the other SCS subscales nor the FFMQ subscales correlated significantly with vmHRV. The demographic variables of BMI, gender, and age did not significantly correlate with vmHRV.

Hierarchical linear regression analyses showed that only the SCS total scores, and not the FFMQ total scores, significantly explained variance in vmHRV. Regardless of whether the FFMQ total scores were included in the first or the second step of the model, the FFMQ total scores did not significantly explain vmHRV. The SCS total scores explained 7.3% of the level of vmHRV when the FFMQ total scores were entered in the first step of the model and explained 11.7% when the SCS total scores were included in the first step. Results thus supported our hypotheses, indicating that dispositional self-compassion explained variance beyond dispositional mindfulness on vmHRV.

Regarding the outcome measures of STAI-T and RRQ-Rum, hierarchical linear regression analyses showed that both the FFMQ and the SCS significantly explained lower levels in these variables when entered in the first step of the model. Whether entered in the first or second step, the SCS total scores explained more variance than the FFMQ total scores.

5. Discussion

5.1 General discussion of the main findings

The overall objective of the present thesis was to investigate how dispositional self-compassion relates with emotional and psychophysiological functioning in healthy adults. The findings supported the *á priori* expectations that higher levels of self-compassion associated with higher levels of mindfulness, lower levels of emotional stress symptoms, and with higher levels of psychophysiological flexibility. Specifically, we found higher levels of dispositional self-compassion to be an important mediator of the relationship between higher levels of mindfulness and lower levels of depression, to relate with higher levels of vmHRV, and to explain higher levels of vmHRV as well as lower levels of emotional stress symptoms beyond mindfulness. All in all, the findings support previous research indicating that self-compassion represents an adaptive form of self-responding facilitating flexible mental and physiological functioning. In the following, the thesis' main questions will be discussed, relating to the role of self-compassion as a mediator to mindfulness, and its association with psychophysiological flexibility.

5.1.1 Self-compassion and rumination as mediators of the association between mindfulness and lower depressive symptoms.

As expected, we found self-compassion to positively mediate the effect of being mindful in leading to a lower tendency to experience depressive symptoms. High levels of rumination showed to negatively mediate the relationship. This supports the opposite effects of self-compassion and rumination in relation to depression. No previous study had examined dispositional self-compassion as a mediator of the relation between dispositional mindfulness and reduced levels of depressive symptoms. However, the finding is consistent with theory and data indicating that self-compassion is one of the key mechanisms of change in MBCT (Holzel et al., 2011; Kuyken et al., 2010; van der Velden et al., 2015). The finding is thus in

accordance with a previous study (Kuyken et al., 2010) reporting that increases in self-compassion after an MBCT intervention protected against depressive symptoms and cognitive reactivity to induced sad mood. Two recent studies, also examining effects of mindfulness-based interventions, reported similar findings. Duarte and Pinto-Gouveia (2017) found that increases in self-compassion mediated the effect of a six-week mindfulness intervention (based on MBSR principles) on reduced levels of depression in a sample of nurses. Likewise, Takahashi and colleagues (2019), using a Japanese sample of patients suffering from depression and anxiety, found that increased self-compassion mediated the effects of a mindfulness intervention on reduced levels of depression. Both these studies further support the notion that mindfulness works to reduce depressive symptoms through increasing self-compassion.

However, we expected *à priori* self-compassion to act as a stronger pathway between mindfulness and depression than rumination, which the results did not support. This suggests that both increased self-compassion and reduced rumination represent important pathways. The relative effect of self-compassion vs rumination as mediators has to our knowledge not been examined in other research on the relation between mindfulness and depressive symptoms. However the role of rumination as a mediator is in accordance with previous evidence suggesting rumination as a mediator of the effect of dispositional mindfulness (Alleva et al., 2014; Coffey & Hartman, 2008; Desrosiers et al., 2013) and mindfulness training (e.g. Heeren & Philippot, 2011; Jain et al., 2007; Labelle et al., 2010; van Aalderen et al., 2012) on depressive symptoms. Although there are some contradictory findings in the previous literature, in which one study failed to find a significant effect of rumination in mediating the mindfulness-depressive symptoms relationship (Kearns et al., 2016), some newer studies provide additional evidence supporting its mediating effects. For instance, Petrocchi and Ottaviani (2016), studying a sample of university employees and students over the time course of two years, found that rumination mediated the relationship between higher levels of non-judging mindfulness and lower levels of depressive symptoms. Likewise, Jury and Jose (2019) found that rumination represented a longitudinal mediator between dispositional mindfulness and depressive

symptoms in a nonclinical sample of adults. They found that higher levels of mindfulness predicted reduced rumination three months later. In turn, reduced rumination positively predicted reduced depressive symptoms three additional months later. This indicates that rumination indeed represents a pathway through which mindfulness works in reducing depressive symptoms.

However, the present findings do not imply that self-compassion and rumination are the only mediators of the inverse relationship between mindfulness and depressive symptoms. Support has been found for several other potential mediators, such as emotion regulation (e.g. VeIotti, Garofalo, & Bizzi, 2015), decentering (i.e. the ability to observe thoughts and emotions as transitory events; Carmody, Baer, E, & Olendzki, 2009), and attention regulation skills (i.e. the capacity to consciously control attentional focus; van den Hurk, Gionmi, Gielen, Speckens, & Barendregt, 2010). Being a complex construct, it is likely that mindfulness works to reduce depressive symptoms through several pathways, and elucidating these potential pathways represents an important avenue for future research.

5.1.2 Self-compassion relating to higher vmHRV, and lower anxiety and rumination

Another main finding of the present thesis is that higher dispositional self-compassion relates with the more objective psychophysiological outcome measure of vmHRV, in addition to self-reports. Despite the consistent inverse associations found between dispositional self-compassion and emotional stress symptoms in previous literature (e.g. MacBeth & Gumley, 2012), no previous study had examined the relation between dispositional self-compassion and vmHRV. In addition to relating to higher resting levels of vmHRV, we found that higher dispositional self-compassion also related to higher levels of an ambulatory 24-hour vmHRV measure, in a subsample of participants. This serves to ecologically validate that the predictive effect of higher levels of trait self-compassion on resting vmHRV was representative for the participants' everyday lives. Moreover, we replicated previous study findings (e.g. MacBeth & Gumley, 2012; Raes, 2010) that self-compassion associates with

lower anxiety and rumination. We found that the positive association between self-compassion and vmHRV could not be explained by anxiety nor rumination, as it persisted even when controlling for these self-reported emotional stress symptoms. In sum, this indicates that having a high tendency to meet oneself in a compassionate way enables a better ability to physiologically adapt emotional responses. This is in accordance with theories suggesting that self-compassion serves to activate the safeness and contentment system and deactivate the threat protection system, thus allowing for more flexible interplay between the parasympathetic and sympathetic branches of the autonomic nervous system (Gilbert, 2005). It is further in accordance with the theories of Porges (2007) and Thayer and Lane (2000; 2009) proposing that a better ability for emotion regulation may be reflected in an enhanced vagal inhibition.

When these findings were published in 2016, no previous study had examined the relationship between dispositional self-compassion and vmHRV. Recently two new studies (Ceccarelli, Giuliano, Glazebrook, & Strachan, 2019; Luo, Qiao, & Che, 2018) have examined the relationship. Like our study, Luo and colleagues (2018) used a student sample, but in contrast to our study they included a social stress test (consisting of preparing for a mock job interview and giving a speech). They found that individuals with higher levels of dispositional self-compassion showed higher vmHRV in response to the stress test as compared to individuals lower in self-compassion. Individuals high in dispositional self-compassion also reported less negative affect in response to the test than individuals lower in self-compassion. However, it should be noted that the study's sample consisted of only men, and in addition was relatively low ($n=34$). Ceccarelli and colleagues (2019) used a larger sample ($n=91$), consisting of national level athletes. They also included a stress test, but rather than being of social-evaluative nature it consisted of recalling a previous incident of sports failure, while vmHRV was recorded. The results showed that participants higher in dispositional self-compassion had lower reductions in vmHRV in response to recalling the failure. These two studies further support our finding that higher levels of self-compassion are associated with higher vmHRV.

Our finding of a positive association between dispositional self-compassion and vmHRV is also consistent with previous studies linking state and trained self-compassion to increased vmHRV (Arch et al., 2014; Kirschner et al., 2019; Kok et al., 2013; Matos et al., 2017; Petrocchi, Ottaviani, & Couyoumdjian, 2017; Rockliff et al., 2008). Since the publication of paper II, several new studies have been conducted establishing such links. For instance, Matos and colleagues (2017) examined the effect of a compassion intervention on vmHRV in a combined student and general community sample. The intervention consisted of a two-hour introduction session to different compassionate imagery practices, as well as written information and audio files that participants were encouraged to use during the following two weeks. Participants were also encouraged to employ self-compassion during challenging everyday life situations throughout the two weeks. The results showed that the experimental group had significant increases in resting vmHRV as compared to the control group. In another study (Petrocchi et al. 2017), employing a general population sample, participants were exposed to a short self-compassion intervention in which they were asked to repeat self-compassionate phrases to themselves for five minutes. Participants who looked at themselves in the mirror while repeating the phrases showed significantly higher vmHRV than participants who did not repeat self-compassion-phrases. The authors speculate that looking in the mirror may have made it easier for the participants to regard themselves from an external point of view, and regard themselves more objectively and less judgmentally. Further, in an interesting recent study, Kirschner and colleagues (2019) examined the effect of a brief self-compassion induction on resting vmHRV in a student sample. Different contingencies were designed to activate the three distinct emotional systems as outlined in Gilbert's (2009) theory (i.e contentment system, drive system, and threat system), and all groups listened to an audio file describing a scenario. The two first conditions were aimed at activating self-compassion and the contentment system; the first directly through a lovingkindness practice of offering friendly wishes toward oneself, and the second indirectly through directing compassionate attention to concrete body sensations in a compassionate body scan. The third was a positive excitement condition aimed at stimulating the drive system,

where participants were asked to think about a situation where they achieved something valuable. The fourth was a self-critical rumination condition aimed at stimulating the threat system, in which participants were asked to think about an unachieved assignment. The fifth was a neutral control, consisting of being guided through a routine grocery store scenario. Interestingly, although participants in both the self-compassion and drive/positive excitement groups showed increased state self-compassion and decreased self-criticism, only the self-compassion groups showed the psychophysiological pattern of increased vmHRV. This supports the specific role of self-compassion in activating the soothing contentment system.

Dispositional self-compassion may thus be understood as an emotion regulation strategy enabling people to respond more flexibly in potentially stressing situations. Self-compassion can be hypothesized to exert its effects on several levels of emotion regulation as outlined in the process model by Gross (2014), such as situation selection (choosing to approach or avoid certain situations), situation modification (trying to change aspects of a situation in order to modify its emotional impact), attentional deployment (directing attention toward more or less emotionally activating aspects of a situation), cognitive change (altering one's cognitive evaluations of a situation), and response modulation (trying to influence physiological, experiential or behavioral aspects of an emotion). For example, on the level of situation selection, self-compassionate individuals may be hypothesized to seek out more healthy situations, such as approaching friendly individuals or eating a healthy diet (Neff, 2003b), or putting themselves in situations eliciting feelings of common humanity, such as deciding to talk to friends about emotions. On the level of attentional deployment self-compassionate individuals may have less attentional biases towards threat cues and pay more attention to cues of safety or soothing (Finlay-Jones, 2017). On the level of cognitive change, self-compassionate individuals may have more access to cognitive reappraising situations in a positive manner. This may be illustrated in a study by Diedrich and colleagues (2016). Using a clinical sample, they found that the efficacy of cognitive reappraisal increased in participants who had employed self-compassion before being instructed to try to cognitively reappraise a negative situation. The authors conclude that self-

compassion facilitates the subsequent use of explicit cognitive reappraisal. Likewise, Karl, Williams, Cardy, Kuyken and Crane (2018) found that dispositional self-compassion was associated with the selection of more adaptive cognitive emotion regulations strategies in a sample of depressed outpatients.

Although we had a main focus on total scores of self-compassion, since we were interested in participants' daily tendencies to treat themselves compassionately, we also found that the negative components of self-compassion (i.e. self-judgment, isolation, and over-identification) correlated more strongly with the outcome measures than the positive subscales (i.e. self-kindness, common humanity, mindfulness). This is consistent with previous evidence that the negative subscales are more robustly associated with psychopathology. However, these previous research findings could be due to overlap in self-reported items, and therefore it was interesting that the negative components also seemed to associate more strongly than the positive ones with the psychophysiological measure of vmHRV in our study. A possible interpretation of this finding is that it is more important to treat oneself less unkindly than it is to actively treat oneself kindly. Indeed, some theorists (e.g. Hanson, 2009) argue that the brain has an evolved "negativity bias", in which one generally reacts more intensely to negative stimuli than to equally strong positive stimuli. Related to this, there has been debate as to whether the negative components should be included in the SCS, which will be further addressed in chapter 5.2.

