THE IMPACT OF SELF-COMPASSION ON EMOTIONAL AND BIOLOGICAL MARKERS OF STRESS IN YOUTH

by

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Abstract

Emotional and biological responses to stress play a key role in determining risk for psychopathology following exposure to environmental stressors. Thus, it is critical to determine factors that influence individual differences in the stress response. Self-compassion may be one such factor, as researchers have theorized that self-compassion promotes adaptive responses to stress. The focus of this dissertation is on examining the association of self-compassion with emotional and biological markers of stress in youth. In Chapter 1, I assessed the association of self-compassion with emotional (negative and positive affect) and biological (cortisol) responses to an acute laboratory stressor. In Chapters 2 and 3, I examined the association of self-compassion with markers of emotional (negative and positive affect) and biological (cortisol) stress during a naturalistic stressor, namely the transition from elementary school to high school (Chapter 2) and the COVID-19 pandemic and subsequent school closures and social distancing measures (Chapter 3). Overall, findings provided mixed evidence for the role of self-compassion in buffering responses to stressors. Specifically, results suggest that self-compassion may be differentially associated with affective versus biological markers of stress. This dissertation is an important addition to the nascent literature examining self-compassion as a factor that promotes adaptive responses to stress in adolescents.
Lay Summary

Self-compassion is a way of relating to oneself with kindness, being mindful of painful emotions, and remembering that everyone suffers at times. Individuals who are more self-compassionate may be less at risk for developing mental illness because they respond to stressful experiences more adaptively. In this dissertation, I examined the association between levels of self-compassion and emotional and biological responses to stressful events in a group of adolescents. Overall, the findings provided evidence that greater self-compassion was associated with less negative emotions. However, associations of self-compassion with positive emotions and cortisol (a stress hormone) were mixed. This research supports the proposition that self-compassion is associated with responses to stress and provides a springboard for future research.
Preface

This dissertation is based on work conducted in Dr. Joelle LeMoult’s Depression, Anxiety, and Stress (DAS) Lab at the University of British Columbia’s Department of Psychology. This dissertation is original, unpublished, and independent work by the author, Alison Elizabeth Nutini, conducted under the supervision of Dr. LeMoult. The research reported here was approved by the UBC Behavioral Research Ethics Board [certificate # H17-01901].
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Introduction

In 1904, psychologist G. Stanley Hall introduced the concept of “adolescence.” He defined this transitional period between childhood and adulthood as a time of “storm and stress” (Hall, 1904). Proponents of the storm and stress theory have posited that the experience of adolescence is universally one of disequilibrium, destined to be marked by conflict and distress (Cote, 1994). Although contemporary psychologists overwhelmingly reject the idea that storm and stress is an inevitable and universal corollary of adolescence, there is a basic consensus that some turbulence during this age is the norm. Adolescence is a time of great change, when youth begin striving for more independence from their parents and more connection with peers while simultaneously experiencing rapid physical maturation and brain development. This confluence of psychological and physical changes happens alongside environmental changes such as entering high school and social-structure shifts that accompany increased independence. This transitional nature of adolescence, characterized by multiple simultaneous changes, contributes to the stress adolescents often experience (Spear, 2000). Importantly, early adolescence is also a time of increased vulnerability for psychiatric conditions, and rates of psychopathology increase sharply from childhood to adolescence (Kessler, 2005). Evidence from epidemiological studies shows that psychiatric disorders such as depression, panic disorder, agoraphobia, and substance use disorder increase across the transition into adolescence (Costello et al., 2011).

One reason for this sharp increase in psychopathology may be the increased stress experienced during adolescence. Most models of developmental psychopathology place importance on the role of stressors in the etiology and maintenance of mental health disorders in youth (McMahon et al., 2003). Supporting this theoretical assumption, an extensive body of research provides empirical evidence for the role of life stressors in the onset, maintenance, and
recurrence of many disorders, including depressive and anxiety disorders (Hammen, 2005; Hankin & Abela, 2005; Mineka & Zinbarg, 2006). In fact, amongst studies assessing community samples, it was determined that stressful life events preceded 80% of depression cases (Mazure, 1998). Similarly, Mineka and Zinbarg (2006) note that individuals who experience unpredictable and uncontrollable life stressors are also vulnerable to symptoms of generalized anxiety disorder (GAD), and at its extreme, the experience of stressful life events can lead to the development of post-traumatic stress disorder (PTSD; Mueser et al., 2002).

Of course, not all individuals who are exposed to environmental stressors develop later psychopathology (Smith & Pollak, 2020). As such, it is important to investigate factors that lead to some individuals being more vulnerable than others. Developmental models of psychopathology have been critical to understanding the potential mechanisms that explain why some adolescence develop psychopathology following exposure to environmental stressors. One such model by Grant et al. (2005) offers a particularly salient framework for understanding psychopathology in adolescence. A core proposition of Grant et al.’s (2005) general conceptual model (see Figure 1) is that the association between stressors and psychopathology is explained by mediators that are activated by exposure to the stressor and moderators that determine who is at greatest risk. One example of a mediator is individual differences in emotional and biological changes exhibited in response to the stressor. Consistent with Grant et al.’s proposition, people do not exhibit identical responses to the same stressor (Russell & Lightman, 2019; Sapolsky, 1994). Indeed, there are substantial individual differences in people’s stress responses (Orem et al., 2019; Singh et al., 1999), and moderators alter risk by influencing the expression of those individual differences. In turn, empirical evidence indicates that these individual differences play
a critical role in subsequent risk for psychiatric disorders (Ruscio et al., 2015; Schiweck et al., 2019).

**Figure 1**

*Adapted Version of the General Conceptual Model Presented by Grant et al. (2005)*

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**Emotional and Biological Responses to Stress**

It is well acknowledged that stressful events lead to a psychological response that includes a subjective emotional stress experience (Campbell & Ehlert, 2012). Exposure to environmental stressors triggers a range of negative emotions, some of the most common being sadness, anger, anxiety, and shame (Ursin & Eriksen, 2004). Of particular importance, evidence suggests that greater negative affect in response to stressors leads to the development of psychopathology (Cohen et al., 2005; Davidson et al., 2002). For example, in a longitudinal study, greater increases in negative affect in response to daily stressors predicted increased depressive symptoms two months later (Parrish et al., 2011). The stress response is also
associated with a reduction in positive emotions such as decreases in feeling happy, amused, and calm (Hastings et al., 2007). Importantly, greater reduction of positive affect after a psychosocial stressor has also been associated with later psychopathology in adolescents (Hastings et al., 2007). Whereas greater decreases in positive affect in response to interpersonal stressors in everyday life predicted larger increases in depressive symptoms over time (O’Neill et al., 2004), maintaining greater positive affect during the stressor lowers risk of developing psychopathology such as depression (Wichers et al., 2007).

Exposure to stressors can also trigger a biological stress response. A central component of the biological stress response system is the hypothalamic-pituitary-adrenal (HPA) axis, which prepares people to cope with stressful situations that may demand action (Gunnar et al., 1989). When the HPA axis is activated in response to a stressor, the hypothalamus releases corticotrophin-releasing hormone (CRH). CRH is then transported by blood vessels to the pituitary gland, which triggers the release of adrenocorticotropic hormone (ACTH). ACTH is transported via the bloodstream to the adrenal gland where it initiates biosynthesis of cortisol.

Cortisol is a critical marker of HPA-axis activity and the primary stress hormone. It is essential to normal physiological functioning, including cardiovascular activity and metabolism, and as such, is released by the body spontaneously throughout the day (Lovallo & Thomas, 2000). In addition, cortisol is released in response to acute stressors (Bhattacharyya et al., 2008; McEwan et al., 1997). While moderate cortisol levels are a necessary and adaptive part of responding to an individual’s environment, too much cortisol has deleterious effects (McEwan, 2008). Chronically elevated levels of cortisol can disrupt an individual’s ability to regulate emotions and cope with stress.
Historically, stress research has focused on either emotional or biological responses to stress, and it is less common to examine both. In studies employing acute laboratory stressors, many studies have focused solely on biological responses to stress and less attention has been paid to subjective emotional responses (Campbell & Ehlert, 2012; Dickerson & Kemeny, 2004). The opposite is true for naturalistic studies, where the focus is most often on emotional responses to stress (Allen & Leary, 2010; Chishima et al., 2018; Krieger et al., 2015). In recent years, there has been increasing importance placed on assessing multiple markers of the stress response (Campbell & Ehlert, 2012; Ellenbogen et al., 2002; Ellenbogen et al., 2006; Scherer, 2004). Although theorists have assumed for many decades that emotional and biological responses to stress are coherent or tightly coupled (Mauss et al., 2005), the evidence does not support this (Campbell & Ehlert, 2012; Mauss et al., 2005). In fact, a review found significant correlations between affect and cortisol stress responses in only 25% of studies (Campbell & Ehlert, 2012), which highlights the importance of assessing both of these factors as interrelated, yet distinct, entities. Assessing biological responses to stress also overcomes limitations of self-report measures, including that some individuals may have difficulty accurately recognizing or describing their emotions, or may be motivated by social desirability factors to downplay their experience of negative emotions (Campbell & Ehlert, 2012; Lerner et al., 2007). On the other hand, subjective emotional responses may sometimes be a better indicator of the experience of stress, as elevated biological markers of stress could be reflective of activation in general, or the experience of more positive emotions such as excitement or alertness (Campbell & Ehlert, 2012). Thus, it is critical to assess both emotional and biological responses to stress.
Self-Compassion as a Moderator of the Stress Response

Given the adverse effects of increased emotional and biological responses to stress, it is important to determine factors that may protect individuals from developing maladaptive patterns. Thus, a critical question is: What influences individual differences in the stress response? Returning to the general conceptual model (Figure 1), Grant et al. (2005) posit that moderators alter risk for psychopathology following exposure to environmental stressors by influencing individual differences in the emotional and biological stress responses. Moderators can be conceptualized as either protective or vulnerability factors and, as such, can either increase or decrease the stress response.

One possible moderator is the way an individual thinks about themselves and stressful events (Grant et al., 2005). As such, self-compassion may be one such moderating factor given it is a mechanism that has been theorized to help cope with environmental stressors (Neff, 2003a). Self-compassion is a construct that has been steadily gaining traction in the psychological literature as an adaptive means of relating to oneself (Neff et al., 2007). It has roots in Buddhist philosophy and has been part of Eastern philosophical thought for many centuries but has much more recently been incorporated into Western psychology. A number of scholars have been integral to conceptualizing and measuring self-compassion in psychological research. Gilbert (1989; 2005) proposed the Social Mentality Theory framework, which presents the ability to be compassionate, towards others as well as towards oneself, as evolving from the drive to care for offspring and ensure their survival. Compassion is presented as a social mentality that requires the ability to engage with and understand suffering and as a motivational system to regulate negative affect in self and others (Gilbert, 1989). Gilbert’s model of compassion and the corresponding compassion training were created to combat another evolved social mentality
consisting of shame and self-criticism, which they proposed develops to protect individuals from social threats (Gilbert & Irons, 2009). More recently, Gilbert and colleagues developed a new model of compassion that focuses on the motivation to alleviate distress and engage with self and others in a meaningful way (Gilbert et al., 2017). In this model self-compassion is just one aspect of compassion alongside having compassion for others and receiving compassion from others.

Another framework of compassion, that includes an element of self-compassion, was developed by Strauss et al. (2016). Strauss and colleagues conducted a systematic review of all measures of compassion for self and others, synthesized existing conceptualizations, and then proposed a new framework that integrated common elements. This new framework includes the following five key elements of both general compassion and self-compassion: recognizing suffering, understanding the universality of suffering, feeling empathy for the person suffering, tolerating uncomfortable feelings, and feeling motivated to alleviate the suffering.

Although scholars like Gilbert and Strauss have contributed valuable insights to our understanding of self-compassion, I focus here on the conceptualization of self-compassion developed by Dr. Kristin Neff (2003a). Neff conceptualized self-compassion as a construct made up of six distinct but interrelated facets. Three facets – self-kindness, common humanity, and mindfulness – represent increased compassionate self-responding and three facets – self-judgement, isolation, and overidentification – represent decreased uncompassionate self-responding. Self-kindness is the act of being kind and understanding to oneself, while self-judgement entails harsh criticism for one’s perceived failures. Common humanity is the understanding that everyone suffers and identifying with universal suffering, while isolation involves feeling alone in one’s misery. Finally, mindfulness is the act of being aware of painful
thoughts and feelings, while overidentification involves over-thinking, passing judgement, and becoming fused with one’s suffering (Neff, 2003a; Neff, 2020).

One of the main differences between Neff’s conceptualization of self-compassion and those posited by Gilbert and Strauss is that Neff focuses solely on compassion towards the self, whereas Gilbert et al. (2017) and Strauss et al. (2016) focus more on general compassion towards others. The second main difference is that Neff conceptualizes self-compassion as existing on a bipolar continuum, with compassionate self-responding (CS; i.e., mindfulness, self-kindness, and common humanity) on one end and uncompassionate self-responding (UCS; i.e., overidentification, self-criticism, and overidentification) on the other (2022). Thus, not only are CS and UCS thought of as existing along one continuum, but they also represent qualitatively distinct dimensions with different causes and correlates (Neff, 2016). Finally, another advantage to using Neff’s conceptualization of self-compassion is that it predominates the field of self-compassion research. Thus, positioning my research within Neff’s framework facilitates comparison with most self-compassion research. In contrast, Gilbert’s work is more widely used in the literature pertaining to therapy with his therapeutic model of Compassion Focused Therapy, whereas the framework of self-compassion developed by Strauss and colleagues is still emerging and being substantiated.

Researchers using Neff’s (2003a) conceptualization of self-compassion have posited that self-compassion may be particularly important during adolescence, as adolescents’ sense of identity is developing and at this stage youth are often consumed with self-judgment and questioning their self-worth (Bluth & Blanton, 2015). Additionally, adolescents frequently feel that the difficult thoughts and feelings they experience are unique and no one else would understand, causing them to feel isolated and alone (Elkind, 1978). For these reasons, Neff’s
facets of self-compassion may be particularly helpful in allowing youth to feel understood and connected to others. Self-compassion also has benefits over related constructs. Self-esteem is one such related construct which has been thoroughly researched. Research has shown self-esteem is difficult to raise (Sedikides, 1993; Swann, 1996) and most school programs to increase self-esteem have failed (Baumeister et al., 2003). Further, high self-esteem has been linked to problematic behaviors, including bullying, aggression, and narcissism (Baumeister et al., 2000; Crocker & Park, 2004; Neff & McGehee, 2010). In contrast, self-compassion can be raised through intervention and practice, and it is more strongly associated with positive benefits than self-esteem, without being associated with negative behaviours (Neff & McGehee, 2010).

In the last decade, the field of self-compassion has grown exponentially. Researchers have found an inverse association between levels of self-compassion and many different forms of psychopathology including, but not limited to, depression, anxiety, eating disorders, PTSD, obsessive compulsive disorder, and schizophrenia (e.g., Bergen-Cico & Cheon, 2014; Eicher et al., 2013; Gill et al., 2018; Kelly et al., 2020; Leeuwerik et al, 2020; Raes, 2011; Seligowski et al., 2015). The majority of studies in self-compassion have examined adult samples, but self-compassion in children and adolescence is also a burgeoning literature. Findings from the first meta-analysis to synthesize the research regarding self-compassion and psychological distress in adolescents found a large inverse effect size ($r = -0.55; 95\% \text{ CI } -0.61 \text{ to } -0.47$), suggesting that higher levels of self-compassion are associated with lower levels of anxiety, depression, and stress (Marsh et al., 2017). Researchers have concluded from these findings that a lack of self-compassion may play a major role in the onset or maintenance of emotional difficulties in adolescents. However, the majority of studies are cross-sectional in that they look at the correlation between self-compassion and symptoms of psychopathology at one timepoint (Bluth
et al., 2016). As such, they do not elucidate the nature of the relationship between the two variables. With this in mind, there have been recent calls in the literature to better understand why low self-compassion might increase risk for psychopathology. For example, a recent systematic review examining the association between self-compassion and depression symptoms in adolescents pointed to the paucity of research regarding the actual mechanism of change and highlighted this as an important area for future development (Pullmer et al., 2019).

One possibility is that self-compassion may buffer adolescents’ response to environmental stressors. This supposition is consistent with conceptualizations of self-compassion as a resiliency factor that helps individuals cope with negative events (Neff, 2003b). It is also consistent with evidence that self-compassion allows individuals to think differently about a stressor and their subsequent reaction, which can attenuate responses to stress (Allen & Leary, 2010). In fact, preliminary evidence suggests that self-compassion influences emotional and biological markers of stress (Arch et al., 2014; Breines et al., 2014; Luo et al., 2018). However, all but one of these studies has been conducted in adults, and very few studies have measured both emotional and biological responses to stress. Thus, though there is reason to believe that individual differences in self-compassion are associated with individual differences in emotional and biological markers of stress, data is lacking on this relationship in adolescence. By establishing the link between self-compassion and individual differences in responses to stress, this work will set the foundation for future research to test Grant et al.’s (2005) full moderated-mediation model. Before doing so, we must first establish the association between self-compassion and individual differences in adolescents’ responses to stress.
Main Objective

This dissertation will focus on elucidating the association of self-compassion with emotional and biological markers of stress in adolescence. Overall, I expect that those who have higher levels of self-compassion will have more adaptive emotional and biological markers of stress. In Chapter 1, I assess the association of self-compassion with emotional and biological responses to an acute laboratory stressor. In Chapters 2 and 3, I examine the association of self-compassion with markers of emotional and biological stress during a naturalistic stressor, namely the transition from elementary school to high school (Chapter 2) and the COVID-19 pandemic and subsequent school closures and social distancing measures (Chapter 3). See Figure 2 for an overview of this research.

Figure 2

Overview Including Timeline and Sample Size for the Three chapters of the Dissertation
Chapter 1

Introduction

Individual differences in emotional and biological responses to environmental stressors have been identified as important risk factors for the development of multiple psychiatric disorders (LeMoult et al., 2020; Ruscio et al., 2015; Schiweck et al., 2018; Vaccarino et al., 2015). Thus, it is critical to understand mechanisms that may influence individual differences in responses to stress. Self-compassion is one mechanism that can influence the way an individual responds to themselves and, as such, to the stressful situations they might encounter. Self-compassion involves engaging in the three facets of compassionate self-responding: (1) self-kindness – the act of being kind and non-judgmental toward oneself; (2) common humanity – remembering the universality of suffering; and (3) mindfulness – bringing attention and awareness to thoughts and feelings without overthinking. Self-compassion also involves simultaneously disengaging in the three facets of uncompassionate self-responding: (4) self-judgement – criticizing one’s self for perceived failures; (5) isolation – feeling alone in one’s misery; and (6) overidentification – becoming fused to suffering and losing perspective (Neff, 2003a; Neff, 2020).

Researchers have documented that self-compassion is inversely related to perceived stress in both adults and adolescents (Bluth & Blanton, 2014; Neely et al., 2009; Sirois, 2014). This burgeoning research suggests that self-compassion may buffer the negative impacts of stress; however, most of the extant self-compassion and stress literature has employed retrospective, self-report measures of perceived stress (Sirois et al., 2015). Few studies have measured moment-to-moment responses to an acute stressor using, for example, an acute laboratory stressor. The dearth of research using acute laboratory stressors is surprising given
their advantages and ecological validity (Kidd et al., 2014; Zhaoyang et al., 2020). For example, laboratory stressors ensure that all participants complete the same standardized stressor (Breines et al., 2014). Standardization of the stressor is important as it allows all individuals to be exposed to the same type and objective magnitude of stress, thereby allowing for more meaningful interpretation of individual differences in the stress response.

Acute laboratory stressors have been demonstrated to produce large and reliable stress responses, with subjective emotional responses and cortisol being two of the most commonly reported metrics (Campbell & Ehlert, 2012; Ellenbogen et al., 2002; Goodman et al., 2017). Research shows that subjective emotional responses occur rapidly, with negative affect rising when faced with the stressor, and then falling once the stressor is over (Campbell & Ehlert, 2012). In addition to negative affect, levels of positive affect decrease in response to a stressor and then increase across the recovery period (Campbell & Ehlert, 2012). In contrast to emotional responses, cortisol has a slower stress response, reaching a peak between 21- and 30-minutes following stressor onset (Dickerson & Kemeny, 2004) and declining significantly by 21-40 minutes post-stressor (Dickerson & Kemeny, 2004).

There are several important components of the stress response. The first, reactivity, captures the emotional and biological changes that occur in response to the stressor onset, and reflects an individual’s sensitivity to the stressor. The second, recovery, captures the degree to which the reactivity persists, or the levels return to baseline (Ji et al., 2015). The third, total levels of affect and cortisol, reflect the total amount of the variable across the stressor. It is important to assess total levels of affect and cortisol across a stressor, as total output reflects the overall stress response and is uniquely associated with mental and physical health outcomes (Ellenbogen et al., 2011; McEwan, 2008). Area under the curve with respect to ground (AUCg)
is a frequently used measure that indexes total amount of a variable that was collected at multiple points in time (Golden et al., 2013; Pruessner et al., 2003). It is advantageous because it takes into account the difference in time between each measurement of the variable, as well as the value of the outcome at each measurement point (Pruessner et al., 2003). Another common metric is area under the curve with respect to increase (AUCi) which measures increases in a variable without regard for baseline levels. Whereas AUCi quantifies total reactivity and recovery, AUCg quantifies total output, including baseline levels, reactivity, and recovery (Pruessner et al., 2003). As such, AUCg provides information not captured by metrics of reactivity or recovery.

While moderate and short-term responses to stress allow individuals to cope with environmental demands, exaggerated and sustained responses to stress are maladaptive and associated with negative outcomes. For example, exaggerated emotional responses to stress, as measured via negative affect, have direct and indirect effects on enhanced risk for morbidity and mortality (Kiecolt-Glaser et al., 2002). Conversely, lower levels of positive affect are associated with psychological disorders such as depression and anxiety (Carl et al., 2013; Gilbert, 2012), whereas higher levels of positive affect protect against illness and injury (Davidson et al., 2010; Pressman & Cohen, 2005; Yang et al., 2018).

Similarly, excess cortisol responses to stress can be problematic (Colich et al., 2015; McEwen, 2008). Higher overall levels of cortisol lead to deleterious effects on cardiovascular health, immune functioning, and cognition (Hinkelmann et al., 2009; Kiecolt-Glaser et al., 2002). Further, consistent evidence shows that slower cortisol recovery post-stressor is associated with psychopathology, such as depression (Burke et al., 2005). Given the negative consequences of
increased reactivity and delayed recovery from stress, it is important to identify factors that could mitigate these patterns of responding and subsequently their deleterious effects.

Although there is some evidence that self-compassion modulates emotional and biological responses to a laboratory stressor in adult samples (Arch et al., 2014; Breines et al., 2014; Luo et al., 2018), just one study to date has employed a laboratory stress induction to examine the association between trait levels of self-compassion and responses to stress in adolescents (Bluth et al., 2016). Bluth and colleagues (2016) examined the effect of trait self-compassion on biological (but not emotional) responses to an acute laboratory stressor in a sample of youth aged 13 to 18. They found that youth who were low in self-compassion (based on a median split) did not differ from those high in self-compassion in their cortisol response to the stressor.

A number of reasons may explain why Bluth et al. (2016) did not find an association between self-compassion and cortisol. For one, the small sample size (n = 28) lacked statistical power; in fact, Bluth et al. (2016) noted the importance of employing a larger sample size to replicate their study in order to provide more definitive results. Bluth et al. (2016) also did not assess psychopathology. This is surprising given that the presence of psychiatric disorders such as depression and anxiety can influence patterns of cortisol production and levels of self-compassion. For example, meta-analytic evidence indicates that depression is associated with dysregulated cortisol reactivity in response to laboratory stressors (Burke et al., 2005; Lopez-Duran et al., 2009). Evidence of significant differences in cortisol responses to stress between individuals with social anxiety and healthy controls has also been found (Furlan et al., 2001; Roelofs et al., 2009; Van West et al., 2008). Thus, it is important to assess and control for psychopathology when assessing self-compassion and biological responses to stress.
Another opportunity for improvement would be to treat self-compassion as a continuous variable. Bluth et al. (2016) used a median split for self-compassion, which created an arbitrary dichotomy. This is problematic because there is no reason to believe that self-compassion has an underlying dichotomy or bi-modal presentation in an unselected sample. There are also no established cut-offs that would lead to an informed decision on splitting the continuous variable into two groups, and statisticians have stated that there is no reason to think a dichotomy would lie at the median (Altman & Royston, 2006). Dichotomizing also leads to a loss of information and a subsequent loss of power (Altman & Royston, 2006). Analytic methods that allow self-compassion to be considered as a continuous measure and that take into account the nested nature of the data would offer more accuracy and statistical power.