5.1.3 Self-compassion relating to vmHRV beyond mindfulness

The third and final main finding of this thesis was that dispositional self-compassion as measured by the SCS was a stronger predictor of vmHRV than dispositional mindfulness as measured by the FFMQ. The SCS total scores predicted higher vmHRV whether controlling for the FFMQ total scores or not, indicating that self-compassion associates with a more flexible modulation of physiological responses.

This finding is in accordance with Neff and Dahm's (2015) suggestion that despite self-compassion having a close connection and overlap with mindfulness, it can be meaningfully distinguished from mindfulness in several ways that may be particularly important for stress regulation. For instance, self-compassion adds the

important element of self-soothing, which is thought to be connected to vagal activity (Porges, 2007). Moreover, self-compassion complements mindfulness by including feelings of common humanity, entailing the remembrance that painful experiences are normal and part of being human. Although feelings of self-soothing and common humanity may often accompany mindfulness of difficult experiences, so that self-compassion naturally co-arises with mindfulness, Neff and Dam (2015) argue that they do not *always* co-arise. For instance, it is possible to be mindfully aware of a painful emotion without actively soothing and comforting oneself and without actively remembering that the feelings are part of common humanity. Further, self-compassion's exclusive focus on painful experiences, such as stress or suffering, (as opposed to the broad focus on all sorts of experiences in mindfulness) may lead to self-compassion targeting emotional stress reactivity more explicitly. Finally, the target of self-compassion is one's own self, whereas the target of mindfulness predominantly is the experience one has, i.e. the thoughts, and emotions arising from moment to moment (Neff & Dahm, 2015). Thus, although both focus on acceptance, self-compassion is more targeted toward *self*-acceptance, whereas mindfulness typically focuses on acceptance of moment to moment experience (Germer & Neff, 2015). We (Visted et al., 2017) have previously shown that the ability to respond to difficulties with an accepting stance is associated with better psychophysiological stress regulation as indexed by higher level of vmHRV.

To our knowledge, no previous study has investigated the differential effects of dispositional self-compassion and mindfulness on vmHRV. However, our finding is consistent with previous research showing that self-compassion explains level of self-reported emotional distress and well-being beyond mindfulness, a finding we also replicated (with symptoms of anxiety and rumination). In previous research this has been shown with the outcome measures of depressive and anxiety symptoms (Van Dam et al., 2011; Woodruff et al., 2014), worry (Van Dam et al., 2011), psychological well-being (Baer et al., 2012; Van Dam et al., 2011), shame proneness (Woods & Proeve, 2014), and posttraumatic stress symptoms (Dahm et al. 2015). Furthermore, it has also been shown using sad mood inductions, in that self-

compassion explained variance beyond mindfulness in mood recovery (Beshai et al., 2018).

We found that the multifaceted construct of mindfulness as measured by the FFMQ did not significantly associate with level of vmHRV. In previous research examining associations between mindfulness and vmHRV, it seems that the most consistent positive association between level of mindfulness and vmHRV is found in studies measuring effects of mindfulness training (e.g. Delgado-Pastor et al., 2013; Ditto et al., 2006; Nijjar et al., 2014; Shearer et al., 2016), rather than dispositional mindfulness. However, as described previously, mindfulness training is shown to increase levels of self-compassion (Kuyken et al., 2010; Shapiro et al., 2005), hence effects of such training may encompass also augmented levels of self-compassion. In previous studies investigating the relationship between dispositional mindfulness and level of vmHRV, a significant association seems predominantly to have been found under stress contingencies (Fogarty et al., 2015; Kadziolka et al., 2016), and with high levels of anxiety symptoms (Mankus et al., 2013). In contrast, we measured resting levels of vmHRV, as resting levels have been highlighted to be a trait marker of psychophysiological flexibility (Thayer, Hansen, Saus-Rose, & Johnsen, 2009; Thayer & Lane, 2009).

There are indications that negative stress indicators more strongly predict level of vmHRV than positive, competence measures (Silvia, Jackson, & Sopko, 2014; D. P. Williams et al., 2017). This may represent another explanation why self-compassion associates stronger with higher vmHRV than mindfulness in our study, due to the greater focus on suffering in self-compassion. Like paper one and two, we were interested in the global constructs of self-compassion and mindfulness, and thus chose total scores of the SCS and FFMQ, respectively, as indicative of these abilities. However, some previous studies have reported that the predictive strength of the FFMQ is increased when it is analyzed as subscales rather than a total score. For instance, in one study (Woodruff et al., 2014) it was shown that although total scores of the SCS predicted greater variance than mindfulness as measured by the FFMQ, when individual scores were considered they predicted equal variance in negative

outcome measures (although the SCS subscales still were the best predictors of positive outcome measures).

Further, it has been raised concerns that mindfulness may tap into higher-order cognitive processes that are challenging for individuals to self-report on (Van Dam et al., 2011). It is possible that it is easier for participants to self-rate their level of positive attitudes toward themselves than it is to self-report frequency of past mindful states (Van Dam et al., 2011), and that this may contribute to explain the lack of significance association between mindfulness and vmHRV in our study. Using self-reports to measure these complex constructs may restrict richer understanding of them (Grossman & Van Dam, 2011). Indeed, there are several inherent difficulties to measuring abstract and complex constructs using self-report scales, an issue we will further discuss in the next section.

5.2 Methodological discussion

5.2.1 Validity

Issues with self-reports in general

Self-report measures are prone to several biases which may compromise construct validity, i.e. the extent to which the measure assesses the phenomenon of interest (Kazdin, 2014). Answering questions related to one's own mental habits and behaviors is a difficult cognitive task (Schwarz & Oyserman, 2001), and it is likely that participants do not have a detailed memory or insight into all relevant behavior. Thus, participants' self-ratings might represent their own perceptions of levels of self-compassion and mindfulness rather than "objective" or true levels, and the validity thus relies on participants' memory and introspective abilities (e.g. Grossman & Van Dam, 2011). Self-reports may also be influenced by factors such as social desirability, in which one responds in a perceived socially acceptable manner rather than according to how one truly behaves or feels.

Another inherent problem with self-reports is that items may be interpreted differently by different individuals (Schwarz, 1999). This was demonstrated in a study (Brooks, Kay-Lambkin, Bowman, & Childs, 2012) that investigated self-

compassion using the SCS among clients with problematic alcohol use. There were some indications that items aimed at measuring self-kindness (for example “I’m kind to myself when I’m experiencing suffering”), was interpreted by participants in the meaning of using alcohol to self-medicate, rather than the intended meaning of self-kind behavior facilitating adaptive responding in the long term.

Issues pertaining to the SCS in particular

The psychometric properties of the SCS has recently been put into question, particularly regarding construct validity (i.e. whether the SCS truly measures self-compassion). Several theorists (e.g. Costa et al., 2016; Lopez et al., 2015; Muris, 2016; Muris et al., 2016; Muris & Petrocchi, 2017; Pfattheicher, Geiger, Hartung, Weiss, & Schindler, 2017) argue that the negative components (i.e. self-judgment, isolation and over-identification) should be excluded from the scale. They claim that the protective factor of being self-compassionate is best tapped by the positive components self-kindness, common humanity, and mindfulness, whereas the negative components are too similar to psychopathology (Muris et al., 2016) and neuroticism (Pfattheicher et al., 2017). Supporting the argument that the negative self-compassion components are redundant with neuroticism, Pfattheicher and colleagues (2017) found that they did not have incremental validity, i.e. did not predict life satisfaction above neuroticism.

Owing to this debate, some argue that it is not warranted to use a total score of SCS as indicative of participants’ level of self-compassion, as we have done in all three papers. Some (e.g. Costa et al., 2016; Lopez et al., 2015) have argued that rather than using a total score, one should distinguish between compassionate (i.e. consisting of self-kindness, common humanity, and mindfulness) versus uncompassionate (i.e. consisting of self-judgment, isolation, and over-identification) self-responding. Using confirmatory factor analyses studies Lopez and colleagues (2015) and Costa and colleagues (2016) found support for such a two-factor solution and did not find support for one overarching total score. Similarly, Williams, Dalgleish, Karl, and Kuyken (2014) found support for a six-factor structure (representing each of the subscales), but not for an overarching total score.

On the other hand, Neff (e.g. Neff, 2016a, 2016b; Neff, Toth-Kiraly, & Colosimo, 2018) argue that the use of a total score is warranted, and in line with the intention of the scale. As self-compassion is conceptualized as a dynamic system, the lack of self-compassion is as important to the definition as the presence of self-compassion and using a total SCS score to assess the relative balance of the systems components is meaningful. Theoretically, if two individuals displayed approximately the same levels of self-kindness, common humanity, and mindfulness, but the first individual was more self-judgmental, isolated, and overidentified than the second person, the first would be considered less self-compassionate. Support for this is reported in recent comprehensive examination of the SCS's factor structure (Neff et al., 2019), comprising a total of 20 samples of which 13 are international and seven from the United States. Neff and colleagues (2019) found support for the use of a total score and six subscale scores, but not support for use of the two compassionate versus uncompassionate scores. They state that it is problematic to argue that self-kindness, common humanity and mindfulness versus self-judgment, isolation and overidentification form unitary constructs, as proposed by for example Costa et al. (2016) and Lopez et al. (2015). They argue that three subscales are distinct, not unitary constructs, and that self-compassion is a higher-order integration of the three components. Support for use of a total score and six subscale scores was also found by Neff, Whittaker and Karl (2017) in four different samples consisting of students, community members, meditators, and individuals with recurrent depression.

However, given the multidimensional nature of self-compassion, and the fact that no one agreed-upon definition of self-compassion exists, more research is necessary to replicate the findings of the present thesis using other self-compassion scales, such as the FSCRS (Gilbert et al., 2004). In a review of definitions and measures of compassion, Strauss and colleagues (2016) conclude that no single measure existing today measures the construct accurately and request the development of a more psychometrically robust measure. However, they identify the SCS as the strongest self-compassion measure to date.

Issues pertaining to the FFMQ in particular

Like the SCS, the FFMQ has also been subject to psychometric criticism. For instance, a systematic review of mindfulness instruments (Park, Reilly-Spong, & Gross, 2013) concludes that the FFMQ (and other available mindfulness measures) do not have satisfactory evidence of content validity, i.e. evidence that they capture all essential aspects of mindfulness. Moreover, in a study examining the factor structure of the FFMQ (M. Williams et al., 2014), it was found that the observing subscale did not significantly load onto an overarching mindfulness factor in two non-meditating samples while it did in a meditating sample. This could be due to the items in this subscale having different meanings for meditators and non-meditators (e.g. Grossman & Van Dam, 2011; M. Williams et al., 2014). As we were interested in the global construct of mindfulness, like we were with the global construct of self-compassion, we chose to employ a total score of the FFMQ as a measure of the capacity for dispositional mindfulness. However, if meditation experience is a prerequisite for the observing facet functioning the intended way, it would perhaps be preferable to exclude this facet given our non-meditating sample. Thus, more research is necessary to further elucidate the relation between mindfulness and vmHRV.

VmHRV

Despite considerable theoretical rationale for expecting vmHRV to represent a biomarker of emotion regulation capacity (Appelhans & Luecken, 2006; Thayer & Lane, 2000), it should be noted that there are some contradictory findings in previous literature. For instance, a recent meta-analysis (Holzman & Bridgett, 2017) of 123 studies investigating relations between vmHRV and aspects of self-regulation (such as emotion regulation and executive functioning) yielded only a small effect size ($r=0.09$) of the relationship between vmHRV and better self-regulation. It is thus possible to question the specificity of vmHRV as a measure of emotion regulation capacity. Similarly, another recent meta-analytic investigation (Balzarotti, Biassoni, Colombo, & Ciceri, 2017) point out that several previous studies have failed to find a significant association between emotion regulation and vmHRV. However, they

conclude that despite these conflicting results existing literature support the use of vmHRV as a biomarker of emotion regulation.

Relatedly, the construct validity of vmHRV may be compromised by several confounding variables (Quintana & Heathers, 2014). Although we controlled for some (age, gender, BMI, rumination and trait anxiety), several other potential covariates were not taken account of, such as sleep, physical activity, smoking, and diet. Moreover, we did not record respiration rate, which may affect vagal tone (Ritz & Dahme, 2006). The influence of respiration rate is, however, shown to be differential depending on the vmHRV measure used. RMSSD seems to be less affected by the respiration rate compared with HF (Penttila et al., 2001). In our study, RMSSD and HF correlated highly ($r = .94$, $p > .001$), which indicates that respiration rate has not influenced our results significantly when relying on HF as an outcome measure. Thus, we used HF as the vmHRV measure in paper III partly because it was the most commonly used measure in previous research examining the associations between self-compassion, mindfulness and vmHRV. Using the HF index thus increased the ability to compare results from other, previous studies.

5.2.2 External validity

External validity refers to the degree to which the results can be generalized to other populations, settings, and circumstances (Kazdin, 2014). Both samples used in the present thesis consisted of healthy, well-functioning students with a limited age range. Moreover, although the gender distribution was more equal in the sample of the first study, the sample for the second and third paper consisted of a majority of females. Research has shown that women generally report lower self-compassion than men (Yarnell et al., 2015), and that individuals with lower education levels have lower self-compassion scores than individuals with higher education (Lopez, Sanderman, Ranchor, & Schroevers, 2018). Thus, the sample characteristics may reduce generalizability to other populations, such as the general community, clinical populations, older individuals, and less educated individuals. For instance, it is

possible that the link between dispositional self-compassion and vmHRV will not persist in less homogenous samples, such as depressed outpatients.

Relatedly, as we used a sample consisting of individuals without mindfulness experience, caution should be taken before generalizing the findings to individuals with mindfulness experience. It is possible that self-reported levels of dispositional mindfulness do not capture the actual practice of mindfulness meditation (Van Dam et al., 2018). Thus, although we found in paper III that self-compassion is more related to vmHRV than mindfulness, it is unknown whether this generalizes to meditating samples.

Moreover, as the samples of the second and third papers were self-selected, it is possible that they differ from the general population in important ways that reduce generalizability of the findings. For instance, it is possible that individuals self-recruiting to a study delivering mindfulness interventions are inherently more self-reflective or interested in gaining new insight in their own mental habits. Alternatively, it is possible that they have a higher stress level than the general population, motivating them to self-recruit to a program known in the media to have the possibility of stress reduction. Using a random sampling procedure to select participants could have increased external validity of our study.

Finally, our studies are performed in a particular cultural and historical context, and it remains to be seen if it persists in the future.

5.2.3 Reliability

Reliability refers to the consistency of a measure (Kazdin, 2014). In the original publication presenting the SCS (Neff, 2003a), internal consistency was shown to be good, with a Cronbach's alpha of .92. Since then, the SCS has evidenced good internal consistency across a wide variety of populations (e.g. Allen, Goldwasser, & Leary, 2012; Neff & Pommier, 2013; K. H. Werner et al., 2012). The Norwegian translation of the FFMQ showed a Cronbach's alpha of .86 (Dundas et al., 2013). In the current thesis, the Cronbach's alpha levels for the SCS and FFMQ were adequate

and in accordance with what is reported previously. Moreover, both the SCS (Neff, 2003a) and the FFMQ (Veehof et al 2011) have shown adequate test-retest reliability.

Resting vmHRV is in general shown to be a stable measure over time (Tarkiainen et al., 2005) with a high trait specificity (e.g., 73%; Bertsch et al., 2012).

5.3 Strengths and limitations of the dissertation

A strength of the thesis is the use of both self-report and psychophysiological measures, reducing susceptibility to same method variance. Further, a strength of the first study was the inclusion of participants from several areas of study, as well as a relatively equal gender balance, increasing generalizability of the findings.

However, there are several limitations important to address. A major limitation was the use of cross-sectional research designs, precluding casual inferences. In paper I, we proposed a causal chain from dispositional mindfulness to reduced depressive symptoms via increased self-compassion and reduced rumination, however we cannot rule out other causal relations. In order to determine whether mindfulness works to reduce depressive symptoms through self-compassion and rumination, the study design should ideally allow for the establishment of temporal precedence. This means that we should be able to determine if changes in the level of self-compassion and rumination (i.e. the mediators) occurred *prior* to changes in depressive symptoms (dependent variable; Kraemer, Wilson, Fairburn, & Agras, 2002). Future research using more rigorous and longitudinal designs are thus necessary in order to gain more knowledge about the causalities of these relationships. In future research more potential mediators should be taken into consideration in the same model, in order to gain a better understanding of potential shared variance between mediators and the processes explaining the effects of being mindful on reduced depressive symptoms.

Likewise, for paper II, the relation between self-compassion and vmHRV is not certain regarding causality. We hypothesized a causal chain from self-compassion to vmHRV, such that being self-compassionate positively influenced psychophysiological stress regulation. An alternative way of inferring the results may

be that the causal relation is opposite, namely that individuals' pre-existing levels of vmHRV influences the degree to which they have access and abilities to be compassionate toward themselves. An example of a study focusing on this causal relation comes from De Bruin, van der Zwan and Bogels (2016). They found that vmHRV bio- feedback training in which one systematically trained in increasing vmHRV in response to stimuli, led to higher self-compassion levels. This indicates that one's pre-existing vmHRV levels enables compassion. Yet another possibility is that they reciprocally influence each other, so that one's level of self-compassion affects the amount of vagal (parasympathetic) modulation of heart rate, which in turn also influences the amount of self-compassion one is able to access. More research is thus needed to gain more understanding of the causal relations between self-compassion and vmHRV.

Moreover, the size of the sample used in Paper II and III was relatively low, perhaps leading to underpowered analyses. Power refers to the extent to which the study can detect a difference when one exists (Kazdin, 2014). Since the results of paper II and III are based on a pilot study investigating the effects of a brief mindfulness intervention, the calculation of sample size needed was based on the hypotheses for this larger project rather than specific to paper II and III. This yielded smaller sample sizes than what would be optimal for the current thesis. Conducting an intervention study is resource demanding, which typically leads to a lower sample size compared to only conducting a baseline design study. We did not find a significant association between dispositional mindfulness and vmHRV in paper III, however, it is possible that such an association would have been significant with a larger sample size.

The participants in our studies orally confirmed no mental health diagnosis, however, this was not screened formally with the use of clinical diagnostic instruments. Although, they filled out questionnaires on symptoms of mental health problems, which to some extent was included as variables in the current thesis.

5.4 Ethics

An important principle in research ethics is that research should aim at maximizing benefits and minimizing possible costs and harms, - not only at a societal level, but also for the individual participants (World Medical Association, 2013). Participants in the sample used in paper I did not receive any compensation for participation, thus not receiving any benefits. On the other hand, it may be reasonable to argue that the cost of participation was correspondingly low, as it only included 15 minutes of answering questionnaires. The burden of participation was probably somewhat larger for participants recruited for paper II and III, as the question a package was lengthier, and the testing also included vmHRV measurements as well as cognitive tests not included in the present thesis. For instance, one of the cognitive tests was reported by several participants to be boring and frustrating due to its monotone nature. Moreover, disclosing private and intimate information such as one's level of anxiety, feelings of isolation or self-judgment may also represent a burden to individual participants. In combination, this may have caused attrition and feelings of burden to individual participants. On the other hand, these participants received a pilot mindfulness intervention consisting of three 2,5 hour sessions and one all-day silent retreat with experienced mindfulness teachers free of charge, which has hopefully served as compensation for the time and effort spent.

Another ethical issue concerns the homogeneity in cultural background of the recruited sample, as our studies mainly included participants who self-identified as Caucasian. This is a possible ethical issue, since most of the self-compassion literature, and psychology research in general, has been conducted on Caucasian, mainly American and European samples, rather than individuals from other cultural backgrounds which may also be exposed to more stress factors (Tomlinson et al., 2018). In addition to reducing generalizability to populations from other cultural backgrounds, this is a potential challenge as it reduces understanding of self-compassion in other groups. However, research is emerging on other ethnical groups and the SCS has recently been found psychometrically sound in a sample of African Americans (Zhang et al., 2019).

5.5 Implications and future directions

The present thesis' findings contribute to a growing awareness of self-compassion as an adaptive emotion regulation strategy, facilitating psychophysiological flexibility and lower levels of emotional distress. Thus, a possible implication of the findings is that it may be particularly important to target self-compassion in clinical work. In line with this, self-compassion is increasingly integrated as an explicit focus across third wave therapies, such as acceptance and commitment therapy and dialectical behavioral therapy (Wilson, Mackintosh, Power, & Chan, 2019). Likewise, the second edition of MBCT manual (Segal, Williams, & Teasdale, 2013) explicitly focuses on the promotion of self-compassion as an aim of the therapy, in contrast to the first version where self-compassion was not explicitly mentioned as a therapy aim.

Second, the present thesis' findings support the promotion of self-compassion in a preventive perspective. As levels of dispositional self-compassion is suggested to be influenced by childhood experiences (Gilbert, 2005), the educational system may represent an important avenue for targeting children's self-compassion levels, such as in kindergartens and schools. An example of such a program is the "Making friends with yourself" (Bluth & Eisenlohr-Moul, 2017) program developed in the United States, specifically designed for increasing levels of self-compassion among teens.

The research field of self-compassion is still in its infancy, and there are several interesting avenues for future research. Given the previously discussed drawbacks of self-reports of self-compassion, future research would be advanced by complementing self-report methodology with alternative measuring methods. One such alternative method is qualitative in-depth investigations of how individuals treat themselves in everyday life. In this way it would be possible to address potential semantic complexities and response biases and obtain richer information about individuals' self-compassion levels (Grossman, 2011). Another alternative to self-report is observational assessments, such as audio or video recordings. An example of this can be found in a study measuring individuals' reactions to a recent divorce (Sbarra, Smith, & Mehl, 2012), where self-compassion was measured using coding of

audio files where participants spoke about their thoughts and feelings regarding the separation in a stream-of-consciousness manner for four minutes. The audio files were then rated by trained judges on a modified version of the SCS. Likewise, other theorists have suggested that observable behaviours such as using a soft tone of voice, or sighing may validly indicate levels of compassion (Cameron, Mazer, DeLuca, Mohile, & Epstein, 2015), and in the same manner one may argue that levels of self-compassion can be inferred through observable behaviour such as body posture, or actions one chooses to do when one feels stressed, such as holding one's own hand or putting one's hand on one's stomach. On the other hand, however, such behavioural acts may often be difficult to spot (as in the case of inner, supportive self-talk) and infer (Strauss et al., 2016). Another possibility is partner-ratings, which has shown to strongly associate with self-reported self-compassion level among couples in long-term romantic relationships (Neff & Beretvas, 2013).

In order to reduce reliance on participants' retrospective abilities when self-reporting level of self-compassion, future studies could make use of technological advances enabling self-ratings on the go throughout the day, for example using smart phone apps. In this way the assessment of self-compassion could be carried out in more naturalistic settings, possibly increasing external validity.

As the association between self-compassion and vmHRV to date is predominantly investigated in samples of healthy adults, an important task for future research to investigate whether the relation persists in clinical groups, such as individuals with a history of depressive symptoms. Future studies could also be advanced by including other psychophysiological measures than vmHRV, such as immune markers and stress hormone levels.

Finally, an interesting task for future research will be to further investigate the beneficial effects of self-compassion using experimental designs where state self-compassion is induced. The previously described study by Kirschner and colleagues (2019), proposed a new experimental paradigm for this purpose, consisting of the already described brief inductions of self-compassion, and importantly, measurement of state change using visual analogue scales from 0 to 100, covering two questions related to how kind and understanding participants feels in the present moment, as

well as how tolerant they feel of their flaws and inadequacies. Future research would be advanced by employing this or similar paradigms in combination with physiological measures like vmHRV, for example under stress contingencies or after stress modulation. Technological advances also enable novel ways of inducing state self-compassion, such as virtual reality (e.g. Cebolla et al., 2019).

6. Conclusion

The purpose of the present thesis was to examine how dispositional self-compassion relates with emotional stress symptoms, mindfulness, and psychophysiological flexibility. The findings suggest that treating oneself with compassion specifically protects against emotional stress symptoms, such as depressive symptoms, anxiety symptoms and rumination. Being self-compassionate also seems to relate with the general capacity to be mindful of the present moment and may mediate the effects of mindfulness on depressive symptoms. Extending previous research, the findings of the present thesis suggest that self-compassionate individuals have a higher flexibility in adapting psychophysiological responses, as indexed by vmHRV. Together, these suggests the emerging picture of self-compassion being an adaptive way of treating oneself in meeting with inevitable life difficulties.

7. References

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I

II

Trait Self-Compassion Reflects Emotional Flexibility Through an Association with High Vagally Mediated Heart Rate Variability

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Abstract Converging evidence shows a positive effect of self-compassion on self-reported well-being and mental health. However, few studies have examined the relation between self-compassion and psychophysiological measures. In the present study, we therefore examined the relation between trait self-compassion and vagally mediated heart rate variability (vmHRV) in 53 students (39 female, mean age = 23.63). Trait self-compassion was assessed using the Self-Compassion Scale, and resting vmHRV was measured during a 5-min ECG baseline period. We hypothesized that higher levels of trait self-compassion would predict higher levels of resting vmHRV. Controlling for potential covariates (including age, gender, and BMI), the results confirmed our hypotheses, showing that higher levels of trait self-compassion predicted higher vmHRV. These results were validated with a 24-h measure of vmHRV, acquired from a subsample of the participants ($n = 26$, 16 female, mean age = 23.85), confirming the positive correlation between high trait self-compassion and higher vmHRV. The relation between trait

self-compassion, vmHRV, self-reported trait anxiety (the trait scale of the State-Trait Anxiety Inventory; STAI) and self-reported rumination (the Rumination subscale of the Rumination-Reflection Questionnaire; RRQ-Rum) was also investigated. Higher levels of trait anxiety and rumination were highly correlated with low levels of trait self-compassion. Trait anxiety, but not rumination, correlated marginally significantly with the level of vmHRV. The findings of the present study indicate that trait self-compassion predicts a better ability to physiologically and psychologically adapt emotional responses. Possible implications and limitations of the study are discussed.