The aim of the current chapter was to overcome these limitations and extend our understanding of the impact of self-compassion on youths’ affective and biological responses to an acute laboratory stressor. Toward this goal, I recruited a sample of youth (ages 11 to 13) who completed the Self-Compassion Scale – Short Form (Raes et al., 2011) to assess trait levels of self-compassion followed by a psychosocial laboratory stressor: the Trier Social Stress Test for Children (TSST-C; Buske-Kirschbaum et al, 1997). Participants’ emotional (positive affect and negative affect) and biological (cortisol) responses to stress were measured throughout the TSST-C. Various measures of self-compassion were considered. Gilbert and colleagues, for example, developed the Forms of Self-Criticism and Self Reassurance Scales (Gilbert et al., 2004) based on the Social Mentality Theory. This scale assesses the constructs as they are defined in SMT and, thus, is used by researchers working within the SMT framework. Gilbert and colleagues also developed the Compassion Engagement and Action Scales based on their new model of compassion that focuses on the motivation to alleviate distress and engage with
self and others in a meaningful way (Gilbert et al., 2017). Moreover, Gu et al. (2020) created the Sussex-Oxford Compassion for the Self Scale (SOCS-S) to assess the model of compassion and self-compassion formulated by Strauss and colleagues (2016). Although all of these measures have adequate psychometric properties (Gilbert et al., 2017; Gu et al., 2020), the Self-Compassion Scale (SCS; 2003a) is the only measure that assesses all six facets of self-compassion proposed by Neff (2003a), including kindness and common humanity, and it is the most commonly used measures of self-compassion in the literature. Given that both the long and short form of the SCS (Neff, 2003a; Raes et al., 2011) show strong psychometric properties, I administered the short form to minimize participant burnout. In order to examine the association between self-compassion and responses to stress, I used analytic techniques that allowed self-compassion to be treated as a continuous variable and that took into account the repeated assessment of emotional and biological markers of stress over time. I also assessed a number of important potential covariates, including pubertal status and current and past psychopathology, which were controlled for as necessary.

**Aim 1**

The first aim was to examine the association between self-compassion and total emotional and biological stress across the TSST-C, calculated based on AUCg for positive affect, negative affect, and cortisol, respectively. I expected that higher levels of self-compassion would be associated with less emotional and biological stress such that higher levels of self-compassion would be associated with: (1) more positive affect, (2) less negative affect, and (3) less cortisol output across the TSST-C.
**Aim 2**

The second aim was to examine the association between self-compassion and *patterns* of emotional and biological reactivity to and recovery from stress during the TSST-C. I expected that self-compassion would be associated with an attenuated response to the stressor and faster recovery from the stressor, as indicated by: (1) a smaller increase in negative affect from pre- to post-stressor and a faster decline in negative affect through the recovery period, (2) a smaller decrease in positive affect from pre- to post-stressor and faster increase in positive affect through the recovery period, and (3) a smaller increase in salivary cortisol from pre- to post-stressor and faster decline in salivary cortisol post-stressor.

**Method**

**Participants**

Eighty-three youth and one of their parents/legal guardians were recruited from the Greater Vancouver community via flyers posted in public places (e.g., coffee shops, community centers) and advertisements posted online (e.g., facebook.com and craigslist.ca). Eligible participants were entering Grade 8 in the upcoming academic year, fluent in English, and had at least one parent/legal guardian who was fluent in English. Participants were not eligible for participation if they had a history of severe head trauma, psychotic symptoms, manic/hypomanic episodes, or alcohol or substance use disorder in the past six months. Further, participants were excluded if they were currently taking corticosteroids (including glucocorticoids), oral or inhaled steroids, or depot neuroleptics, as there is evidence to suggest that these medications can alter HPA activity (Burke et al., 2005; Cohen et al., 2003). Initial eligibility criteria were assessed via a telephone-based interview (See Appendix A) with a parent/legal guardian and were confirmed via an in-person interview with participants and their parent/legal guardian.
**Procedure**

Eligible participants completed two laboratory sessions. In the first laboratory session (T1), participants and their parent/legal guardian first provided consent and assent, respectively. Youth then completed a diagnostic interview and self-report questionnaires. The second laboratory session (T2) was completed approximately two weeks later. In it, participants completed the laboratory stressor and were debriefed. Participants received a $60 honorarium for their participation.

**Measures**

**Diagnostic Interview.** To assess the presence of current or past DSM-5 psychological disorders, youth completed a structured clinical interview – the KSADS-PL (Kaufman et al., 2016). In addition, the parent/legal guardian also completed the parent version of the KSADS-PL (Kaufman et al., 2016) to assess the parents’ report of youth psychopathology. Interviews were administered by trained graduate students or advanced research assistants. Participants were deemed to meet criteria for a DSM-5 diagnosis if indicated by either youth or parent report (Grant et al., 2020).

**Self-Compassion.** Participants in this study completed the Self-Compassion Scale – Short Form (SCS-SF; Raes et al., 2011) to assess trait level of self-compassion (see Appendix B), which is how self-compassionate people are in general towards themselves. The SCS-SF assesses all three facets of self-compassion, along with their negative counterparts: self-kindness versus self-judgement, common humanity versus isolation, and mindfulness versus over-identification. The short form version of the Self-Compassion Scale was chosen to reduce participant burden. It has been used as an alternative to the long-form of the scale as it has the same factor structure, good internal consistency (α ≥ .86 in all samples), acceptable test-retest
reliability ($r = .71$), and a near-perfect correlation ($r \geq .97$ all samples) with the full SCS (Babenko & Guo, 2020; Castilho et al., 2015; Raes et al., 2011). The SCS-SF also has shown good convergent validity with constructs such as shame, anxiety, and depression (Babenko & Guo, 2020; Castilho et al., 2015; Kelly et al., 2013; Reid et al., 2014). Further, this scale was found to be a valid and reliable measure to assess self-compassion among adolescents in previous research (Cunha et al., 2016). The SCS-SF assesses how participants typically act towards themselves, with responses on a Likert scale ranging from 1 (Almost Never) to 5 (Almost Always). The total SCS-SF-trait score was computed by first reverse scoring the negative subscale items and then taking the average of all items. The SCS-SF scale showed acceptable internal reliability with this sample, $\alpha = .699$.

**Laboratory Stressor.** Participants were instructed not to eat or drink anything other than water, not to consume nicotine or caffeine, and not to engage in physical activity for two hours prior to their lab session, as these variables are known to affect levels of cortisol (Garde et al., 2009). Further, all lab sessions were scheduled between 1:00 and 4:00 PM in order to minimize the effects of diurnal cortisol variations (Kirschbaum & Hellhammer, 1989).

The laboratory stress procedure is depicted in Figure 3. When participants arrived at the lab for T2, they were instructed to rest and watch a calming 15-minute nature video (*baseline period*). This rest period allowed for mood and cortisol levels to reach a baseline before beginning the stressor. Research from a recent meta-analysis (Goodman et al., 2017) suggests that an acclimation period of 15 minutes is sufficient to allow for cortisol levels to return to baseline.

Next, youth completed the Trier Social Stress Test for Children (TSST-C), a highly standardized paradigm that is the most widely used stressor in children and adolescents (Buske-
Kirschbaum et al., 1997; Chen et al., 2014). The TSST-C was conducted as follows: participants were given a story prompt and were told that they would finish telling the story out loud in front of a committee of judges (one female and one male). They were told that the committee would be monitoring their behaviour and rating the quality of their story. Unbeknownst to the participant, this committee was made up of research confederates who were trained to play this role in a standardized friendly and supportive manner. Further, participants were told that their performance would be video recorded in line with the standard protocol of the TSSTC; in reality, the performance was not recorded. They were then given 5 minutes to prepare for the task (the preparation period).

Following this preparation period, participants completed the stressor period, during which they performed two 5-minute tasks in front of the “committee of judges” (i.e., the two confederates). During the first task, participants were asked to complete the unfinished story that was provided to them during the preparation period. If a participant completed the story in less than 5 minutes, the confederates asked them to continue. Next, the participant was given instructions to complete an unexpected math task of orally counting backwards from 1,023 in 13 step sequences. During the math task, if participants made an error, they were asked to begin again at 1,023. Following the Stressor phase, participants rested for 30 minutes while they watched a second calming nature video (recovery period). The verbal task instructions and math task instructions can be found in Appendices C and D.
**Positive and Negative Affect.** Self-reported affect was assessed during the laboratory stressor using items from the Positive and Negative Affect Scale for Children (PANAS-C; Laurent et al., 1999). Participants responded to this scale using a 5-point Likert scale ranging from 1 (*Very Slightly or Not at All*) to 5 (*Extremely*). Consistent with our past work (Jopling, 2019; Zareian et al, 2022), a positive affect composite measure was calculated by taking the sum of happy, excited, proud, and calm affect scores and a negative affect composite measure was calculated by taking the sum of stressed, upset, nervous, and ashamed affect scores. The negative affect items of upset, nervous, and ashamed were chosen from the PANAS-C because there is a general consensus in the literature that negative affect as a result of stress is best indexed by assessing a number of specific emotional experiences including sadness, nervousness, and shame (Gray & Watson, 2007; Stanton & Watson, 2014). We added stressed given it is a common emotion during the transition to high school (e.g., Benner, 2011). Positive affect items were chosen to represent a range of emotions with good face validity and strong item-total correlations (Laurent et al, 2009).
Affect was assessed at 6 time-points (see S1-S6 in Figure 3): following the baseline period, after the preparation period, after the stressor, and at 3 timepoints during the recovery period. For positive affect, between-person reliability was $R_{kf} = .97$ and within-person reliability was $R_{c} = .59$ (Cranford et al., 2006). For negative affect, between-person reliability was $R_{kf} = .97$ and within-person reliability was $R_{c} = .76$ (Cranford et al., 2006). Note that within-person reliabilities calculated for short scales administered on a frequent basis are expected to have lower values than classical reliability measures (Nezlek, 2017). The PANAS can be found in Appendix E.

**Salivary Cortisol.** Saliva samples were collected during the laboratory stressor in order to measure the hormone cortisol, a central biological marker of stress. Samples were collected at the same 6 times that affect was assessed (see S1-S6 in Figure 3): following the baseline period, after the preparation period, after the stressor (0 minutes following stressor offset), and at 3 timepoints during the recovery period (10-30 minutes following stressor offset). These timepoints were chosen to ensure that the following were captured: (1) a baseline level of cortisol prior to the stress task, (2) peak cortisol levels which typically occur between 21- and 30-minutes following stressor onset (Dickerson & Kemeny, 2004) and (3) a significant decline in cortisol levels which typically occurs 21-40 minutes post-stressor onset (Dickerson & Kemeny, 2004). Saliva was collected using Salivettes (Sarstedt, Germany), and stored in a -30°C freezer in our laboratory prior to analysis. Biochemical analyses of cortisol from saliva samples was performed at Dresden LabService in Dresden, Germany. The inter and intraassay coefficient of variance were both below 8%. Raw cortisol measurements from all six time points were positively skewed, which is typical in the literature (Granger et al., 2012). There were also 34 outliers across the six time points. In order to normalize the data, a natural logarithmic (ln)
transformation was applied, as is common in the literature (e.g., Shrout et al., 2020; Sin et al., 2017). The ln transformed cortisol data at each time point (S1-S6) were normally distributed and there were no outliers. Thus, the natural log-transformed values, measured in nanomoles per litre (nMol/l), were used in all reported analyses.

**Covariates.** Participants completed questionnaires to assess variables known to affect cortisol levels or responses to stress. Specifically, participants provided information on age, biological sex, and past and present psychosocial and pharmacological treatment (Hibel et al., 2007; Kajantie & Phillips, 2006; see Appendix F). Participants completed the Tanner Staging Questionnaire to assess pubertal status based on pubic hair and breast/genitalia growth (Marshall & Tanner, 1968; see Appendix G). Participants also reported on health-related variables known to affect the response of the HPA axis, including height and weight (used to calculate BMI), whether or not clients ate or drank anything besides water, consumed caffeine, consumed nicotine, or exercised in the 2 hours prior to study participation (Garde et al., 2009; see Appendix H). All participants were instructed to refrain from doing any of the aforementioned in the 2 hours prior to T2. During T2, participants were asked to report on their compliance with the instructions in order to test it as a potential covariate. Unfortunately, due to an administration error, BMI and compliance data were not collected from a subset of participants (n = 28 out of the 83 participants enrolled in the study). Thus, BMI and compliance variables (whether or not they ate or drank, consumed caffeine or nicotine, or exercised in the 2 hours prior) were tested as covariates on a subset of the sample (n = 55).
**Data Analytic Approach**

**Aim 1**

The first aim was to examine the association between self-compassion and total positive affect, negative affect, and cortisol across the TSST-C. In order to quantify total emotional and biological stress across the TSST-C, I calculated area under the curve to ground (AUCg) using trapezoidal integration for positive affect, negative affect, and cortisol, respectively (Pruessner et al., 2003).