Keywords Self-compassion · Heart rate variability · Emotion regulation · Emotional flexibility · Young adults

Introduction

Self-compassion—the ability to be kind and caring toward oneself in times of suffering—is found to be positively associated with mental health and well-being (e.g., Hollis-Walker and Colosimo 2011; Neff 2003b; Neff et al. 2007b). Although there are strong reasons to expect a positive association with physiological health as well, there is a lack of studies examining the relation between self-compassion and physiological indices such as vagally mediated heart rate variability (vmHRV). High vmHRV is an index of healthy heart function and is suggested as a physiological index of emotion regulation capacity, reflecting an ability to effectively adapt to stress and environmental demands (Appelhaus and Luecken 2006; Beevers et al. 2011; Thayer and Lane 2000). As self-compassion seems to be an effective emotion regulation strategy (Neff 2003b; Neff et al. 2005), we predicted in the current

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study that high trait self-compassion is related to high vmHRV.

Emotion regulation is the processes through which one shapes which emotions one has, when one has them, and how one experiences or expresses them (Gross 1998, 2014). Trait self-compassion can be viewed as an implicit (predominantly unconscious and autonomic) strategy of emotion regulation in making an individual more accepting and less judgmental toward possible intrinsic and extrinsic stressors. It comprises three pairs of opposing components: (a) self-kindness vs. self-judgment, which is the tendency to be kind and understanding toward oneself in times of suffering, instead of critical and self-blaming; (b) common humanity vs. isolation, which refers to the recognition that imperfection and failure are normal parts of life, as opposed to feeling separated and disconnected from other individuals in difficult times; and (c) mindfulness vs. over-identification, which entails holding painful emotions and thoughts in balanced awareness, instead of avoiding, suppressing or over-identifying with them (Neff 2003a, see Table 1).

The role of self-compassion as an emotion regulation strategy is illustrated in a large body of research. Self-compassion has been found to moderate negative emotions after receiving ambivalent feedback, and to predict a lower level of negative emotions when experiencing difficult everyday situations (Leary et al. 2007). Thus, it seems to make individuals more emotionally flexible when experiencing negative life events, which is also evidenced in a reduced risk of depression (e.g., MacBeth and Gumley 2012; Raes 2011; Van Dam et al. 2011), less anxiety (Neff 2003b), and less rumination and thought suppression (Neff and Vonk 2009). Self-compassion has been proposed as a key mechanism of change in the positive effects of mindfulness-based cognitive therapy (MBCT; Kuyken et al. 2010), and high self-compassion is found to associate with

happiness and optimism (Neff et al. 2007b), higher psychological well-being (Hollis-Walker and Colosimo 2011), and greater life satisfaction (Neff 2003b; Neff and Faso 2015). In fact, self-compassion remains positively correlated with overall positive affect even when controlling for high self-esteem (Neff and Vonk 2009), indicating that it contributes uniquely to feelings of worth and acceptance (Barnard and Curry 2011).

The positive effect of self-compassion is expected to have a soothing effect on heart rate and potential stress reactions. Inner self-talk that has a caring and supportive quality is thought to have similar effects as early attachment experiences of being soothed by significant caregivers through stimulating the mammalian oxytocin-opiate caregiving system (Gilbert 2009). Hence self-compassion is linked to feelings of being safe, because one knows that although things go wrong or one makes a mistake, one will not be met by harsh self-condemnation. When individuals feel safe, they tend to have a larger behavioral flexibility in different situations (Gilbert 2009), as well as higher physiological flexibility (Thayer and Lane 2000). Self-compassion is therefore likely to have a positive influence on the level of HRV, an index of physiological flexibility, defined as the variation in the time intervals between subsequent heartbeats (Appelhans and Luecken 2006; Thayer and Lane 2000). As the brain's integrative system for emotion regulation has an inhibitory effect on the heart through the vagus nerve (Thayer and Lane 2000), we expect self-compassion to associate with high vagally mediated HRV (vmHRV; Williams et al. 2015). High vmHRV indicates increased parasympathetic influence on the heart (Appelhans and Luecken 2006; Thayer and Lane 2000) and is linked to a better ability to self-soothe when stressed (Porges 2007). Self-compassion is thus expected to lead to more flexible emotional and physiological responses, calming potential stress reactions by suppressing sympathetic activity and increasing parasympathetic influence through the stimulation of the vagus nerve (Porges 2003).

Table 1 Overview of the components of self-compassion

Components of self-compassion		
(a) Self-kindness	Self-kindness	The ability to treat oneself kindly and with compassion when one is challenged by suffering, failure, or difficult situations
	vs. Self-judgment	Criticizing or judging oneself for one's suffering
(b) Common humanity	Common humanity	Recognizing that suffering is part of being human
	vs. Isolation	Feeling isolated and alone in one's suffering
(c) Mindfulness	Mindfulness	Holding the experience suffering in non-judgmental awareness
	vs. Over-identification	Over-identifying with the feelings of suffering

There are three lines of evidence indicating that self-compassion relates to higher vmHRV as well as to other biological processes underlying emotion regulation and stress responding. First, emotional stress responses such as anxiety (Chalmers et al. 2014; Thayer et al. 1996), depression (Beevers et al. 2011; Yeh et al. 2016), and rumination (Brosschot et al. 2007; Woody et al. 2014) are consistently shown to associate with lower vmHRV. Self-compassion correlates strongly with lower levels of such stress responses (e.g., Krieger et al. 2013; MacBeth and Gumley 2012) and therefore self-compassion is likely to associate with higher vmHRV. Second, studies examining self-compassion as a state and trained ability have found links with vmHRV. One study (Arch et al. 2014) found that participants who had received self-compassion training had smaller reductions in vmHRV before and after exposure to a psychosocial stressor as compared to two control groups. In another study (Rockliff et al. 2008), imagining receiving compassion associated with elevated vmHRV levels in some participants, and a more threat-like response in other participants. There were some indications that self-compassion affected the results, and the participants that responded with increased vmHRV also had a drop in cortisol levels. Another study (Kok et al. 2013) found compassion meditation to result in increased vmHRV. Third, self-compassion also seems to relate positively to other biological stress indexes than vmHRV. A study (Pace et al. 2009) measuring the effect of a 6-week compassion meditation training found a correlation between amount of meditation practice and decrease in the blood inflammation cytokine interleukin-6 after a psychosocial stressor. The group that received brief self-compassion training also had lower salivary alpha-amylase concentration, another marker of autonomic nervous system activation (Rohleder et al. 2004). Two recent studies (Breines et al. 2015; Breines et al. 2014) focused on trait rather than induced self-compassion, in contrast to the other studies. They found that participants higher in trait self-compassion had lower increases in blood inflammation (interleukin-6; Breines et al. 2014) and salivary alpha-amylase concentration (Breines et al. 2015) after a psychosocial stressor. Together these studies indicate that self-compassion may protect against physiological stress responses.

On the basis of this converging evidence of a positive association between self-compassion and mental and physical health, we wanted to investigate the relationship between trait self-compassion and vmHRV. To our knowledge, no prior studies have examined this relationship. We expected higher levels of trait self-compassion in a group of young healthy adults to predict higher levels of vmHRV. We further expected trait self-

compassion to reflect lower trait anxiety and negative rumination. Since a large body of evidence supports the relationship between self-compassion and reduced levels of anxiety and rumination (e.g., MacBeth and Gumley 2012; Neff and Vonk 2009), and as trait anxiety and rumination also have been shown to associate with vmHRV (e.g., Williams et al. 2015; Woody et al. 2014), we also wanted to take into account trait anxiety and rumination when investigating the effect of self-compassion on vmHRV. We thus expected that the prediction of high trait self-compassion on vmHRV would sustain even when controlling for higher levels of trait anxiety and rumination. Finally, to validate that the predictive effect of higher levels of trait self-compassion on resting vmHRV was representative for the participants' everyday lives, we also expected to find that higher levels of trait self-compassion would predict a higher level of a 24-h measure of vmHRV in a subsample of the healthy adults included in our study. Throughout this article, the term vmHRV will be used to refer to the 5-min resting condition, whereas the term 24-h vmHRV will be employed when referring to the 24-h measure.

Method

Participants

Data presented in the current paper were collected from a pilot study for a larger study on the effects of mindfulness-based cognitive therapy. The participants were recruited through internal announcements to the student population at the University of Bergen, Norway by email and posters during the fall and spring 2014. Initially 56 participants were recruited, but due to poor data quality on the resting vmHRV measures, three participants were excluded from further analysis. Thus, the sample consisted of 53 students (36 (68 %) female, mean age=23.6 years, SD=2.52). Of these, 34 participants wore monitors for 24 h, however due to poor data quality eight were excluded from further analysis. The subsample thus consisted of 26 participants, representative of the main sample with regard to the gender distribution, age range, and BMI (16 (62 %) women; mean age=23.85; SD=2.72).

Exclusion criteria were heart conditions, usage of sedative or psychoactive medication, and previous experience with mindfulness, i.e., attendance at mindfulness courses, retreats, or other kinds of formalized mindfulness instruction. The protocol was approved by the Regional Ethics Committee (South-East) and the participants gave written consent in accordance with the Helsinki declaration.

Procedure

Upon arrival on the testing day, participants were given a detailed explanation of the tests they would undergo, but no information regarding hypotheses of the study. They were then assigned to a room in which they were asked to fill out a package of questionnaires, including the self-compassion scale and information about age, gender, and BMI. One at a time, they were asked to move to an experimental room, in order to record their heart rate with an electrocardiogram (ECG). After that, the 24-h monitors were attached. Participants were asked not to smoke, drink caffeine, or exercise 6 h prior to the experiment.

Measures

Heart Rate Variability

The electrocardiogram (ECG) was recorded with a standard lead-II setup and digitized at 1000 Hz. The signal was obtained through an A/D converter (Biopac, MP36, Biopac system INC. Santa Barbara, CA) recorded with Biopac 4.0 BSL (Biopac Systems, Inc., Santa Barbara, CA). The data were collected at approximately the same time in the afternoon for all participants in order to control for circadian effects. Resting vmHRV was assessed during a 5-min period with the following instruction: “Give yourself some time to find a position that feels comfortable. See if you can breathe slowly, and relax as much as possible.”

Heart rate data were first checked manually for artifacts (electrode noise, movement, and extraordinary peaks) offline, before they were subjected to a vmHRV analysis with Kubios version 2.0 (Tarvainen et al. 2014). Low frequency was defined as the frequency band between 0.04 and 0.14 Hz, and high frequency was defined as 0.14–0.4 Hz. The applied measure was the root mean square of successive differences (RMSSD), measured in milliseconds. RMSSD is considered to be a valid measure of vmHRV (Li et al. 2009; Thayer and Sternberg 2006; Williams et al. 2015), and has a high trait specificity of 73 % (Bertsch et al. 2012), suggesting that the one-time assessment of RMSSD predominantly indicates a physiological trait measure (Williams et al. 2015). Moreover, RMSSD seems to be less affected by breathing than the high-frequency (HF) power (Penttilä et al. 2001). As participants were told to breathe naturally, RMSSD is probably the best index of vagally mediated heart rate variability in our sample. However, the applied RMSSD measure correlated highly with high-frequency (HF) power ($r = .94, p > .001$) in the main sample ($n = 53$).

For a subsample of 26 participants, 24-h inter-beat interval (IBI) data was also acquired using Actiheart monitors (Cambridge Neurotechnology, Cambridge, UK)—a device

that has shown to give a reliable account of IBI data (Brage et al. 2005). The Actiheart recorder was placed horizontally below the apex of sternum, midway below the V1 and V2 positions using two adhesive Ag/AgCl ECG electrodes (T815 Dia. 55). The IBI data was transferred into a computer with the Actiheart commercial software (Actiheart software 2.132), and noisy and missing HR data was edited using the manufacturers algorithm (Cambridge Neurotechnology Ltd.; Brage et al. 2005). The complete IBI time series was subsequently inspected and remaining artifacts were manually removed.

All HRV data were subsequently subjected to a HRV analysis with Kubios version 2.0 (Tarvainen et al. 2014) from which root mean square of successive differences in R-R intervals (RMSSD) was calculated. Trend components were removed with the smoothness priors detrending method ($\lambda = 500$).

Self-Compassion Scale The Self-Compassion Scale (SCS) (Neff 2003a) consists of 26 items loading on three positive and three negative subscales. The positive subscales are: self-kindness (for example: “I’m kind to myself when I’m experiencing suffering.”), common humanity (for example: “When I’m down and out, I remind myself that there are lots of other people in the world feeling like I am”), and mindfulness (for example: “When I fail at something important to me I try to keep things in perspective”). The negative subscales are: self-judgment (for example: “I’m disapproving and judgmental about my own flaws and inadequacies.”), isolation (for example: “When I’m feeling down, I tend to feel like most other people are probably happier than I am”), and over-identification (for example: “When I’m feeling down I tend to obsess and fixate on everything that’s wrong”). Items are rated on a five-point Likert-type scale from 1 (“almost never”) to 5 (“almost always”). High scores on the positive subscales and low scores on the negative subscales reflects an overall high level of self-compassion.