I conducted three hierarchical linear regression analyses with self-compassion predicting each outcome. Covariates were controlled for as needed in Block 1, and self-compassion was added in Block 2. Based on previous research (Garde et al., 2009; Hibel et al., 2007; Kajantie & Phillips, 2006; Martin et al., 2012), the following covariates were considered for positive and negative affect: age, sex, and pubertal stage, past or current DSM-5 diagnosis, past and present psychosocial treatment, past and present use of psychotropic medication, current use of non-psychotropic medication, use of nicotine, caffeine consumption, or eating/drinking in the 2 hours prior to the experiment, exercise the day of the experiment, BMI, and number of minutes between midnight and the first saliva sample. Several additional variables were tested as potential covariates for cortisol given evidence that they can influence functioning of the HPA axis: use of nicotine, caffeine consumption, or eating/drinking in the 2 hours prior to the experiment, exercise the day of the experiment, BMI, and number of minutes between midnight and the first saliva sample (Minutes from Midnight). These potential covariates were included in Block 1 of the regression analyses only if significant. Self-compassion was added in Block 2. For all regression analyses, effect sizes are reported as $R^2$ or the coefficient of determination. $R^2$ represents the amount of variance in the outcome variable explained by the predictor variable. $R^2$
values of 0.01, 0.09, and 0.25 represent small, medium, and large effects, respectively (Foster et al., 2018).

**Aim 2**

The second aim was to test the association of self-compassion with stress reactivity and recovery. Given that time is nested within participants, I used a hierarchical linear modeling (HLM) approach to examine the effect of self-compassion on affective and biological responses to a social stressor (Raudenbush & Bryk, 2002). This approach is ideally suited to analyze nested data as it allows for the exact time of the affect and cortisol measurements to vary by individual, and it does not assume independence of data points (Hruschka et al., 2005). HLM also has the advantage of allowing for a participant to be missing some within-subject data without excluding that participant entirely. Finally, the partial pooling approach use by HLM builds multiplicity into models from the start which leads to more unbiased and valid estimates compared to other approaches (Gelman et al., 2012).

At Level 1, repeated measurements of positive affect, negative affect, and cortisol were modelled within individuals as a function of time. For each outcome variable, changes across time were modeled with linear, quadratic, and piecewise formats. I then selected the model that best fit the data based on deviance statistics, visual inspection of the data, and the smallest value of the Akaike Information Criterion (AIC) which indicates overall better model fit. Next, I tested potential covariates at Level 2 to see if any were associated with an outcome measure (i.e., positive affect, negative affect, and cortisol). Consistent with the analyses in Aim 1, the following covariates were considered: age, sex, and pubertal stage, past or current DSM-5 diagnosis, past and psychosocial treatment, past and present use of psychotropic medication, current use of non-psychotropic medication, use of nicotine, caffeine consumption, or
eating/drinking in the 2 hours prior to the experiment, exercise the day of the experiment, BMI, 
and number of minutes between midnight and the first saliva sample. Only significant covariates 
were retained in the final model, in keeping with best-practice recommendations (Raudenbush et 
al., 2004). Finally, self-compassion as a characteristic that varied across individuals was tested at 
Level 2 to see if it was associated with between-person variability in Level 1 parameters after 
controlling for relevant covariates. All HLM analyses were run using hierarchical linear 
modeling software (HLM-7; Raudenbush et al., 2011). When calculating deviance estimates and 
AIC for model fit, full information maximum likelihood was used. When estimating model 
parameters, restricted maximum likelihood was used. Following recommendation by 
Raudenbush and Bryk (2002), robust standard errors were used for all analyses in order to reduce 
bias. Two-tailed testing was used for all tests of significance. Research suggests that Level 2 
sample sizes should be greater than 50 to achieve adequate power in hierarchical models (Maas 
& Hox, 2005), and the current sample exceeded this minimum. Using HLM, the B values 
represent unstandardized coefficients rather than Beta coefficients and, as such, do not represent 
a measure of effect size. HLM is not well suited to traditional computations of effect size or 
proportion of variance explained, since estimates are generally biased and not directly 
interpretable (Carels et al., 2007; Kircanski et al., 2015; Snijders & Bosker, 2011).

**Modelling Affect.** Based on visual inspection of the data and preliminary analyses, we 
compared a linear, quadratic, and piecewise model. The piecewise model consisted of the value 
of positive/negative affect at baseline (S1; immediately following the 15-minute nature video rest 
period), during stress reactivity (slope from S1 to S3; baseline to immediately after the stressor), 
and during stress recovery (slope from S3 to S6; immediately after the stressor to approximately 
30 minutes post-stressor offset). For both positive and negative affect, the piecewise model (AIC
= 2202.26 and 2290.69 for positive and negative affect, respectively) fit the data significantly better than the linear model (AIC = 2360.92 and 2553.69 for positive and negative affect, respectively; ps < .001), and the quadratic model was not able to run. Thus, the following Level 1 models (one for positive affect and one for negative affect) were specified:

\[ \text{Affect} = \pi_{0j}(\text{baseline}) + \pi_{1j}(\text{stress reactivity}) + \pi_{2j}(\text{stress recovery}) + e_{ij} \]

In the above equation, \( \pi_{0j} \) represents the level of positive/negative affect for participant \( j \) at baseline, \( \pi_{1j} \) represents the slope of change in positive/negative affect during the preparatory period and stressor for participant \( j \) (with positive values indicating an increase in affect and higher values indicating a steeper slope), \( \pi_{2j} \) represents the slope of change in positive/negative affect across the recovery period for participant \( j \) (with negative values indicating a decrease in affect during the recovery period and lower values indicating a greater decrease), and \( e_{ij} \) represents the within-person random effect for participant \( j \).

The following potential covariates were then tested: age, sex, pubertal stage, past or current DSM-5 diagnosis, past and present psychosocial treatment, present use of psychotropic medication (as 0% of participants endorsed past psychotropic medication use this was not included as a variable), and current use of non-psychotropic medication. For positive affect, pubertal stage was significantly associated with stress recovery, \( \beta = -0.02, t(63) = -2.13, p = .037 \), but not with baseline levels of positive affect or stress reactivity, \( ps > .05 \). No other variables were significantly associated with positive affect levels at baseline, the slope of affect reactivity, or the slope of affect recovery, \( ps > .05 \). Thus, pubertal stage was included as a covariate in the corresponding Level 2 models. The predictor variable, self-compassion, was included in all Level 2 equations to determine if self-compassion was associated with individual differences in positive affect:
Baseline Positive Affect: \( \pi_0 = B_{00} + B_{01}(\text{self-compassion}) + r_0 \)

Positive Affect Stress Reactivity: \( \pi_1 = B_{10} + B_{11}(\text{self-compassion}) + r_1 \)

Positive Affect Stress Recovery: \( \pi_2 = B_{20} + B_{21}(\text{self-compassion}) + B_{12}(\text{pubertal stage}) + r_2 \)

For negative affect, past or current DSM-5 diagnosis was significantly associated with stress reactivity, \( \beta = 0.18, t(63) = 2.21, p > .003 \), but not with baseline affect or stress recovery, \( ps > .05 \). No other variables were significantly associated with negative affect levels at baseline, the slope of affect reactivity, or the slope of affect recovery, \( ps > .05 \). Thus, for negative affect, past or current DSM-5 diagnosis was included alongside self-compassion in the corresponding Level 2 model:

Baseline Negative Affect: \( \pi_0 = B_{00} + B_{01}(\text{self-compassion}) + r_0 \)

Negative Affect Stress Reactivity: \( \pi_1 = B_{10} + B_{11}(\text{self-compassion}) + B_{12}(\text{DSM-5 diagnosis}) + r_1 \)

Negative Affect Stress Recovery: \( \pi_2 = B_{20} + B_{21}(\text{self-compassion}) + r_2 \)

Modelling Cortisol. Based on visual inspection of the data and preliminary analyses, we compared a linear, quadratic, and piecewise model. The piecewise model consisted of the value of cortisol at baseline (S1; immediately following the 15-minute nature video rest period), stress reactivity (slope from S1 to S4), and stress recovery (slope from S4 to S6). For cortisol, the piecewise model (AIC = 734.47) fit the data significantly better than the linear model (AIC = 973.52; \( p < .001 \)), and the quadratic model (AIC = 882.59; \( p < .001 \)). Thus, the following Level 1 was specified:

\[ \text{Cortisol} = \pi_0(\text{baseline}) + \pi_1(\text{stress reactivity}) + \pi_2(\text{stress recovery}) + e_{ij} \]
In this equation, \( \pi_{0j} \) represents the level of cortisol for participant \( j \) at baseline, \( \pi_{1j} \) represents the slope of change for stress reactivity for participant \( j \) (with positive values indicating an increase in cortisol and higher values indicating a steeper slope), \( \pi_{2j} \) represents the slope of change for stress recovery for participant \( j \) (with negative values indicating a decrease in cortisol during the recovery period and lower values indicating a greater decrease), and \( e_{0j} \) represents the within-person random effect for participant \( j \).

The following potential covariates were then tested: age, sex, pubertal stage, past or current DSM-5 diagnosis, past and present psychosocial treatment, present use of psychotropic medication, current use of non-psychotropic medication, use of nicotine, caffeine consumption, or eating/drinking in the 2 hours prior to the experiment, exercise the day of the experiment, BMI, and number of minutes between midnight and the first saliva sample (Minutes from Midnight). Minutes from Midnight was significantly associated with baseline levels of cortisol, \( \beta = .004, t(66) = 4.79, p < .001 \), but not with stress reactivity or recovery. No other variables were significantly associated with cortisol levels at baseline, the slope of cortisol reactivity, or the slope of cortisol recovery, \( ps > .05 \). Thus, Minutes from Midnight was included as a covariate in the corresponding Level 2 models. The predictor variable, self-compassion, was included in all Level 2 equations to determine if self-compassion was associated with individual differences in cortisol responses:

**Baseline Cortisol:** \( \pi_{0j} = B_{00} + B_{01}(self\text{-}compassion) + B_{02}(minutes\ from\ midnight) + r_{0j} \)

**Cortisol Stress Reactivity:** \( \pi_{1j} = B_{10} + B_{11}(self\text{-}compassion) + r_{1j} \)

**Cortisol Stress Recovery:** \( \pi_{2j} = B_{20} + B_{21}(self\text{-}compassion) + r_{2j} \)
Results

Demographic Characteristics

Participants included 83 preadolescent youth between the ages of 11.88 and 13.89 years ($M = 12.85, SD = 0.40$) with an average Tanner stage of 2.71 ($SD = 1.05$). Just over half (52%) of participants identified their sex assigned at birth as male. One participant identified their gender as non-binary, and all others identified as cisgender. In terms of race/ethnicity, 63% of the sample identified as European Canadian, 17% identified as Chinese, 4% identified as Latinx, 4% identified as South Asian, 2% identified as Indigenous Canadian, 2% identified as Korean Canadian, 1% identified as Japanese Canadian, 1% identified as West Asian, and the remaining 6% identified as more than one category (Chinese/Japanese, Chinese/Korean, European Canadian/West Asian, and South Asian/Latinx). Six participants (7%) met criteria for one or more current or past DSM-5 disorders: one participant met criteria for persistent depressive disorder, social anxiety disorder, and unspecified depressive disorder, current; one participant met criteria for social anxiety disorder, current; one participant met criteria for obsessive-compulsive disorder in partial remission; one participant met criteria for major depressive disorder with insufficient symptoms, social anxiety disorder with insufficient symptoms, and generalized anxiety disorder, current; one participant met criteria for unspecified anxiety disorder, current; and one participant met criteria for separation anxiety disorder, current. At the time of study participation, 5% of youth were taking current psychotropic medication, and no participants had a history of taking psychotropic medications in the past. In terms of non-pharmacological treatment, 5% of participants reported current participation in psychosocial treatment and 30% reported past participation in psychosocial treatment. Demographic characteristics are presented in Table 1.
Table 1

*Participant Characteristics for Chapter 1*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, $M(SD)$</td>
<td>12.85 (0.40)</td>
</tr>
<tr>
<td>SCS score, $M(SD)$</td>
<td>3.24 (0.57)</td>
</tr>
<tr>
<td>Sex (% Male)</td>
<td>52%</td>
</tr>
<tr>
<td>Gender, %</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>52%</td>
</tr>
<tr>
<td>Female</td>
<td>47%</td>
</tr>
<tr>
<td>Non-Binary</td>
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</tr>
<tr>
<td>Pubertal Stage, $M(SD)$</td>
<td>2.71 (1.05)</td>
</tr>
<tr>
<td>Current or past DSM-5 diagnosis, %</td>
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</tr>
<tr>
<td>Household Income</td>
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<tr>
<td>$20,000-$39,999</td>
<td>4%</td>
</tr>
<tr>
<td>$40,000-$59,999</td>
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</tr>
<tr>
<td>$60,000-$79,999</td>
<td>4%</td>
</tr>
<tr>
<td>$80,000-$99,999</td>
<td>10%</td>
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<td>$180,000-$199,999</td>
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<tr>
<td>$200,000 and over</td>
<td>17%</td>
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<tr>
<td>Variable</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------</td>
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<td><strong>Racial Identity</strong></td>
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<tr>
<td>Chinese</td>
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<tr>
<td>Indigenous Canadian</td>
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<tr>
<td>Japanese Canadian</td>
<td>1%</td>
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<tr>
<td>Korean Canadian</td>
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<tr>
<td>Latinx</td>
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<td>South Asian</td>
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<tr>
<td>West Asian</td>
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<tr>
<td>Another specified race*</td>
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<tr>
<td><strong>Psychiatric Intervention, %</strong></td>
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<tr>
<td>Current Psychosocial Treatment</td>
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<tr>
<td>Past Psychosocial Treatment</td>
<td>29%</td>
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<tr>
<td>Never Psychosocial Treatment</td>
<td>66%</td>
</tr>
<tr>
<td><strong>BMI, $M(SD)</strong>**</td>
<td>19.43 (3.64)</td>
</tr>
<tr>
<td>Drank or Ate in 2 hours prior</td>
<td>6/58 (0.1%)</td>
</tr>
<tr>
<td>Caffeine in 2 hours prior</td>
<td>1/55 (0.02%)</td>
</tr>
<tr>
<td>Nicotine in 2 hours prior</td>
<td>0/55 (0%)</td>
</tr>
<tr>
<td>Exercised 30 mins or more that day</td>
<td>17/55 (31%)</td>
</tr>
</tbody>
</table>
Note. SCS = Self Compassion Scale

*Additional racial identities included Chinese-Japanese, Chinese-Korean, European Canadian and West Asian, South Asian and Latinx

**data available for 44 participants

**Effect of Self-Compassion on Total Positive Affect, Negative Affect, and Cortisol across the TSST-C.**

Positive Affect. Five participants are missing affect at one or more timepoints and thus area under the curve could not be calculated. The total positive affect (AUCg) analysis was conducted with the remaining 78 participants. A hierarchical linear regression was conducted with potential covariates as described above (entered in Block 1) and self-compassion (entered in Block 2) predicting positive affect AUCg. Sex was the only potential covariate that accounted for a significant proportion of the variability in positive affect AUCg, $R^2 = .07$, $F(1,76) = 5.92$, $p = .017$, and as such it was kept in the model. Specifically, males had a significantly greater positive affect AUCg than females, $\beta = -.27$, $t(76) = -2.43$, $p = .017$. When self-compassion was entered in Block 2, it explained a significant proportion of the variability in positive affect AUCg, $R^2_{change} = .13$, $F(2,75) = 9.58$, $p = .001$, and the overall model remained significant, $R = .45$, $p < .001$. The $R^2_{change}$ value of .13 represents a medium effect size and indicates that 13% of the variance in positive affect can be explained by self-compassion, after accounting for the impact of sex. Specifically, higher levels of self-compassion were associated with more positive affect across the TSST-C, $\beta = .37$, $t(77) = 3.52$, $p < .001$ (see Figure 4).
Negative Affect. Five participants are missing affect at one or more timepoints and thus area under the curve could not be calculated. The total negative affect (AUCg) analysis was conducted with the remaining 78 participants. A hierarchical linear regression was conducted with potential covariates as described above (entered in Block 1) and self-compassion (entered in Block 2) predicting negative affect AUCg. DSM-5 diagnosis was the only potential covariate that accounted for a significant proportion of the variability in negative affect AUCg, $R^2 = .08$, $F(1,76) = 6.84, p = .011$, and as such it was kept in the model. Specifically, those that had a past or present DSM-5 diagnosis had a significantly greater negative affect AUCg than those that did.
not, $\beta = .29$, $t(80) = -2.61$, $p = .011$. When self-compassion was entered in Block 2, it explained a significant proportion of the variability in negative affect AUCg, $R^2_{\text{change}} = .07$, $F(1,75) = 6.70$, $p = .002$, and the overall model was significant, $R = .39$, $p = .002$. The $R^2_{\text{change}}$ value of .07 represents a small, approaching medium, effect size and indicates that 7% of the variance in negative affect can be explained by self-compassion, after accounting for the impact of DSM-5 diagnosis. Specifically, higher levels of self-compassion were associated with less negative affect across the TSST-C, $\beta = -.27$, $t(77) = -2.47$, $p = .016$ (see Figure 5).

**Figure 5**

*Associations between Self-Compassion and Total Negative Affect (AUCg) across the TSST-C*
Cortisol. Two participants are missing cortisol data at one time point and thus area under the curve could not be calculated. The total cortisol (AUCg) analysis was conducted with the remaining 81 participants. A hierarchical linear regression was conducted with potential covariates as described above (entered in Block 1) and self-compassion (entered in Block 2) predicting cortisol AUCg. Minutes from Midnight was the only potential covariate that accounted for a significant proportion of the variability in cortisol AUCg, $R^2 = .21$, $F(1,79) = 20.91, p < .001$, and as such it was kept in the model. Specifically, wake times that were later in the day were associated with greater cortisol production, $\beta = .46$, $t(79) = 4.57, p < .001$. When self-compassion was entered in Block 2, it did not explain a significant proportion of the variability in cortisol AUCg, $R^2_{\text{change}} = .04$, $F(1,78) = 3.91, p = .052$, and the overall model was not significant, $R = .50, p = .052$ (see Figure 6).
**Figure 6**

*Associations between Self-Compassion and Total Natural Log Transformed Cortisol Output (AUCg, nMol/l) across the TSST-C*

![Graph showing associations between Self-Compassion and Total Natural Log Transformed Cortisol Output (AUCg, nMol/l) across the TSST-C.](image)

**Effect of Self-Compassion on Positive and Negative Affect Reactivity and Recovery**

**Positive Affect.** One participant was missing all affect data and thus 82 participants are used in the positive affect HLM analyses. Positive affect across all 6 timepoints is presented in Figure 7. First, in order to assess the basic pattern of positive affect across the stressor, a baseline model without any predictors at Level 2 was run. This model indicated that participants’ average level of positive affect was significantly different from zero at baseline, $B = 10.13, t(81) = 29.67, p < .001$. Levels of positive affect significantly decreased across the stress reactivity period, $B = -$
0.12, $t(81) = -9.13, p < .001$, and then significantly increased across the recovery period, $B = 0.11, t(81) = 13.05, p < .001$.

**Figure 7**

*Positive Affect Ratings for All Participants across all Six Time Points of the TSST-C*

Tanner stage was included as a covariate as described above. Level of self-compassion was then added at Level 2 to examine whether individual differences in the change in positive affect across the psychosocial stressor were explained by levels of self-compassion. Tanner stage was significantly associated with positive affect recovery from the stressor, $B = -0.02, t(69) = -2.58, p = .012$, such that higher tanner stage was associated with less positive affect recovery, as measured via a smaller increase in positive affect across the recovery period. Self-compassion
significantly predicted baseline levels of positive affect, $B = 1.82$, $t(70) = 3.23$, $p = .002$, such that greater self-compassion was associated with higher levels of positive affect at baseline. In contrast, self-compassion did not significantly predict positive affect reactivity to the stressor, $B = 0.01$, $t(70) = 0.17$, $p = .863$, or the slope of positive affect recovery from the stressor, $B = 0.01$, $t(69) = 0.560$, $p = .577$. Figure 8 depicts positive affect responses to the stressor for participants split, for visual purposes, into low and high self-compassion groups using a median split.

**Figure 8**

*Positive Affect Ratings for Participants High and Low on Self-Compassion Displayed Using a Median Split*
**Negative Affect.** One participant was missing all affect data and thus 82 participants are used in the negative affect HLM analyses. Negative affect across all 6 timepoints is presented in Figure 9. First, in order to assess the basic pattern of negative affect across the stressor, a baseline model without any predictors at Level 2 was run. This model indicated that participants’ average level of negative affect was significantly different from zero at baseline, $B = 5.92$, $t(81) = 27.96$, $p < .001$. Levels of negative affect significantly increased across the stress reactivity period, $B = 0.19$, $t(81) = 10.02$, $p < .001$, and then significantly decreased across the recovery period, $B = -0.15$, $t(81) = -13.72$, $p < .001$.

**Figure 9**

*Negative Affect Ratings for All Participants across all Six Time Points of the TSST-C*
Past or Current DSM-5 diagnosis was included as a covariate as described above. Level of self-compassion was then added at Level 2 to examine whether individual differences in the change in negative affect across the psychosocial stressor were explained by levels of self-compassion. With the addition of self-compassion to level 2, DSM-5 diagnosis was no longer significantly associated with reactivity to the stressor, $B = 0.10, t(79) = 1.47, p = .147$. Self-compassion was significantly associated with baseline levels of negative affect, $B = -0.98, t(80) = -2.09, p = .039$, such that higher levels of self-compassion was associated with lower levels of negative affect at baseline. Self-compassion did not significantly predict negative affect reactivity to the stressor, $B = -0.06, t(79) = -1.98, p = .052$, or negative affect recovery from the stressor, $B = 0.03, t(80) = 1.73, p = .088$. Figure 10 depicts negative affect responses to the stressor for participants split for visual purposes into low and high self-compassion groups using a median split.
Effect of Self-Compassion on Cortisol Reactivity and Recovery.

All participants have at least some cortisol data and thus all 83 participants are used in the cortisol HLM analyses. Natural log transformed values of cortisol across all 6 timepoints is presented in Figure 11. First, in order to assess the basic pattern of cortisol across the stressor, a baseline model without any predictors at Level 2 was run. This model indicated that participants’ average level of cortisol was significantly different from zero at baseline, $B = 0.48$, $t(82) = 5.65$, $p < .001$. Levels of cortisol significantly increased across the stress reactivity period, $B = 0.03$, ...
\[ t(82) = 9.19, \ p < .001, \] and then significantly decreased across the recovery period, \( B = -0.02, \)
\[ t(82) = -8.15, \ p < .001. \]

**Figure 11**

*Natural Log Transformed Cortisol Values (nMol/l) for All Participants across all Six Time Points of the TSST-C*

Minutes from Midnight was included as a covariate as described above. Level of self-compassion was then added at Level 2 to examine whether individual differences in the change in levels of cortisol across the psychosocial stressor were explained by levels of self-compassion. Minutes from midnight was significantly associated with baseline cortisol, \( B = 0.003, \ t(80) = -5.59, \ p < .001, \) such that greater minutes from midnight was associated with lower cortisol levels.
at baseline. Self-compassion did not predict baseline levels of cortisol, $B = -0.04$, $t(80) = -0.33$, $p = .741$, cortisol reactivity to the stressor, $B = -0.01$, $t(81) = -0.82$, $p = .413$, or cortisol recovery from the stressor, $B = -0.004$, $t(81) = -1.38$, $p = .173$. Figure 12 depicts cortisol responses to the stressor for participants split, for visual purposes, into low and high self-compassion groups using a median split.

**Figure 12**

*Natural Log Transformed Cortisol Levels (nMol/l) for Participants High and Low on Self-Compassion Displayed Using a Median Split*

![Cortisol Levels Graph](image)

**Discussion**

The aim of this chapter was to extend previous work by examining the association of self-compassion on both affective and biological responses to an acute laboratory stressor in
youth. Results indicated that participants experienced the expected stress response to the TSST-C, as indicated by an increase in negative affect, decrease in positive affect, and increase in cortisol levels in response to the stressor. I found that, as expected, greater self-compassion was associated with greater total positive affect and less total negative affect across the stressor. However, contrary to my expectations, self-compassion was not associated with reactivity to, or recovery from, the stressor, as measured by positive affect, negative affect, and cortisol.

With regard to total affect, I found that participants with higher levels of self-compassion had significantly greater total positive affect and less total negative affect across the stressor. This finding is consistent with previous research in adults, which documents that higher levels of self-compassion are associated with higher levels of positive affect (Neff et al., 2007; Neff & Vonk, 2009; Sirois et al., 2015; Zessin et al., 2015) and lower levels of negative affect in everyday life (Barnard & Curry, 2011; Leary et al., 2007; Sirois et al., 2015). Our finding is also consistent with survey studies of adolescents that found a significant correlation between self-compassion and negative affect in everyday life (Bluth & Blanton, 2014; Bluth & Blanton, 2015) as well as a longitudinal study showing that increases in self-compassion after a meditation retreat predicted reduced negative affect in adolescents immediately following the retreat and 3 months later (Galla, 2016). Our findings extend previous work by showing that higher positive affect in more self-compassionate individuals is present in response to acute stressors. Thus, the benefits of self-compassion are likely to persist during times of stress.