The SCS has shown good reliability and cross-cultural validity (Neff et al. 2008). We used a Norwegian translation of the Self-Compassion Scale (Dundas et al. 2015). In the current study, the level of self-compassion ranged from 1.31 to 4.27, with a mean level of 2.78 (SD = 0.83).

Rumination The 12-item Rumination subscale of the Rumination-Reflection Questionnaire (RRQ-Rum) (Trapnell and Campbell 1999) was used. Example items are “My attention is often focused on aspects of myself I wish I’d stop thinking about” and “I often find myself re-evaluating something I have done.” Answers are rated on a five-point Likert-type scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). The RRQ-Rum scale has been reported to have a high internal reliability (Cronbach’s alpha = .91; (Verplanken et al.

2007). The level of RRQ-Rum in the present study ranged from 14.0 to 57.0, with a mean level of 43.71 (SD = 10.58).

Trait Anxiety Trait anxiety (STAI) was measured using the Trait scale of the State-Trait Anxiety Inventory (STAI; Spielberger 1983), consisting of 20 items. Examples of items are “I worry too much over something that really doesn’t matter” and “I have disturbing thoughts.” Scores are rated on a four point Likert scale ranging from 1 (“almost never”) to 4 (“almost always”). The Trait scale of the STAI has shown excellent internal consistency (average $\alpha < .89$) and test-retest reliability (average $r = .88$; Barnes et al. 2002). The level of trait anxiety in the current study ranged from 20 to 69 with a mean of 43.75 (SD = 12.58), thus overlapping with other study samples of university students both regarding range (Williams et al. 2015) and mean scores (Andrade et al. 2001).

Statistical Analysis

All HRV measures were log transformed in order to approximate a normal distribution. The data were analyzed statistically using the Statistical Package for the Social Sciences version 22.0 (SPSS; IBM Corp. 2011). A multiple hierarchical linear regression analysis was computed including the vmHRV as the outcome variable and the SCS total score as a predictor. In the first step of this hierarchical linear regression analysis, the possible confounding variables of age, sex, and BMI were entered as covariates, and in the second step the SCS total score was entered as a predictor (i.e., with F analysis of change in explained variance from step 1 to step 2). Further, we conducted a follow up analysis of how the SCS total score predicted vmHRV when adding covariates of trait anxiety and rumination in the first step of the multiple hierarchical linear regression analysis together with the covariates of age, sex, and BMI. To avoid problems with multicollinearity when controlling for level of trait anxiety and rumination, posed by the expected high correlation between trait self-compassion and trait anxiety/rumination, we entered residual scores where the variance in the symptom scores of trait anxiety and rumination that was explained by the self-compassion scale score were extracted (i.e., residual scores of trait anxiety and of rumination: the variance explained by the SCS total score was extracted in linear regression analyses run prior to this main multiple hierarchical linear regression analysis). Bivariate correlational analyses were conducted to show the relationship between level of vmHRV and the total score of SCS, the subscales of SCS, and rumination and trait anxiety. To ecologically validate the predictive effect of SCS total score on resting HRV, we ran a partial and bivariate correlational analysis in a subsample ($n = 26$) between SCS total score and a 24-h vmHRV measure. Similar to the 5-min

resting measurements, the applied measure of 24-h vmHRV was also the RMSSD.

There were no outliers in the current sample defined by a plus/minus 3 standard deviation threshold from the sample mean. We used an alpha level of 5 % ($p < .05$) as a threshold for significant effects. Missing item scores were replaced by sample mean for each item. Five participants had some missing items scores, and a total of six item scores were missing.

Results

The results showed that the SCS total score explained 12 percent of the variance of the vmHRV after controlling for the effects of the covariates of age, gender, and BMI in the analysis. These covariates did not contribute significantly to explain the variance of vmHRV either in the first or the second step of the analysis (see Table 2, model 1). Results were also significant using HF and NN50 as outcome measures of vmHRV (see supplementary tables).

To control for the possible confounding effect of higher levels of trait anxiety and rumination in the positive prediction of the SCS total score on the vmHRV, we repeated the same multiple hierarchical linear regression analysis by adding residual scores of trait anxiety and rumination as covariates in addition to age, gender, and BMI in the first step of the analysis. Still, the SCS total score explained 11 % of the variance of the vmHRV after controlling for the effect of these covariates on vmHRV, and SCS was the only significant contributor to explain the variance of the vmHRV in the second step of the analysis (see Table 2, model 2).

Bivariate correlational analyses showed that higher levels of the SCS total score related negatively with higher levels of trait anxiety and rumination (see Table 3). Furthermore, the positive SCS subscale scores were inversely correlated with trait anxiety and rumination, whereas the negative SCS subscales were positively correlated with trait anxiety and rumination. The trait anxiety residual score (in which the variance that was explained by the SCS total score in the trait anxiety score was extracted) correlated only with the trait anxiety score and the rumination residual score. The rumination residual score (in which the variance that was explained by the SCS total score was extracted) correlated with the rumination score, the self-compassion subscale of common humanity, as well as the trait anxiety score and the residual score of trait anxiety.

Bivariate correlational analyses further showed that higher levels of vmHRV correlated significantly with higher SCS total scale scores, and that higher vmHRV correlated with lower scores on the negative subscales of self-judgment, isolation, and over-identification. The positive self-compassion subscale self-kindness was marginally significant ($p = .06$).

Table 2 Hierarchical regression analyses of the relationship between vmHRV and self-compassion

Total sample (<i>n</i> = 53)	Model	Step	Predictor	<i>R</i> ²	ΔR^2	<i>df</i>	ΔF	β step 2
	Model 1	1	Age	.03	.03	3/49	.55	.02
			Gender					-.24
			BMI					-.06
	Model 2	1	Self-compassion	.15	.12	1/48	6.56	.37*
			Age	.04	.04	5/47	.42	.03
			Gender					-.21
			BMI					-.06
		2	STAI-T residual					-.03
			RRQ residual					.09
			Self-compassion	.16	.11	1/46	6.14	.36*

STAI-T residual—the variance explained by the SCS total score is extracted from the STAI-T score in a linear regression analyses with the STAI-T as an outcome variable and the SCS total score as a predictor. RRQ residual—the variance explained by the SCS total score is extracted from the RRQ score in a linear regression analyses with the RRQ as an outcome variable and the SCS total score as a predictor. Age, gender, and BMI were included as covariates in the first step of the hierarchical regression analysis. In the second model, the residual scores of trait anxiety and rumination were also included in the first step

**p* = .02

Higher levels of vmHRV was marginally correlated with trait anxiety (*p* = .06), but did not correlate with rumination. Neither the trait anxiety residual score nor the rumination residual score was found to correlate with vmHRV.

A partial correlation analysis, controlling for the covariates of age, gender, and BMI, showed that the SCS total score correlated significantly also with the 24-h vmHRV (*df* = 21; *r* = .50; *p* < .02), showing a similar level of association as with

the 5-min resting vmHRV in this subsample (*df* = 21; *r* = .52; *p* = .01). Bivariate correlation analyses showed that the 24-h vmHRV associated moderately with the 5-min resting vmHRV. Further, these correlation analyses showed that the SCS total score correlated with the 24-h vmHRV at the same level as the SCS total score correlated with the 5-min resting vmHRV in the bivariate correlational analyses conducted in the total sample (Fig. 1).

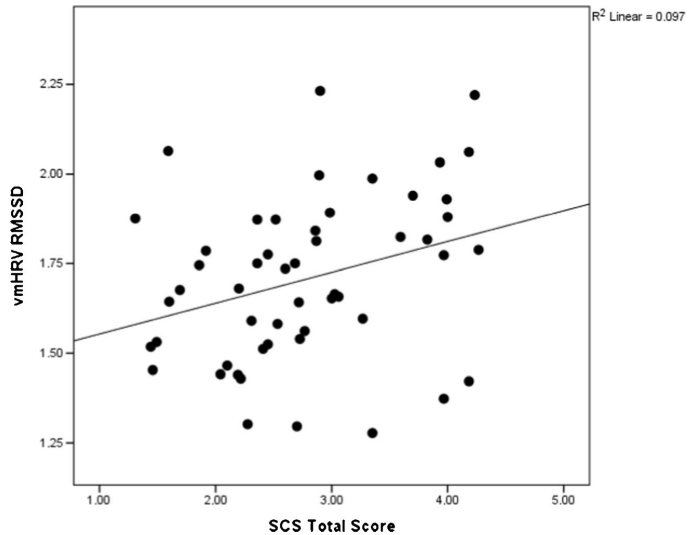
Table 3 Bivariate correlations between vmHRV, SCS, RRQ, and STAI

	1	2	3	4	5	6	7	8	9	10	11	12
1. vmHRV (rest)		.31*	.27***	.16	.21	-.28*	-.30*	-.29*	-.14	.26***	.13	-.01
2. SCS total			.83**	.76**	.80**	.84**	-.86**	-.85**	-.73**	-.80**	.00	.03
3. Self-kindness				.58**	.63**	-.86**	-.54**	-.57**	-.59**	-.54**	.01	.22
4. Common humanity					.61**	-.56**	-.64**	-.49**	-.40**	-.61**	.27*	.08
5. Mindfulness						-.52**	-.57**	-.71**	-.55**	-.61**	.04	.03
6. Self-judgment							.61**	.61**	.66**	-.58**	.06	-.19
7. Isolation								.79**	.62**	.78**	-.01	.14
8. Over-identification									-.77**	.77**	.21	.15
9. RRQ (rumination)										.74**	.68**	.22
10. STAI-T (anxiety)											.35**	.57**
11. RRQ residual												.35**
12. STAI-T residual												
Subsample (<i>n</i> = 26)												
24-h vmHRV	.50*	.30	.30	-.05	.15	-.20	-.38	-.31	-.26	-.27	-.02	-.07

N = 53. RRQ residual—the variance explained by the SCS total score is extracted from the RRQ score in a linear regression analyses with the RRQ as an outcome variable and the SCS total score as a predictor. STAI-T residual—the variance explained by the SCS total score is extracted from the STAI-T score in a linear regression analyses with the STAI-T as an outcome variable and the SCS total score as a predictor

p* < .05; *p* < .01; ****p* = .06

Fig. 1 Scatterplot on the relation between self-compassion and vmHRV



Discussion

The aim of the current study was to investigate the relation between trait self-compassion and vmHRV (i.e., RMSSD) in a group of young, healthy adults. Our findings suggest that higher levels of trait self-compassion predicts a better ability to physiologically adapt emotional responses after contextual conditions in that higher SCS total scores predicted higher levels of vmHRV. These findings were ecologically validated with a 24-h measure of vmHRV, acquired from a subsample of the participants, confirming the positive correlation between high trait self-compassion and higher vmHRV. As expected, being more self-compassionate also associated with lower levels of trait anxiety and rumination, but the positive association between self-compassion and vmHRV could not be explained by trait anxiety or rumination. These results indicate that self-compassionate individuals have more adaptive emotion regulation abilities and less emotional stress reactions.

Despite the large base of studies reporting positive effects of self-compassion on mental health (e.g., Neff et al. 2005; Neff et al. 2007a), this is as far as we know the first study to show an association between high trait self-compassion and high vmHRV. However, our findings correspond to previous studies showing higher state-induced self-compassion to predict higher vmHRV (Arch et al. 2014; Kok et al. 2013; Rockliff et al. 2008), and previous studies showing higher induced (Pace et al. 2009) and trait self-compassion (Breines et al. 2015; Breines et al. 2014) to predict other biological stress indexes than vmHRV. The finding that a better psychological emotion regulation strategy reflects an enhanced physiological emotional regulation in increased vagal inhibition of

the heart is in accordance with the theories of Porges (2007) and Thayer and Lane (2000). Self-compassion as an emotion regulation strategy thus seems to allow people to be more flexible when facing situations that can elicit stress reactions.

Self-compassion can be understood to effect multiple levels of emotion regulation, such as situation selection, situation modification, attention, cognitive change, and response modulation as conceptualized by Gross (2014). On the level of attention, self-compassionate individuals may be less attentive to threat cues and more attentive to soothing cues, which serves to reduce emotional arousal. Also, having a broader attentional focus in different situations may help to create a psychological distance between experiences and self-value, so that one is able to observe and reflect in an emotional situation, rather than automatically reacting on the first spontaneous emotional impulse. On the level of cognitive change, self-compassionate individuals may have more resources available to cognitively moderate their view of stressful situations. This is because self-compassion may have a soothing effect on the limbic system, thereby liberating prefrontal resources and allowing for more explicit (i.e., more conscious and effortful) regulation such as cognitive reappraisal. Consequently, self-compassionate individuals may open to a more balanced views of stressful situations and engage in more supportive and soothing self-talk than less self-compassionate individuals.

This emotion regulatory capacity of self-compassion was further supported in that self-compassion reflected lower levels of trait anxiety and rumination. Thus, individuals low in self-compassion and high in self-criticism seem to have

reduced capacity to modulate emotions. This may manifest in a bias toward threat cues (attention) and negative interpretations (cognitive change) of situations, in which they tell themselves that it is their fault that they feel bad, or that they always make mistakes. These stress reactions through negative self-talk serves to activate the body's stress response and deactivate the body's self-soothing system (Gilbert 2005). This, in turn, leads to lower vmHRV, due to vagal withdrawal (Porges 2007; Thayer and Lane 2000). Indeed, the findings in the current study showed that the self-critical SCS subscales all predicted lower vmHRV, which points to a higher level of emotional stress reactions in everyday life. These negative SCS subscales also correlated with higher levels of anxiety and rumination.

Self-compassion as a trait covers both compassionate and uncompassionate behavior toward oneself, as represented by the positive and negative subscales, and recently Neff (2016) has emphasized that the lack of self-compassion is as important as the presence of it. We found that it was mainly the negative SCS subscales that showed to associate with vmHRV, although the positive SCS subscales were in the predicted direction, and the positive subscale of self-kindness was marginally significant ($p=.06$). The negative SCS subscales reflect a self-critical attitude toward oneself, feeling alone and isolated with one's thoughts and emotions, as well as identifying highly with them. This is interesting since isolation has been subject to much less research attention than self-criticism and over-identification (Neff 2016), which have long been recognized as important vulnerability factors in psychopathology (Blatt et al. 1982; Germer 2009; Gilbert and Procter 2006). There is evidence that early family experiences and insecure attachment make some individuals more vulnerable to develop high levels of self-criticism (Gilbert et al. 2004). Such experiences may also lead to altered cardiovascular responses to stress (Luecken et al. 2005), as the first living years represent an important period for the myelination process of the vagus nerve (Porges 2007). Thus it is possible that the negative effect on vmHRV of being self-critical, self-isolated, and self-absorbed is stronger than the positive effect of being self-supporting. However, it is important to note that the positive subscales also showed a tendency to associate with vmHRV. In particular, the positive subscale of self-kindness associated almost as strongly with vmHRV as did the negative subscales. This means that the positive subscales also contributed to the total SCS score predictions of high vmHRV, which is also supported in the high correlation between all the SCS subscales and the total SCS score.

There may be many reasons why individuals differ in their levels of self-compassion. The quality of attachment with significant caregivers in childhood may be one such reason, in addition to the amount of stress and negative life events and

the level of self-regulative abilities (Gilbert 2005). Being more self-compassionate can therefore be both a result of an innate trait and/or a trait that has been nurtured. In our study, we predicted higher self-compassion to lead to higher vmHRV based on theories of self-compassion as an emotion regulation strategy (Neff 2003b), and on this basis we treated self-compassion as a trait. However, with a cross-sectional study design, we cannot draw certain conclusions about causality (see Williams et al. 2015) (see Williams et al. 2015). Thus, the previous findings that state-induced self-compassion predicts higher vmHRV (Arch et al. 2014; Rockliff et al. 2008) (Arch et al. 2014; Rockliff et al. 2008), support our hypothesis that it is higher self-compassion that predicts higher vmHRV.

Also, as the diagnosis of anxiety and the tendency to ruminate are shown to associate with lower vmHRV (e.g., Gorman and Sloan 2000; Williams et al. 2015; Woody et al. 2014), we wanted to ensure that the prediction of high self-compassion on high vmHRV was not better explained by lower levels of anxiety or rumination. We found that higher levels of anxiety together with rumination were strongly correlated with low self-compassion, which may be due to them capturing a wider aspect of emotional regulation than just emotional stress (Andrade et al. 2001; Caci et al. 2003). However, of these self-reported forms of emotional stress, it was only trait anxiety that marginally significantly correlated with vmHRV. This may seem surprising, given that previous research has found anxiety and rumination to significantly associate with vmHRV (Williams et al. 2015). Noteworthy is that we found the same correlation level as did these authors (trait anxiety $-.27$), however, the significance level appeared different; a differential effect probably due to a larger sample size in the study of Williams et al. (2015). In the prediction analyses, low trait anxiety or rumination did not better explain high vmHRV than did high trait self-compassion. This was further demonstrated in that residual trait anxiety and rumination scores consisting of the variance not explained by self-compassion did not correlate with vmHRV, but correlated strongly with the trait anxiety score and rumination score, respectively.

The present study has several limitations. First, the sample consisted of a relatively small number of well-functioning, healthy young adults, which may reduce generalizability of findings to other populations and age ranges. Second, the present study used a cross-sectional design, thus the question of causality remains unknown. Although higher levels of self-compassion may protect against lower levels of vmHRV, it is also possible that a person's level of vmHRV influences his or her ability to be self-compassionate. Thus, future research would benefit from using longitudinal designs to examine the effects of changing self-compassion levels on vmHRV.

The present results may have several clinical implications. Our results contribute to a growing awareness of self-

compassion as an adaptive emotion regulation strategy, and indicate that self-compassion predicts flexible physiological responding in potentially stressful situations. Developing higher self-compassion may thus help individuals to more flexibly adapt their emotions and physiological responses in different situations. Indeed, there is today a growing focus on training the ability to be more self-compassionate, for example, through mindfulness training such as MBCT (Kuyken et al. 2010), a specific self-compassion training program (Mindful Self-Compassion program; Neff and Germer 2013), or through compassion-focused therapy (Gilbert 2010). Further, as reduced vmHRV is a risk factor for cardiovascular disease and all-cause mortality (Thayer and Lane 2007) our finding that self-compassion predicts vmHRV may have implications for physical health. Increasing self-compassion may thus not only have positive effects on psychological health, but also on physiological health, through enhanced vagal activation.

Compliance with Ethical Standards

Funding This study was funded through internal fundings by the University of Bergen, and a scholarship to the corresponding author from the University of Bergen.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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

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

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Supplementary tables

Supplementary table 1: HF and self-compassion

Total sample (n=53)	Model	Step	Predictor	R^2	ΔR^2	df	ΔF	β Step 2
	Model 1	1	Age	.05	.05	3/49	.78	.01
			Gender					-.28*
			BMI					-.06
		2	Self-compassion	.16	.11	1/48	6.46	.36**

Note: *= $p=.05$; **= $p=.01$. HF= High frequency heart rate variability. Age, gender and BMI were included as covariates in the first step of the hierarchical regression analysis.

Supplementary table 2: NN50 and self-compassion

Total sample (n=53)	Model	Step	Predictor	R^2	ΔR^2	df	ΔF	β Step 2
	Model 1	1	Age	.09	.09	3/49	1.65	.05
			Gender					-.34**
			BMI					-.02
		2	Self-compassion	.16	.07	1/48	4.00	.29*

Note: *= $p=.05$; **= $p=.02$; ***= $p=.01$. NN50= Number of pairs of adjacent NN intervals differing by more than 50 ms. Age, gender and BMI were included as covariates in the first step of the hierarchical regression analysis.



Correction to: Trait Self-Compassion Reflects Emotional Flexibility Through an Association with High Vagally Mediated Heart Rate Variability

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The authors would like to note a mistake in the published version of this paper. Unfortunately an old version of the correlation matrix (Table 3) was submitted. The mistake does not change any scientific conclusions drawn in the paper. We here present the corrected values for Table 3. The authors would like to apologize for any inconvenience due to this mistake.

The online version of the original article can be found at <https://doi.org/10.1007/s12671-016-0549-1>

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Table 3 Bivariate correlations between vmHRV, SCS, RRQ, and STAI

	1	2	3	4	5	6	7	8	9	10	11	12
1. vmHRV (rest)		.31*	.26***	.16	.21	-.28*	-.30*	-.29*	-.14	-.26***	.13	-.01
2. SCS Total			.83**	.77**	.82**	-.84**	-.86**	-.86**	-.73**	-.80**	.00	.03
3. Self-kindness				.57**	.66**	-.86**	-.53**	-.58**	-.60**	-.55**	.01	.22
4. Common humanity					.65**	-.55**	-.62**	-.50**	-.38**	-.59**	.27*	.08
5. Mindfulness						-.56**	-.60**	-.71**	-.58**	-.66**	.03	.03
6. Self-judgment							.60**	.63**	.66**	.58**	.06	-.19
7. Isolation								.81**	.62**	.79**	-.01	.14
8. Over-identification									.78**	.79**	.21	.15
9. RRQ (rumination)										.73**	.68**	.22
10. STAI-T (anxiety)											.21	.57**
11. RRQ residual												.35**
12. STAI-T residual												
Subsample ($n = 26$)												
24-h vmHRV	.50*	.30	.30	-.05	.15	-.20	-.38	-.31	-.26	-.27	-.15	-.10

$N = 53$. RRQ residual—the variance explained by the SCS total score is extracted from the RRQ score in a linear regression analysis with the RRQ as an outcome variable and the SCS total score as a predictor. STAI-T residual—the variance explained by the SCS total score is extracted from the STAI-T score in a linear regression analysis with the STAI-T as an outcome variable and the SCS total score as a predictor

* $p < .05$; ** $p < .01$; *** $p = .06$

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	Mykletun, Arnstein, Dr. psychol.	Mortality and work-related disability as long-term consequences of anxiety and depression: Historical cohort designs based on the HUNT-2 study
	Sivertsen, Børge, PhD	Insomnia in older adults. Consequences, assessment and treatment.
2007	Singhammer, John, Dr. philos.	Social conditions from before birth to early adulthood – the influence on health and health behaviour
V	Janvin, Carmen Ani Cristea, PhD	Cognitive impairment in patients with Parkinson's disease: profiles and implications for prognosis
	Braarud, Hanne Cecilie, Dr. psychol.	Infant regulation of distress: A longitudinal study of transactions between mothers and infants
	Tveito, Torill Helene, PhD	Sick Leave and Subjective Health Complaints

	Magnussen, Liv Heide, PhD	Returning disability pensioners with back pain to work
	Thuen, Elin Marie, Dr.philos.	Learning environment, students' coping styles and emotional and behavioural problems. A study of Norwegian secondary school students.
	Solberg, Ole Asbjørn, PhD	Peacekeeping warriors – A longitudinal study of Norwegian peacekeepers in Kosovo
2007	Søreide, Gunn Elisabeth, Dr.philos.	Narrative construction of teacher identity
H	Svensen, Erling, PhD	WORK & HEALTH. Cognitive Activation Theory of Stress applied in an organisational setting.
	Øverland, Simon Nygaard, PhD	Mental health and impairment in disability benefits. Studies applying linkages between health surveys and administrative registries.
	Eichele, Tom, PhD	Electrophysiological and Hemodynamic Correlates of Expectancy in Target Processing
	Børhaug, Kjetil, Dr.philos.	Oppseding til demokrati. Ein studie av politisk oppseding i norsk skule.
	Eikeland, Thorleif, Dr.philos.	Om å vokse opp på barnehjem og på sykehus. En undersøkelse av barnehjemsbarns opplevelser på barnehjem sammenholdt med sanatoriebarns beskrivelse av langvarige sykehusopphold – og et forsøk på forklaring.
	Wadel, Carl Cato, Dr.philos.	Medarbeidersamhandling og medarbeiderledelse i en lagbasert organisasjon
	Vinje, Hege Forbech, PhD	Thriving despite adversity: Job engagement and self-care among community nurses
	Noort, Maurits van den, PhD	Working memory capacity and foreign language acquisition
2008	Breivik, Kyrre, Dr.psychol.	The Adjustment of Children and Adolescents in Different Post-Divorce Family Structures. A Norwegian Study of Risks and Mechanisms.
V	Johnsen, Grethe E., PhD	Memory impairment in patients with posttraumatic stress disorder
	Sætrevik, Bjørn, PhD	Cognitive Control in Auditory Processing
	Carvalho, Susana Fonseca, PhD	Prevention of bullying in schools: an ecological model
2008	Brønnick, Kolbjørn Selvåg	Attentional dysfunction in dementia associated with Parkinson's disease.
H	Posserud, Maj-Britt Rocio	Epidemiology of autism spectrum disorders
	Haug, Ellen	Multilevel correlates of physical activity in the school setting
	Skjerve, Arvid	Assessing mild dementia – a study of brief cognitive tests.