The finding of the present chapter regarding negative affect also supports a previous finding from a study of a laboratory-based stressor which showed that adult participants with higher trait self-compassion reported lower subjective units of distress (SUDS) ratings at baseline and across all timepoints of the TSST (Arch et al., 2016). Our findings improve upon
this research by employing a more complete measure of negative affect which includes feelings of stress, sadness, nervousness, and shame, instead of simply distress. This is important, as there is a general consensus in the literature that negative affect is best indexed by assessing a number of specific emotional experiences including sadness, nervousness, and shame (Gray & Watson, 2007; Stanton & Watson, 2014). Our findings further extend the research conducted by Arch and colleagues (2016) by showing the same association between higher self-compassion and lower negative affect responses to stress hold true in an adolescent sample. This fits with research showing that self-compassion is associated with mental health benefits in adolescence. For example, greater self-compassion in adolescent samples has been associated with lower levels of anxiety (Neff & McGhee, 2010), depression (Castilho et al., 2017), and suicidality (Zeller et al., 2015), and higher levels of emotional wellbeing (Bluth et al., 2017), perceived life satisfaction (Bluth et al., 2016), and sense of community (Akin & Akin, 2015). Adolescence is likely a time when self-compassion can be optimally developed, as youth are beginning to engage in abstract thinking and developing ways of relating to themselves (Klingie & Van Vliet, 2017). As adolescence is also characterized by increased self-criticalness and the feeling that youth are alone in their struggles, self-compassion can play a protective role in fostering resilience.

The findings of this chapter also extend the literature by being the first to assess the impact of self-compassion on positive affect in the context of a laboratory stressor. Research has historically focused more on negative affect than positive affect in response to stress. However, many researchers have proposed that positive and negative valence are two separate and distinct domains (Insel et al., 2010; Kozak & Cuthbert, 2016). Further, positive affect has effects on wellbeing above and beyond those of negative affect. It has been theorized that positive emotion may function as a stress buffer, with higher levels of positive affect during times of stress.
increasing the speed of recovery from stress and preserving wellbeing (Fredrickson, 1998; Ong et al., 2006; Zautra et al., 2005). As such, evidence that self-compassion benefits positive affect during stress lends support to the possibility that self-compassion may have therapeutic benefits.

Contrary to my hypotheses, self-compassion was not associated with individual differences in stress reactivity or stress recovery as measured by levels of positive affect. To my knowledge, there are no studies that assess positive affect in response to an acute stressor, and therefore further research is necessary to assess whether higher self-compassion might lead to a smaller decrease in positive affect from pre- to post-stressor or a faster increase in positive affect through the recovery period. Importantly, it is unclear the extent to which participants engaged in self-compassion during the stressor and recovery period. Just because participants reported that they typically engage in self-compassionate ways of relating to themselves, does not mean that they were actively engaging in self-compassionate thinking during the stressor. Future research should explicitly assess in-the-moment self-compassion in response to stressors. It may also be the case that self-compassion is associated with higher levels of positive affect in general, but not associated with positive affect as it relates to reacting to and recovering from a stressor.

Self-compassion was also not significantly associated with negative affect stress reactivity. This finding is inconsistent with theoretical models of self-compassion that posit higher levels of self-compassion foster a greater capacity for dealing with stressors with less distress (Gilbert, 1989, 2005; Neff et al., 2007). This is consistent with the findings from Bluth and colleagues who found that adolescents high in trait self-compassion did not differ significantly from those low in trait self-compassion on several biological markers of stress, including salivary cortisol, heart rate, blood pressure, and heart rate variability (2016).
Contrary to my hypothesis, self-compassion was not associated with a faster decrease in negative affect through the recovery period. The lack of significant findings for the effect of self-compassion on negative affect stress recovery is surprising, given a number of previous findings that have shown an association between self-compassion and a steeper decline (faster recovery) in levels of subjective anxiety through the recovery period (Arch et al., 2014; Tracy et al., 2021). One important difference between the current research and that past research is that participants were instructed to use self-compassion skills in response to the stressor. In this way, participants were “primed” to respond self-compassionately in a way that participants in our research were not. Past research has also been conducted with adults, who may have been more able to incorporate self-compassion strategies in the moment. Although findings in the adolescent population seem to mirror those in adult samples showing beneficial effects of self-compassion (Marsh et al., 2018), it may be that adolescents need to be reminded or instructed to use self-compassion skills in order for it to have a greater impact on affective responses to stress.

Self-compassion was associated with total cortisol production in the direction I expected, but not significantly. This is inconsistent with many scholars’ theoretical expectations that those high in self-compassion should show a diminished biological response, for example, lower cortisol output (Arch et al., 2014; Bluth et al. 2016; Breines et al., 2014). This is also inconsistent with evidence that individuals higher in self-compassion have lower daily cortisol levels (Herriot et al., 2018). This study by Herriot et al. (2018) examined cortisol levels across the entire day and this may explain why they found a significant association with self-compassion while Bluth et al. (2016) did not. It could be the case that self-compassion has a stronger effect on diurnal cortisol levels across the day, then cortisol levels in response to acute stressors. Given the long-term adverse effects of cortisol elevations on physical and mental health (McEwan, 2008), this
finding of self-compassion’s association with lower cortisol output – if replicated – suggests that self-compassion may serve as a protective factor for youth.

Self-compassion was not associated significantly with cortisol stress reactivity or recovery. This observation is consistent with findings from Bluth et al. (2016), who found that adolescents high in self-compassion did not differ significantly from those low in self-compassion on several biological markers of stress reactivity and recovery, including salivary cortisol. This is also consistent with evidence that brief self-compassion training does not impact salivary cortisol responses to the TSST in adult participants (Arch et al., 2014). It is surprising that studies assessing the impact of self-compassion on responses to stress have thus far failed to find an effect on salivary cortisol. Research has shown self-compassion to be negatively correlated with rumination, thought suppression, and avoidance-oriented coping strategies (Barnard & Curry, 2011; Neff, 2003a; Neff et al., 2007; Neff & Vonk, 2009; Raes, 2010), which have all been shown to predict maladaptive cortisol response to stress (Lam et al., 2009; Lewis et al., 2018; Raymond et al., 2019). Relatedly, a number of studies have shown that individuals with higher levels of self-compassion use more adaptive coping strategies in response to stress, including positive reappraisal, acceptance, and approach-oriented strategies (Allen & Leary, 2010; Chishima et al., 2018; Sirois et al., 2015). These approach-oriented strategies, such as positive reappraisal, are considered adaptive because they have been shown to reduce the magnitude and duration of emotional response to stressors (McRae, 2016). Surprisingly, in contrast to this, researchers have documented that positive reappraisal is associated with an increased cortisol response to psychosocial stressors (Denson et al., 2014; Lam et al., 2009; Raymond et al., 2019). Interestingly, it has been hypothesized that the active nature of positive appraisal may monopolize the activity of the prefrontal cortex which then prevents it from
inhibiting cortisol reactivity (Denson et al., 2014; Raymond et al., 2019). Thus, while it is still considered adaptive in the long term, positive appraisal may be more taxing in the moment. This theory may help to explain the lack of an association between self-compassion and cortisol patterns. As self-compassion is *inversely* linked to coping strategies that show heightened cortisol responding (e.g. rumination) as well as *positively* linked to coping strategies that show heightened cortisol responding (e.g. positive appraisal), these effects may cancel each other out. Research is mixed though, as reappraisal has also been linked to greater cortisol recovery (Lewis et al., 2018).

Although I designed this chapter to overcome the limitations of previous research, it is important to acknowledge the limitations of the present research. First, although I did employ a longer recovery period than the Bluth at al. (2016) study (30 minutes vs. 20 minutes) in an attempt to capture cortisol levels returning to baseline, cortisol levels did not return to baseline as expected. In fact, cortisol levels at the end of the recovery period were still significantly higher than baseline. This was unlikely to have affected our results as self-compassion did not have an effect on cortisol trajectories throughout the response and recovery periods. Still, future research should employ a recovery period longer than 30 minutes post-stressor offset, in order to capture cortisol levels returning to baseline. Second, although my sample size was sufficiently powered to detect a small to medium effect between self-compassion and cortisol, a recent meta-analysis found only a weak correlation ($r = 0.14$) between self-compassion and stress hormones (Phillips & Hine, 2021). My study was underpowered to detect a weak relationship between self-compassion and cortisol, and future research should employ a larger sample size. A third limitation is that the artificial nature of the laboratory-based stressor may not have allowed participants to fully engage in self-compassion, as the situation was too far removed from their
real-life experience. Future research should also assess the association between self-compassion and emotional and biological responses to naturalistic stressors.

Limitations are also present in the measure I used to assess self-compassion- the Self-Compassion Scale – Short Form (SCS-SF; Raes et al., 2011). While the SCS-SF is reliable, valid, and shows a near-perfect correlation with the full-scale SCS, future studies would benefit from using the full-scale version of the scale. This would allow researchers to use the total SCS score, as well as the six subscale scores representing each of the facets of self-compassion. This would allow for a more in-depth examination of the mechanisms of self-compassion and determine whether any of the subscales differentially predict outcomes (Neff, 2020). Another limitation of the SCS-SF is that it is a trait measure and, as such, it assesses how self-compassionate people are in general towards themselves. This is not ideal, as people are not always accurate at judging themselves, and further, how one generally acts towards oneself is not the same as how one is currently acting towards themselves. At the time of study design, there was no validated measure to assess state levels of self-compassion. However, in 2020 Neff and colleagues published a manuscript presenting the State Self-Compassion Scale, which has both long and short forms. It is a limitation of my research that I do not have a measure of the level to which participants were actively engaging in self-compassionate responding during the stressor and recovery period. However, it is important to note that the state scale is very similar to the trait scale, with the main difference being a change of wording to present tense, and it is promising that reliability and validity results are similar to those found with the trait measure (Neff et al., 2020). Future research would benefit from incorporating the state self-compassion measure into research to assess the extent to which participants report engaging in self-compassion during the experiment. A final limitation of the SCS-SF is that it was originally
designed for use in adults. Although it has been shown to be valid and reliable for adolescents in previous research (Cunha et al., 2016), a specific version adapted for younger people would be preferrable. While this was not available at the time of study design, the Self-Compassion Scale—Youth version has since been developed and validated for use with early adolescents (age 11 to 15; Neff et al., 2021). Future research with this age group should employ this measure.

In summary, participants with higher levels of self-compassion had greater total positive affect and less total negative affect during the stressor. Our findings support previous research showing that self-compassion is associated with lower levels of negative affect and it extends the literature by being the first to show that self-compassion is associated with higher levels of positive affect during a laboratory stressor. In contrast, self-compassion was not associated with overall levels of cortisol or individual differences in positive affect, negative affect, or biological reactivity or recovery from the stressor. Thus, although self-compassion is associated with higher positive affect and lower negative affect, it might not have the far-reaching benefits that were originally anticipated with regards to buffering stress. Given the discrepant results, further research is needed to determine whether self-compassion is an effective technique for promoting effective recovery from stress in adolescence.

**Overview of the Next Two Chapters**

The goal of Chapters 2 and 3 was to extend the findings from Chapter 1 by investigating the association between self-compassion and markers of stress in the context of naturalistic stressors. The laboratory stressor employed in Chapter 1 allowed for a tightly controlled environment, standardization, and high internal validity; however, this comes at the cost of external validity (Lucas, 2003). It is important to examine markers of emotional and biological stress during naturalistic stressors that happen in youth’s everyday lives. Not only does this
approach facilitate ecological validity, naturalistic stressors are likely to be more salient to youth (DeVries, 1997). Indeed, researchers have documented that patterns of cortisol and affect during naturalistic stressors are of greater relevance in understanding an individual’s well-being than reactivity to a laboratory stressor (Adam, 2006; van Eck et al., 1996). Despite the importance of examining predictors of emotional and biological stress markers during stressful periods of time, there is a paucity of research examining the impact of self-compassion on responses to naturalistic stressors in adolescent populations.

There is a robust body of literature to show that individual differences in levels of trait self-compassion have important implications for health and wellbeing. Individuals with higher levels of self-compassion score higher on measures of optimism, life satisfaction, social connectedness, emotional intelligence, and subjective well-being (Leary et al., 2007; Neely et al., 2009; Neff, 2003b; Neff et al., 2007). Self-compassion is negatively associated with negative outcomes including depression, anxiety, shame, and academic failure (Castilho et al., 2015; Gilbert & Procter, 2006; Neff et al., 2010; Neff et al., 2005). It is clear from the literature that differences in levels of self-compassion have important ties to mental health and wellbeing outcomes, however, there is substantially less research assessing how self-compassion might lead to these outcomes. In the last 15 years, researchers have started to address this gap by assessing the impact of self-compassion on how an individual copes with stressful events, as a potential mechanism for change (Allen & Leary, 2010).