	Kjønniksen, Lise	The association between adolescent experiences in physical activity and leisure time physical activity in adulthood: a ten year longitudinal study
	Gundersen, Hilde	The effects of alcohol and expectancy on brain function
	Omvik, Siri	Insomnia – a night and day problem
2009 V	Molde, Helge	Pathological gambling: prevalence, mechanisms and treatment outcome.
	Foss, Else	Den omsorgsfulle væremåte. En studie av voksnes væremåte i forhold til barn i barnehagen.
	Westrheim, Kariane	Education in a Political Context: A study of Knowledge Processes and Learning Sites in the PKK.
	Wehling, Eike	Cognitive and olfactory changes in aging
	Wangberg, Silje C.	Internet based interventions to support health behaviours: The role of self-efficacy.
	Nielsen, Morten B.	Methodological issues in research on workplace bullying. Operationalisations, measurements and samples.
	Sandu, Anca Larisa	MRI measures of brain volume and cortical complexity in clinical groups and during development.
	Guribye, Eugene	Refugees and mental health interventions
	Sørensen, Lin	Emotional problems in inattentive children – effects on cognitive control functions.
	Tjomsland, Hege E.	Health promotion with teachers. Evaluation of the Norwegian Network of Health Promoting Schools: Quantitative and qualitative analyses of predisposing, reinforcing and enabling conditions related to teacher participation and program sustainability.
	Helleve, Ingrid	Productive interactions in ICT supported communities of learners
2009 H	Skorpen, Aina Øye, Christine	Dagliglivet i en psykiatrisk institusjon: En analyse av miljøterapeutiske praksiser
	Andreassen, Cecilie Schou	WORKAHOLISM – Antecedents and Outcomes
	Stang, Ingun	Being in the same boat: An empowerment intervention in breast cancer self-help groups
	Sequeira, Sarah Dorothee Dos Santos	The effects of background noise on asymmetrical speech perception
	Kleiven, Jo, dr.philos.	The Lillehammer scales: Measuring common motives for vacation and leisure behavior
	Jónsdóttir, Guðrún	Dubito ergo sum? Ni jenter møter naturfaglig kunnskap.
	Hove, Oddbjørn	Mental health disorders in adults with intellectual disabilities - Methods of assessment and prevalence of mental health disorders and problem behaviour
	Wageningen, Heidi Karin van	The role of glutamate on brain function

	Bjørkvik, Jofrid	God nok? Selvaktelse og interpersonlig fungering hos pasienter innen psykisk helsevern: Forholdet til diagnoser, symptomer og behandlingsutbytte
	Andersson, Martin	A study of attention control in children and elderly using a forced-attention dichotic listening paradigm
	Almås, Aslaug Grov	Teachers in the Digital Network Society: Visions and Realities. A study of teachers' experiences with the use of ICT in teaching and learning.
	Ulvik, Marit	Lærerutdanning som dannning? Tre stemmer i diskusjonen
2010	Skår, Randi	Læringsprosesser i sykepleieres profesjonsutøvelse. En studie av sykepleieres læringserfaringer.
V	Roald, Knut	Kvalitetsvurdering som organisasjonslæring mellom skole og skoleeigar
	Lunde, Linn-Heidi	Chronic pain in older adults. Consequences, assessment and treatment.
	Danielsen, Anne Grete	Perceived psychosocial support, students' self-reported academic initiative and perceived life satisfaction
	Hysing, Mari	Mental health in children with chronic illness
	Olsen, Olav Kjellevoid	Are good leaders moral leaders? The relationship between effective military operational leadership and morals
	Riese, Hanne	Friendship and learning. Entrepreneurship education through mini-enterprises.
	Holthe, Asle	Evaluating the implementation of the Norwegian guidelines for healthy school meals: A case study involving three secondary schools
H	Hauge, Lars Johan	Environmental antecedents of workplace bullying: A multi-design approach
	Bjørkelo, Brita	Whistleblowing at work: Antecedents and consequences
	Reme, Silje Endresen	Common Complaints – Common Cure? Psychiatric comorbidity and predictors of treatment outcome in low back pain and irritable bowel syndrome
	Helland, Wenche Andersen	Communication difficulties in children identified with psychiatric problems
	Beneventi, Harald	Neuronal correlates of working memory in dyslexia
	Thygesen, Elin	Subjective health and coping in care-dependent old persons living at home
	Aanes, Mette Marthinussen	Poor social relationships as a threat to belongingness needs. Interpersonal stress and subjective health complaints: Mediating and moderating factors.
	Anker, Morten Gustav	Client directed outcome informed couple therapy

	Bull, Torill	Combining employment and child care: The subjective well-being of single women in Scandinavia and in Southern Europe
	Viiig, Nina Grieg	Tilrettelegging for læreres deltakelse i helsefremmende arbeid. En kvalitativ og kvantitativ analyse av sammenhengen mellom organisatoriske forhold og læreres deltakelse i utvikling og implementering av Europeisk Nettverk av Helsefremmende Skoler i Norge
	Wolff, Katharina	To know or not to know? Attitudes towards receiving genetic information among patients and the general public.
	Ogden, Terje, dr.philos.	Familiebasert behandling av alvorlige atferdsproblemer blant barn og ungdom. Evaluering og implementering av evidensbaserte behandlingsprogrammer i Norge.
	Solberg, Mona Elin	Self-reported bullying and victimisation at school: Prevalence, overlap and psychosocial adjustment.
2011	Bye, Hege Høivik	Self-presentation in job interviews. Individual and cultural differences in applicant self-presentation during job interviews and hiring managers' evaluation
V	Notelaers, Guy	Workplace bullying. A risk control perspective.
	Moltu, Christian	Being a therapist in difficult therapeutic impasses. A hermeneutic phenomenological analysis of skilled psychotherapists' experiences, needs, and strategies in difficult therapies ending well.
	Myrseth, Helga	Pathological Gambling - Treatment and Personality Factors
	Schanche, Elisabeth	From self-criticism to self-compassion. An empirical investigation of hypothesized change processes in the Affect Phobia Treatment Model of short-term dynamic psychotherapy for patients with Cluster C personality disorders.
	Våpenstad, Eystein Victor, dr.philos.	Det tempererte nærvær. En teoretisk undersøkelse av psykoterapeutens subjektivitet i psykoanalyse og psykoanalytisk psykoterapi.
	Haukebø, Kristin	Cognitive, behavioral and neural correlates of dental and intra-oral injection phobia. Results from one treatment and one fMRI study of randomized, controlled design.
	Harris, Anette	Adaptation and health in extreme and isolated environments. From 78°N to 75°S.
	Bjørknes, Ragnhild	Parent Management Training-Oregon Model: intervention effects on maternal practice and child behavior in ethnic minority families
	Mamen, Asgeir	Aspects of using physical training in patients with substance dependence and additional mental distress
	Espevik, Roar	Expert teams: Do shared mental models of team members make a difference
	Haara, Frode Olav	Unveiling teachers' reasons for choosing practical activities in mathematics teaching

2011 H	Hauge, Hans Abraham	How can employee empowerment be made conducive to both employee health and organisation performance? An empirical investigation of a tailor-made approach to organisation learning in a municipal public service organisation.
	Melkevik, Ole Rogstad	Screen-based sedentary behaviours: pastimes for the poor, inactive and overweight? A cross-national survey of children and adolescents in 39 countries.
	Vøllestad, Jon	Mindfulness-based treatment for anxiety disorders. A quantitative review of the evidence, results from a randomized controlled trial, and a qualitative exploration of patient experiences.
	Tolo, Astrid	Hvordan blir lærerkompetanse konstruert? En kvalitativ studie av PPU-studenters kunnskapsutvikling.
	Saus, Evelyn-Rose	Training effectiveness: Situation awareness training in simulators
	Nordgreen, Tine	Internet-based self-help for social anxiety disorder and panic disorder. Factors associated with effect and use of self-help.
	Munkvold, Linda Helen	Oppositional Defiant Disorder: Informant discrepancies, gender differences, co-occurring mental health problems and neurocognitive function.
	Christiansen, Øivin	Når barn plasseres utenfor hjemmet: beslutninger, forløp og relasjoner. Under barnevernets (ved)tak.
	Brunborg, Geir Scott	Conditionability and Reinforcement Sensitivity in Gambling Behaviour
	Hystad, Sigurd William	Measuring Psychological Resiliency: Validation of an Adapted Norwegian Hardiness Scale
2012 V	Roness, Dag	Hvorfor bli lærer? Motivasjon for utdanning og utøving.
	Fjermestad, Krister Westlye	The therapeutic alliance in cognitive behavioural therapy for youth anxiety disorders
	Jenssen, Eirik Sørnes	Tilpasset opplæring i norsk skole: politikeres, skolelederes og læreres handlingsvalg
	Saksvik-Lehouillier, Ingvild	Shift work tolerance and adaptation to shift work among offshore workers and nurses
	Johansen, Venke Frederike	Når det intime blir offentlig. Om kvinners åpenhet om brystkreft og om markedsføring av brystkreftsaken.
	Herheim, Rune	Pupils collaborating in pairs at a computer in mathematics learning: investigating verbal communication patterns and qualities
	Vie, Tina Løkke	Cognitive appraisal, emotions and subjective health complaints among victims of workplace bullying: A stress-theoretical approach
	Jones, Lise Øen	Effects of reading skills, spelling skills and accompanying efficacy beliefs on participation in education. A study in Norwegian prisons.

2012 H	Danielsen, Yngvild Sørebo	Childhood obesity – characteristics and treatment. Psychological perspectives.
	Horverak, Jøri Gytre	Sense or sensibility in hiring processes. Interviewee and interviewer characteristics as antecedents of immigrant applicants' employment probabilities. An experimental approach.
	Jøsendal, Ola	Development and evaluation of BE smokeFREE, a school-based smoking prevention program
	Osnes, Berge	Temporal and Posterior Frontal Involvement in Auditory Speech Perception
	Drageset, Sigrunn	Psychological distress, coping and social support in the diagnostic and preoperative phase of breast cancer
	Aasland, Merethe Schanke	Destructive leadership: Conceptualization, measurement, prevalence and outcomes
	Bakibinga, Pauline	The experience of job engagement and self-care among Ugandan nurses and midwives
	Skogen, Jens Christoffer	Foetal and early origins of old age health. Linkage between birth records and the old age cohort of the Hordaland Health Study (HUSK)
	Leveresen, Ingrid	Adolescents' leisure activity participation and their life satisfaction: The role of demographic characteristics and psychological processes
	Hanss, Daniel	Explaining sustainable consumption: Findings from cross-sectional and intervention approaches
Rød, Per Arne	Barn i klem mellom foreldrekonflikter og samfunnmessig beskyttelse	
2013 V	Mentzoni, Rune Aune	Structural Characteristics in Gambling
	Knudsen, Ann Kristin	Long-term sickness absence and disability pension award as consequences of common mental disorders. Epidemiological studies using a population-based health survey and official ill health benefit registries.
	Strand, Mari	Emotional information processing in recurrent MDD
	Veseth, Marius	Recovery in bipolar disorder. A reflexive-collaborative exploration of the lived experiences of healing and growth when battling a severe mental illness
	Mæland, Silje	Sick leave for patients with severe subjective health complaints. Challenges in general practice.
	Mjaaland, Thera	At the frontiers of change? Women and girls' pursuit of education in north-western Tigray, Ethiopia
	Odéen, Magnus	Coping at work. The role of knowledge and coping expectancies in health and sick leave.
	Hynninen, Kia Minna Johanna	Anxiety, depression and sleep disturbance in chronic obstructive pulmonary disease (COPD). Associations, prevalence and effect of psychological treatment.

	Flo, Elisabeth	Sleep and health in shift working nurses
	Aasen, Elin Margrethe	From paternalism to patient participation? The older patients undergoing hemodialysis, their next of kin and the nurses: a discursive perspective on perception of patient participation in dialysis units
	Ekornås, Belinda	Emotional and Behavioural Problems in Children: Self-perception, peer relationships, and motor abilities
	Corbin, J. Hope	North-South Partnerships for Health: Key Factors for Partnership Success from the Perspective of the KIWAKKUKI
	Birkeland, Marianne Skogbrott	Development of global self-esteem: The transition from adolescence to adulthood
2013	Gianella-Malca, Camila	Challenges in Implementing the Colombian Constitutional Court's Health-Care System Ruling of 2008
H	Hovland, Anders	Panic disorder – Treatment outcomes and psychophysiological concomitants
	Mortensen, Øystein	The transition to parenthood – Couple relationships put to the test
	Årdal, Guro	Major Depressive Disorder – a Ten Year Follow-up Study. Inhibition, Information Processing and Health Related Quality of Life
	Johansen, Rino Bandlitz	The impact of military identity on performance in the Norwegian armed forces
	Bøe, Tormod	Socioeconomic Status and Mental Health in Children and Adolescents
2014	Nordmo, Ivar	Gjennom nåløyet – studenters læringserfaringer i psykologutdanningen
V	Dovran, Anders	Childhood Trauma and Mental Health Problems in Adult Life
	Hegelstad, Wenche ten Velden	Early Detection and Intervention in Psychosis: A Long-Term Perspective
	Urheim, Ragnar	Forståelse av pasientaggresjon og forklaringer på nedgang i voldsrate ved Regional sikkerhetsavdeling, Sandviken sykehus
	Kinn, Liv Grethe	Round-Trips to Work. Qualitative studies of how persons with severe mental illness experience work integration.
	Rød, Anne Marie Kinn	Consequences of social defeat stress for behaviour and sleep. Short-term and long-term assessments in rats.
	Nygård, Merethe	Schizophrenia – Cognitive Function, Brain Abnormalities, and Cannabis Use
	Tjora, Tore	Smoking from adolescence through adulthood: the role of family, friends, depression and socioeconomic status. Predictors of smoking from age 13 to 30 in the "The Norwegian Longitudinal Health Behaviour Study" (NLHB)
	Vangsnes, Vigdis	The Dramaturgy and Didactics of Computer Gaming. A Study of a Medium in the Educational Context of Kindergartens.

	Nordahl, Kristin Berg	Early Father-Child Interaction in a Father-Friendly Context: Gender Differences, Child Outcomes, and Protective Factors related to Fathers' Parenting Behaviors with One-year-olds
2014	Sandvik, Asle Makoto	Psychopathy – the heterogeneity of the construct
H	Skotheim, Siv	Maternal emotional distress and early mother-infant interaction: Psychological, social and nutritional contributions
	Halleland, Helene Barone	Executive Functioning in adult Attention Deficit Hyperactivity Disorder (ADHD). From basic mechanisms to functional outcome.
	Halvorsen, Kirsti Vindal	Partnerskap i lærerutdanning, sett fra et økologisk perspektiv
	Solbue, Vibeke	Dialogen som visker ut kategorier. En studie av hvilke erfaringer innvandrerdommer og norskfødte med innvandrereldre har med videregående skole. Hva forteller ungdommenes erfaringer om videregående skoles håndtering av etniske ulikheter?
	Kvalevaag, Anne Lise	Fathers' mental health and child development. The predictive value of fathers' psychological distress during pregnancy for the social, emotional and behavioural development of their children
	Sandal, Ann Karin	Ungdom og utdanningsval. Om elevar sine opplevingar av val og overgangsprossessar.
	Haug, Thomas	Predictors and moderators of treatment outcome from high- and low-intensity cognitive behavioral therapy for anxiety disorders. Association between patient and process factors, and the outcome from guided self-help, stepped care, and face-to-face cognitive behavioral therapy.
	Sjølie, Hege	Experiences of Members of a Crisis Resolution Home Treatment Team. Personal history, professional role and emotional support in a CRHT team.
	Falkenberg, Liv Eggset	Neuronal underpinnings of healthy and dysfunctional cognitive control
	Mrdalj, Jelena	The early life condition. Importance for sleep, circadian rhythmicity, behaviour and response to later life challenges
	Hesjedal, Elisabeth	Tverrprofesjonelt samarbeid mellom skule og barnevern: Kva kan støtte utsette barn og unge?
2015	Hauken, May Aasebø	« <i>The cancer treatment was only half the work!</i> » A Mixed-Method Study of Rehabilitation among Young Adult Cancer Survivors
V	Ryland, Hilde Katrin	Social functioning and mental health in children: the influence of chronic illness and intellectual function
	Rønson, Anne Kristin	Vurdering som profesjonskompetanse. Refleksjonsbasert utvikling av læreres kompetanse i formativ vurdering

	Hoff, Helge Andreas	Thinking about Symptoms of Psychopathy in Norway: Content Validation of the Comprehensive Assessment of Psychopathic Personality (CAPP) Model in a Norwegian Setting
	Schmid, Marit Therese	Executive Functioning in recurrent- and first episode Major Depressive Disorder. Longitudinal studies
	Sand, Liv	Body Image Distortion and Eating Disturbances in Children and Adolescents
	Matanda, Dennis Juma	Child physical growth and care practices in Kenya: Evidence from Demographic and Health Surveys
	Amugsi, Dickson Abanimi	Child care practices, resources for care, and nutritional outcomes in Ghana: Findings from Demographic and Health Surveys
	Jakobsen, Hilde	The good beating: Social norms supporting men's partner violence in Tanzania
	Sagoe, Dominic	Nonmedical anabolic-androgenic steroid use: Prevalence, attitudes, and social perception
	Eide, Helene Marie Kjærgård	Narrating the relationship between leadership and learning outcomes. A study of public narratives in the Norwegian educational sector.
2015	Wubs, Annegreet Gera	Intimate partner violence among adolescents in South Africa and Tanzania
H	Hjelmervik, Helene Susanne	Sex and sex-hormonal effects on brain organization of fronto-parietal networks
	Dahl, Berit Misund	The meaning of professional identity in public health nursing
	Røykenes, Kari	Testangst hos sykepleierstudenter: «Alternativ behandling»
	Bless, Josef Johann	The smartphone as a research tool in psychology. Assessment of language lateralization and training of auditory attention.
	Løvvik, Camilla Margrethe Sigvaldsen	Common mental disorders and work participation – the role of return-to-work expectations
	Lehmann, Stine	Mental Disorders in Foster Children: A Study of Prevalence, Comorbidity, and Risk Factors
	Knapstad, Marit	Psychological factors in long-term sickness absence: the role of shame and social support. Epidemiological studies based on the Health Assets Project.
2016	Kvestad, Ingrid	Biological risks and neurodevelopment in young North Indian children
V	Sælør, Knut Tore	Hinderløyper, halmstrå og hengende snører. En kvalitativ studie av håp innenfor psykisk helse- og rusfeltet.
	Mellingen, Sonja	Alkoholbruk, partilfredshet og samlivsstatus. Før, inn i, og etter svangerskapet – korrelerer eller konsekvenser?
	Thun, Eirunn	Shift work: negative consequences and protective factors

	Hilt, Line Torbjørnsen	The borderlands of educational inclusion. Analyses of inclusion and exclusion processes for minority language students
	Havnen, Audun	Treatment of obsessive-compulsive disorder and the importance of assessing clinical effectiveness
	Slåtten, Hilde	Gay-related name-calling among young adolescents. Exploring the importance of the context.
	Ree, Eline	Staying at work. The role of expectancies and beliefs in health and workplace interventions.
	Morken, Frøydis	Reading and writing processing in dyslexia
2016	Løvoll, Helga Synnevåg	Inside the outdoor experience. On the distinction between pleasant and interesting feelings and their implication in the motivational process.
H	Hjeltnes, Aslak	Facing social fears: An investigation of mindfulness-based stress reduction for young adults with social anxiety disorder
	Øyeflaten, Irene Larsen	Long-term sick leave and work rehabilitation. Prognostic factors for return to work.
	Henriksen, Roger Ekeberg	Social relationships, stress and infection risk in mother and child
	Johnsen, Iren	«Only a friend» - The bereavement process of young adults who have lost a friend to a traumatic death. A mixed methods study.
	Helle, Siri	Cannabis use in non-affective psychoses: Relationship to age at onset, cognitive functioning and social cognition
	Glambek, Mats	Workplace bullying and expulsion in working life. A representative study addressing prospective associations and explanatory conditions.
	Oanes, Camilla Jensen	Tilbakemelding i terapi. På hvilke måter opplever terapeuter at tilbakemeldingsprosedyrer kan virke inn på terapeutiske praksiser?
	Reknes, Iselin	Exposure to workplace bullying among nurses: Health outcomes and individual coping
	Chimhutu, Victor	Results-Based Financing (RBF) in the health sector of a low-income country. From agenda setting to implementation: The case of Tanzania
	Ness, Ingunn Johanne	The Room of Opportunity. Understanding how knowledge and ideas are constructed in multidisciplinary groups working with developing innovative ideas.
	Hollekim, Ragnhild	Contemporary discourses on children and parenting in Norway. An empirical study based on two cases.
	Doran, Rouven	Eco-friendly travelling: The relevance of perceived norms and social comparison
2017	Katisi, Masego	The power of context in health partnerships: Exploring synergy and antagonism between external and internal ideologies in implementing Safe Male Circumcision (SMC) for HIV prevention in Botswana
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	Jamaludin, Nor Lelawati Binti	The “why” and “how” of International Students’ Ambassadorship Roles in International Education
	Berthelsen, Mona	Effects of shift work and psychological and social work factors on mental distress. Studies of onshore/offshore workers and nurses in Norway.
	Krane, Vibeke	Lærer-elev-relasjoner, elevers psykiske helse og frafall i videregående skole – en eksplorerende studie om samarbeid og den store betydningen av de små ting
	Søvik, Margaret Ljosnes	Evaluating the implementation of the Empowering Coaching™ program in Norway
	Tonheim, Milfrid	A troublesome transition: Social reintegration of girl soldiers returning ‘home’
	Senneseth, Mette	Improving social network support for partners facing spousal cancer while caring for minors. A randomized controlled trial.
	Urke, Helga Bjørnøy	Child health and child care of very young children in Bolivia, Colombia and Peru.
	Bakhturidze, George	Public Participation in Tobacco Control Policy-making in Georgia
	Fismen, Anne-Siri	Adolescent eating habits. Trends and socio-economic status.
2017 H	Hagatun, Susanne	Internet-based cognitive-behavioural therapy for insomnia. A randomised controlled trial in Norway.
	Eichele, Heike	Electrophysiological Correlates of Performance Monitoring in Children with Tourette Syndrome. A developmental perspective.
	Risan, Ulf Patrick	Accommodating trauma in police interviews. An exploration of rapport in investigative interviews of traumatized victims.
	Sandhåland, Hilde	Safety on board offshore vessels: A study of shipboard factors and situation awareness
	Blågestad, Tone Fidje	Less pain – better sleep and mood? Interrelatedness of pain, sleep and mood in total hip arthroplasty patients
	Kronstad, Morten	Frå skulebenk til deadlines. Korleis nettjournalistar og journaliststudentar lærer, og korleis dei utviklar journalistfagleg kunnskap
	Vedaa, Øystein	Shift work: The importance of sufficient time for rest between shifts.
	Steine, Iris Mulders	Predictors of symptoms outcomes among adult survivors of sexual abuse: The role of abuse characteristics, cumulative childhood maltreatment, genetic variants, and perceived social support.
	Høgheim, Sigve	Making math interesting: An experimental study of interventions to encourage interest in mathematics

2018 V	Brevik, Erlend Joramo	Adult Attention Deficit Hyperactivity Disorder. Beyond the Core Symptoms of the Diagnostic and Statistical Manual of Mental Disorders.
	Erevik, Eilin Kristine	User-generated alcohol-related content on social media: Determinants and relation to offline alcohol use
	Hagen, Egon	Cognitive and psychological functioning in patients with substance use disorder; from initial assessment to one-year recovery
	Adólfssdóttir, Steinunn	Subcomponents of executive functions: Effects of age and brain maturations
	Brattabø, Ingfrid Vaksdal	Detection of child maltreatment, the role of dental health personnel – A national cross-sectional study among public dental health personnel in Norway
	Fylkesnes, Marte Knag	Frykt, forhandlinger og deltakelse. Ungdommer og foreldre med etnisk minoritetsbakgrunn i møte med den norske barnevernstjenesten.
	Stiegler, Jan Reidar	Processing emotions in emotion-focused therapy. Exploring the impact of the two-chair dialogue intervention.
	Egelandsdal, Kjetil	Clickers and Formative Feedback at University Lectures. Exploring students and teachers' reception and use of feedback from clicker interventions.
	Torjussen, Lars Petter Storm	Foreningen av visdom og veltalenhet – utkast til en universitetsdidaktikk gjennom en kritikk og videreføring av Skjervheims pedagogiske filosofi på bakgrunn av Arendt og Foucault. <i>Eller hvorfor menneskelivet er mer som å spille fløyte enn å bygge et hus.</i>
Selvik, Sabreen	A childhood at refuges. Children with multiple relocations at refuges for abused women.	
2018 H	Leino, Tony Mathias	Structural game characteristics, game features, financial outcomes and gambling behaviour
	Raknes, Solfrid	Anxious Adolescents: Prevalence, Correlates, and Preventive Cognitive Behavioural Interventions
	Morken, Katharina Teresa Enehaug	Mentalization-based treatment of female patients with severe personality disorder and substance use disorder
	Braatveit, Kirsten Johanne	Intellectual disability among in-patients with substance use disorders
	Barua, Padmaja	Unequal Interdependencies: Exploring Power and Agency in Domestic Work Relations in Contemporary India
	Darkwah, Ernest	Caring for "parentless" children. An exploration of work-related experiences of caregivers in children's homes in Ghana.
	Valdersnes, Kjersti Bergheim	Safety Climate perceptions in High Reliability Organizations – the role of Psychological Capital

2019	Kongsgården, Petter	Vurderingspraksiser i teknologirike læringsmiljøer. En undersøkelse av læreres vurderingspraksiser i teknologirike læringsmiljøer og implikasjoner på elevenes medvirkning i egen læringsprosess.
V	Vikene, Kjetil	Complexity in Rhythm and Parkinson's disease: Cognitive and Neuronal Correlates
	Heradstveit, Ove	Alcohol- and drug use among adolescents. School-related problems, childhood mental health problems, and psychiatric diagnoses.
	Riise, Eili Nygard	Concentrated exposure and response prevention for obsessive-compulsive disorder in adolescents: the Bergen 4-day treatment
	Vik, Alexandra	Imaging the Aging Brain: From Morphometry to Functional Connectivity
	Krossbakken, Elfrid	Personal and Contextual Factors Influencing Gaming Behaviour. Risk Factors and Prevention of Video Game Addiction.
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