The examination of self-compassion as a coping mechanism and its association with responses to stress have primarily been conducted in the laboratory and with adults. The evidence is mixed, but there are findings from a number of studies that provide evidence for self-compassion buffering responses to laboratory stressors in adults. Breines and colleagues, for
example, have found that adults with greater trait self-compassion had a smaller biological response to the TSST, as measured by salivary alpha-amylase (sAA), a marker of sympathetic nervous system activation, and inflammation (Breines et al., 2014; Breines et al., 2015). Other studies have found that self-compassion was associated with less perceived stress and shame in adults immediately after a psychosocial stressor (Ewert et al., 2018), and self-compassionate adults reported less negative affect and had more flexible patterns of heart rate variability in response to the TSST (Luo et al., 2018).

A handful of studies have also examined the association of self-compassion with laboratory stress response in adolescence. Bluth et al. (2016) found that self-compassion did not predict physiological response to the TSST in a sample of 13- to 18-year-old adolescents. In Chapter 1 of this dissertation, I similarly found that self-compassion was not significantly associated with total levels of cortisol across the baseline, stressor, and recovery period and did not affect trajectories of cortisol reactivity or recovery. I did, however, find evidence that trait levels of self-compassion buffered the effects of stress on affective responses to a stressor. Specifically, greater levels of self-compassion were associated with lower total levels of negative affect and greater total levels of positive affect.

Importantly, there is a paucity of research assessing the impact of self-compassion on markers of stress in naturalistic settings despite the importance of testing whether findings from the laboratory hold true in the real world. To date, I am aware of only two studies that have examined the association between naturally occurring self-compassion with daily markers of subjective stress (Krieger et al., 2015; Zhang et al., 2021). Krieger and colleagues assessed trait levels of self-compassion in a sample of adults, and then assessed positive and negative affect twice per day for 14 days. They found that higher levels of self-compassion were significantly
associated with less negative affect and more positive affect across the 14 days (Krieger et al., 2015). Zhang and colleagues also conducted a 14-day daily diary study and found that daily self-compassion was associated with daily subjective wellbeing in Asian-American adults, despite the experience of racial discrimination during the COVID-19 pandemic (2021). To my knowledge, just two studies have assessed the link between self-compassion and biological markers of stress outside of a laboratory setting. A study by Herriot and colleagues (Herriot et al., 2018) found that higher levels of self-compassion were associated with less total cortisol across the day among older adults who reported experiencing a number of age-related stressors. The authors of this study concluded that self-compassion could protect older adults from stress-related biological disturbances resulting from chronic and uncontrollable stressors (Herriot et al., 2018). The second study was conducted by Ho et al. (2022). They assessed the impact of trait self-compassion on diurnal cortisol across two days in adult cancer survivors and found no significant direct effect of self-compassion on diurnal cortisol (Ho et al., 2022). Importantly, however, the association of self-compassion and daily affect and diurnal cortisol has not been studied in adolescents. This gap is surprising given the push in the last decade to assess the impact of self-compassion in adolescence (Pullmer et al., 2019).

Adolescence is a time of heightened vulnerability to suffering as youth must achieve many developmental tasks in the transition from childhood to adulthood such as increasing autonomy from parents, finding belonging and acceptance in a peer group, and developing their identity and sense of self (Steinberg & Morris, 2001). Self-compassion may be especially beneficial during this time by allowing youth to respond to their perceived failures with kindness and a balanced perspective while avoiding feeling alone in their struggles. While we have some evidence that self-compassion is associated with overall wellbeing and inversely related to
psychopathology in adolescents, we do not know if self-compassion is associated with affect or cortisol in the context of naturalistic stressors. This is important to investigate, as researchers have pointed to the paucity of research on the mechanisms of change in self-compassion research in adolescence (Pullmer et al., 2019). In order to examine the association of self-compassion with markers of stress during naturalistic stressors, youth were assessed during two important life events: the transition to high school (Chapter 2) and the first wave of the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2 or COVID-19) pandemic (Chapter 3).
Chapter 2

Introduction

The transition to high school is a life transition that researchers have long acknowledged as a challenging and stressful event (Hirsch & DuBois, 1992; Isakson & Jarvis, 1999). Studies that have assessed the transition to high school have found that adolescents experience a decrease in self-esteem, increase in feelings of anonymity, and a decrease in grades (Blythe et al., 1983; Ryan et al., 2013). The first two days of high school can be particularly stressful, as youth are entering a new social and academic environment, moving from single to multiple classrooms, with multiple teachers and sets of classmates (Shirtcliff & Essex, 2008). This transition to a novel environment can be socially threatening, which is a particularly salient trigger of cortisol production (Dickerson & Kemeny, 2004). Given the stress associated with the transition to high school, it is critical to identify factors that can promote more adaptive responses. Despite the possibility that self-compassion may promote resilience, researchers have not yet examined whether individual differences in self-compassion are associated with emotional and biological markers of stress during the high-school transition.

Based on the extant literature (Herriot et al., 2018; Ho et al., 2022; Krieger et al., 2015) two outcome variables are likely to be particularly relevant to understanding the association between self-compassion and stress: affect and salivary cortisol. Indeed, Krieger and colleagues documented an association between self-compassion and both positive and negative affect in everyday life. However, it is important to note that Krieger and colleagues collected affect just twice per day, which may not allow for the capture of fluctuating levels of affect across the day. Indeed, several researchers have documented that affect, particularly positive affect, follows a diurnal pattern in healthy individuals. Low levels of positive affect are observed in the morning.
Levels of positive affect then rise throughout the day, reaching highest levels in the afternoon and evening, before lowering again right before bed (Clark et al., 1989; Murray et al., 2002; Murray et al., 2009). Although the majority of this research has been conducted in adults, the handful of studies examining diurnal patterns of affect in an adolescent sample have also documented an inverted U shape for positive affect across the day samples (Barber et al., 1998; Diaz-Morales et al., 2015). Interestingly, negative affect does not seem to show a consistent or predictable diurnal pattern the way positive affect does (Clark et al., 1989; Murray et al., 2002; Murray et al., 2009). This might be because negative affect is particularly sensitive to environmental threats, which do not occur at regularly scheduled times of the day (Watson et al., 1999). Importantly, however, studies of diurnal variation in affect have not assessed diurnal affect patterns on days in which a stressor occurred. Further, to my knowledge, there is no research that examines the impact of self-compassion on changes in affect across the day. Thus, it is unclear whether self-compassion has consistent or differential effects on levels of affect at different times of the day during periods of stress.

A valuable complement to affective markers of stress is salivary cortisol. Indeed, researchers are increasingly emphasizing the importance of understanding biological markers of stress, such as salivary cortisol, given its downstream effects on mental and physical health (Cohen et al., 2007). Cortisol is produced both in response to acute stressors and throughout the day. In fact, cortisol is central to maintaining homeostasis as the hormone is essential for many functions in the human body including the regulation of metabolism, inflammatory responses, and immune function (Oakley & Cidlowski, 2013). Cortisol production reliably follows a diurnal pattern, with levels rising rapidly after waking up in the morning, reaching a peak approximately 30 minutes later, and then falling over the rest of the day (Adam & Kumari, 2009; Kirschbaum &
substantial individual differences in the amount of cortisol that is produced. As such, both basal cortisol levels and diurnal cortisol variation are thought to be influenced by trait or temperamental characteristics of the individual that influence how they modulate the ups and downs of the day (Laceulle et al., 2015).

One common index of diurnal cortisol functioning is the cortisol awakening response (CAR), which is defined as the increase in cortisol from waking to 30 minutes later. The rapid increase in cortisol levels that occurs in the morning is hypothesized to correspond to an individual’s perception of the demands of the day, and thus a steeper CAR is associated with greater perceived stress (Chida & Steptoe, 2009). Researchers posit that moderate to low levels of CAR are considered optimal, as individuals with a greater CAR are at increased risk for developing MDD (Adam et al., 2010; Vrshek-Schallhorn et al., 2013) and anxiety disorders (Adam et al., 2014). In the largest systematic review on the topic, it was found that a steeper CAR was associated with general life stress (Chida & Steptoe, 2009). It should be noted that conversely, a very low CAR represents hypoarousal and has been associated with fatigue, burnout, PTSD, and depression (Chida & Steptoe, 2009; Boggero et al., 2017; Nederhof et al., 2015). However, this hypoarousal has been theorized to develop after an individual has experienced frequently or chronically elevated CARs (Adam et al., 2006). Thus, in samples of generally healthy youth, it is reasonable to expect that a steeper CAR is reflective of greater stress. Consistent with this proposition, researchers have documented greater CAR on days when a stressor was anticipated (Wetherell et al., 2015).

Another common index of cortisol functioning is the diurnal cortisol slope (DCS) – the degree of change in cortisol from peak (30 minutes after waking) to evening (Adam & Kumari,
Research suggests that the DCS is sensitive to emotional and psychosocial stress (Adam & Gunnar, 2001; Adam et al., 2006; Doane & Adam, 2010). Some researchers posit that flat slopes indicate chronic stress (Miller et al., 2007) and flatter slopes have been associated with mental health symptoms in middle school students (Shirtcliff & Essex, 2008), internalizing issues in adolescent girls (Klimes-Dougan et al., 2001), and general distress, negative emotions, and diagnoses of MDD among late adolescents (Doane et al., 2013). A steeper DCS decline has been associated with higher levels of positive affect in adolescents and this finding, along with the findings described above, led researchers to conclude that a steeper slope represents a healthier pattern of cortisol secretion (Hoyt et al., 2015).

A third index is the total daily cortisol secretion, which can be measured as the area under the curve with respect to the ground (AUCg) from the first to last saliva samples of the day. Evidence from multiple sources suggests that cortisol AUCg is associated with multiple psychosocial and health factors (Chida & Steptoe, 2009; LeMoult et al., 2015). For example, a meta-analysis found that depressed youth had significantly greater cortisol levels throughout the day when compared to their non-depressed counterparts (Lopez-Duran et al., 2009). Children exposed to more psychosocial stressors also have a larger cortisol AUCg (Gustafsson et al., 2006). Importantly, elevated daytime levels of cortisol in a sample of late adolescents predicted subsequent development of an affective disorder over the next 2.5 years (Ellenbogen et al., 2011). In contrast, relatively lower values of cortisol AUCg are optimal for positive physical and mental health outcomes (Chida & Steptoe, 2009).

Chapter 2 extends the literature by being the first to assess the impact of self-compassion on adolescents’ positive affect, negative affect, and diurnal cortisol during a period of naturalistic stress – the transition to high school. I followed the sample of youth from Chapter 1.
across their first two days of high school and examined whether levels of self-compassion were associated with markers of stress during the transition to high school. Youth completed the Self-Compassion Scale – Short Form (Raes et al., 2011) to assess trait levels of self-compassion prior to the start of high school. During the first two days of high school, participants reported on positive and negative affect and collected cortisol samples four times per day.

Aim 1

The first aim was to examine the association between self-compassion and total emotional and biological stress during the transition to high school. I expected that lower levels of self-compassion would be associated with (1) less total positive affect, (2) more total negative affect, and (3) greater total cortisol output over the first two days of high school.

Aim 2

The second aim was to examine the association between self-compassion and diurnal patterns of emotional and biological responses during the transition to high school. I expected that lower levels of self-compassion would be associated with less adaptive forms of diurnal cortisol functioning as evidenced by: (1) a steeper CAR, and (2) a flatter diurnal cortisol slope over the first two days of high school. It is unclear from the literature whether self-compassion has consistent or differential effects on levels of affect at different times of the day during periods of stress, as this has never before been studied. Thus, I am examining the association between self-compassion and diurnal patterns of affect in an exploratory manner.
Method

Participants

A subset of participants who completed the Chapter 1 research were invited to provide affect and cortisol data at the beginning of high school. Eligible participants were entering Grade 8, fluent in English, and had at least one parent/legal guardian who was fluent in English. Participants were not eligible for participation if they had a history of severe head trauma, psychotic symptoms, manic/hypomanic episodes, or alcohol or substance use disorder in the past 6 months. Further, participants were excluded if they were currently taking corticosteroids (including glucocorticoids), oral or inhaled steroids, or depot neuroleptics. The 83 participants who took part in the Chapter 1 research came from three different cohorts across three years. The COVID-19 pandemic disrupted data collection for the third cohort, and we were not able to collect data from them during the first two days of high school. For that reason, only participants from the first and second cohort were invited to provide data for Chapter 2, and 76 participants did so. Of the participants invited to participate in Chapter 2, those who did versus did not participate did not differ on any clinical or demographic characteristics at baseline, \( p \)'s > .05. The sample size varied slightly for specific analyses because three participants are missing affect data at one or more time point, and ten participants are missing cortisol data at one or more timepoint (missing data are described in more detail in the Results section). Participants with versus without missing data did not differ on clinical and demographic characteristics, \( p \)'s > .05.

Procedure

Participants completed an initial laboratory session (described in Chapter 1), during which clinical interviews were conducted, demographic data was collected, and participants completed the Self-Compassion Scale – Short Form (SCS-SF; Raes et al., 2011). Eligible
participants were also invited to take part in the diurnal affect and cortisol assessments, which was to be completed during the first two days of high school. The average length of time between the baseline study session and the start of high school was 131.9 days ($SD = 87.2$ days). During the first two days of high school, participants completed affect questionnaires and provided saliva samples four times per day: immediately after waking up (S1), 30 minutes after waking up (S2), 3:00pm (S3), and prior to bed (S4). The timing of these samples was based on work by Gotlib et al. (2015) and LeMoult et al. (2015). Participants were sent a link to complete the questionnaires via email or text, depending on the participant’s preference. Participants were also reminded to collect the saliva sample at the same time that they completed the questionnaires. Participants received a $30$ honorarium for their participation.

**Figure 13**

*Chapter 2 Measures*

Baseline: Prior to High School
- Diagnostic interview
- SCS
- Covariates: demographic variables, pubertal status

Day 1 High School
- Cortisol samples
- Positive & Negative Affect
- Covariates: ate/drank, caffiene, brushed teeth

Day 2 High School
- Cortisol samples
- Positive & Negative Affect
- Covariates: ate/drank, caffiene, brushed teeth

*Note.* SCS = Self Compassion Scale.

*Measures*

**Diagnostic Interview.** At the initial laboratory session, youth completed a structured clinical interview – the KSADS-PL (Kaufman et al., 2016) – in order to assess the presence of
current or past DSM-5 psychological disorders. The parent/legal guardian also completed the parent version of the KSADS-PL (Kaufman et al., 2016) to assess the parents’ report of youth psychopathology. Interviews were administered by trained graduate students or advanced research assistants. Participants were deemed to meet criteria for a DSM-5 diagnosis if indicated by either youth or parent report.

**Self-Compassion.** Participants completed the Self-Compassion Scale – Short Form (SCS-SF; Raes et al., 2011) to assess trait level of self-compassion. The SCS-SF assesses all three facets of self-compassion, along with their negative counterparts: self-kindness versus self-judgement, common humanity versus isolation, and mindfulness versus over-identification. The SCS-SF assesses how participants typically act towards themselves, with responses on a Likert scale ranging from 1 (*almost never*) to 5 (*almost always*). The total SCS-SF score was computed by first reverse scoring the negative subscale items and then taking the average of all items. The SCS-SF scale showed acceptable internal reliability with this sample, $\alpha = .723$.

**Positive and Negative Affect.** Self-reported affect was assessed using items from the Positive and Negative Affect Scale for Children (PANAS-C; Laurent et al., 1999). Participants responded to this scale using a 5-point Likert scale ranging from 1 (Very Slightly or Not at All) to 5 (Extremely). A positive affect composite measure was calculated by taking the sum of happy, excited, proud, and calm affect scores. A negative affect composite measure was calculated by taking the sum of stressed, upset, nervous, and ashamed affect scores. Affect was assessed four times per day for 2 days for a total of 8 time-points. For positive affect, between-person reliability was $R_{kt} = .97$ and within-person reliability was $R_c = .51$ (Cranford et al., 2006). For negative affect, between-person reliability was $R_{kt} = .96$ and within-person reliability was $R_c = .63$ (Cranford et al., 2006). Note that within-person reliabilities calculated for short scales
administered on a frequent basis are expected to have lower values than classical reliability measures (Nezlek, 2017). The PANAS can be found in Appendix E.

**Salivary Cortisol.** Participants collected saliva samples on the first two days of school to assess diurnal cortisol production. Participants and their parents were given detailed instructions regarding saliva collection during the in-person laboratory visit (described in Chapter 1) and via take-home written instructions. They also practiced providing saliva samples during the prior in-person laboratory visit. They received an email or text message prompting them to complete the daily diary questionnaires, which also walked them through the instructions on providing the saliva sample. In the two hours before collecting each saliva sample, participants were asked to refrain from the eating or drinking anything besides water. Participants were also asked to refrain from brushing their teeth in the 15 minutes before collecting a sample. Saliva was collected using Salivette vials (Sarstedt, Germany). Participants recorded the collection times on the vials and then stored them in their freezer until they could be returned to the lab or picked up by a member of the research team. They were then stored in a -30° freezer in our laboratory prior to analysis. Biochemical analysis of cortisol from saliva samples was performed at Dresden LabService in Dresden, Germany. The inter and intraassay coefficient of variance were both below 9%. Raw cortisol measurements from all eight time points were positively skewed, which is typical in the literature (Granger et al., 2012). There were also seven outliers across the eight time points. In order to normalize the data, a natural logarithmic (ln) transformation was applied, as is common in the literature (e.g., Shrout et al., 2020; Sin et al., 2017), and the natural log-transformed values, measured in nanomoles per litre (nMol/l), were used in all reported analyses.

**Covariates.** The following covariates were collected at the initial laboratory session (described in Chapter 1): age, biological sex, gender, past and present psychosocial and
pharmacological treatment, and height and weight (used to calculate BMI). Two to four weeks before starting high school began, participants completed the Tanner Staging Questionnaire to assess pubertal status based on pubic hair and breast/genitalia growth (Marshall & Tanner, 1968). During the daily questionnaires completed during the first two weeks of high school, participants reported on health-related variables known to affect the response of the HPA axis, including whether or not participants ate or drank anything besides water, or consumed caffeine, or exercised in the 2 hours prior or brushed their teeth in the 15 minutes prior to saliva collection (Garde et al., 2009). Additionally, time between baseline and the start of high school was also included as a potential covariate.

Data Analytic Approach

Preliminary Analysis of Stress

In order to test whether the transition to high school was indeed stressful for adolescents, a paired samples t-test was conducted to compare levels of self-reported perceived stress at baseline (the Chapter 1 timepoint in the year prior to starting high school) and during the first two days of high school. Perceived stress at baseline was assessed at the beginning of the second laboratory session. Perceived stress during the transition to high school was assessed by taking the average of the “stressed” items from the PANAS that was completed twice per day for the first two days of high school.

Aim 1

The first aim was to examine the association between self-compassion and total positive affect, negative affect, and cortisol across the first two days of high school. In order to quantify total emotional and biological stress markers across the two days, I calculated area under the
curve to ground (AUCg) using trapezoidal integration for positive affect, negative affect, and cortisol, respectively (Pruessner et al., 2003).

I conducted three hierarchical linear regression analyses with self-compassion predicting positive affect, negative affect, and cortisol AUCg, respectively. All variables described in the Covariates section above were tested as potential covariates and were included in Block 1 of the regression analyses if significant. Self-compassion was added in Block 2. For all regression analyses, effect sizes are reported as $R^2$ or the coefficient of determination. $R^2$ represents the amount of variance in the outcome variable explained by the predictor variable. $R^2$ values of 0.01, 0.09, and 0.25 represent small, medium, and large effects, respectively (Foster et al., 2018).

**Aim 2**

The second aim was to test the association between self-compassion and *diurnal patterns* of emotional and biological responses during the transition to high school. A hierarchical linear modeling (HLM) approach was used as time is nested within participants (Raudenbush & Bryk, 2002). At Level 1, repeated measures of positive affect, negative affect, and cortisol were modelled within individuals as a function of time. Linear, quadratic, and piecewise models were evaluated. The model that best fit the data was then selected based on deviance statistics, visual inspection of the data, and the smallest AIC, which indicates overall better model fit. Next, potential covariates were tested at Level 2 to see if any were associated with an outcome measure (i.e., positive affect, negative affect, and cortisol). I tested the same covariates used for Aim 1 analyses, as described above. Consistent with best-practice recommendations (Raudenbush & Bryk, 2002), only significant covariates were retained in the final model. Finally, self-compassion was added to Level 2 to examine its association with between-person variability in Level 1 parameters. All HLM analyses were run using hierarchical linear modeling software.
(HLM-7; Raudenbush et al., 2004). When calculating deviance estimates and AIC for model fit, full information maximum likelihood models were used. When estimating model parameters, restricted maximum likelihood models were used. Following recommendation by Raudenbush and Bryk (2002), robust standard errors were used for analyses in order to reduce bias. Two-tailed testing was used for all tests of significance. Research suggests that Level 2 sample sizes should be greater than 50 to achieve adequate power in hierarchical models (Maas & Hox, 2005) and my sample exceeds this minimum. Using HLM, the B values represent unstandardized coefficients rather than Beta coefficients and, as such, do not represent a measure of effect size. HLM is not well suited to traditional computations of effect size or proportion of variance explained, since estimates are generally biased and not directly interpretable (Carels et al., 2007; Kircanski et al., 2015; Snijders & Bosker, 2011).

**Modeling Positive Affect.** Based on visual inspection of the data and preliminary analyses, we compared a linear, quadratic, and piecewise model. The piecewise model consisted of the value of positive affect at baseline (S1; immediately after waking), the slope from waking to 3:00 pm (S1-S3), and the slope from 3:00 pm to evening (S3-S4). For positive affect, a piecewise model (AIC = 437.42) fit the data significantly better than the linear (AIC = 460.58; \( p < .001 \)) and the quadratic model (AIC = 443.72; \( p = .007 \)). Thus, the following Level 1 model was specified:

**Positive Affect** = \( \pi_{0j}(\text{baseline}) + \pi_{1j}(\text{slope from waking to 3:00 pm}) + \pi_{2j}(\text{slope from 3:00 pm to evening}) + e_{ij} \)

In this equation, \( \pi_{0j} \) represents the level of positive affect for participant j at baseline, \( \pi_{1j} \) represents the slope of change from waking to 3:00 pm for participant j (with positive values indicating an increase in positive affect and higher values indicating a steeper slope), \( \pi_{2j} \)}
represents the slope of change from 3:00 pm to evening for participant j (with negative values indicating a decrease in positive affect and lower values indicating a greater decrease), and $e_{ij}$ represents the within-person random effect for participant j.

The following potential covariates were then tested: age, sex, pubertal stage, past or current DSM-5 diagnosis, past psychosocial treatment, present psychosocial treatment, present use of psychotropic medication, current use of non-psychotropic medication, and time between baseline and the start of high school. The time between baseline and the start of high school was significantly associated with baseline positive affect, $B = 0.003$, $t(52) = 2.66$, $p = .010$, but not with the slope from waking to 3:00 pm or the slope from 3:00 pm to evening. Sex was significantly associated with the slope from waking to 3:00 pm, $B = -0.0008$, $t(52) = -2.57$, $p = .013$, but not with baseline positive affect or the slope from 3:00 pm to evening. No other variables were significantly associated with positive affect levels at baseline, the slope from waking to 3:00 pm, or the slope from 3:00 pm to evening, $p > .05$. Thus, time between baseline and the start of high school, sex, and past or current DSM-5 diagnosis were included as covariates in the corresponding Level 2 models. The predictor variable, self-compassion, was then added to all Level 2 equations to determine if self-compassion was associated with individual differences in positive affect:

**Baseline Positive Affect:** $\pi_{0j} = B_{00} + B_{01}(\text{self-compassion}) + B_{11}(\text{time between baseline and start high school}) + r_{0j}$

**Positive Affect Wake to 3pm:** $\pi_{1j} = B_{10} + B_{11}(\text{self-compassion}) + B_{12}(\text{sex}) + r_{1j}$

**Positive Affect 3pm to Evening:** $\pi_{2j} = B_{20} + B_{21}(\text{self-compassion}) + r_{2j}$

**Modeling Negative Affect.** Based on visual inspection of the data and preliminary analyses, we compared a linear, quadratic, and piecewise model. The piecewise model consisted
of the value of negative affect at baseline (S1; immediately after waking), the slope from waking to 30 minutes later (S1 to S2), and the slope from 30 minutes after waking to evening (S2-S4).

For negative affect, a quadratic model (AIC = 345.42) fit the data significantly better than the linear model (AIC = 350.22; \( p < .009 \)). The piecewise model did not fit the data significantly better than the quadratic model (AIC = 351.32; \( p > .500 \)). Thus, the following Level 1 was specified:

\[
\text{Negative Affect} = \pi_{0j}(\text{baseline}) + \pi_{1j}(\text{linear slope}) + \pi_{2j}(\text{quadratic slope}) + e_{ij}
\]

In this equation, \( \pi_{0j} \) represents the level of negative affect for participant \( j \) at baseline, \( \pi_{1j} \) represents the linear slope, \( \pi_{2j} \) represents the quadratic slope, and \( e_{ij} \) represents the within-person random effect for participant \( j \). The following potential covariates were then tested: age, sex, pubertal stage, past or current DSM-5 diagnosis, past and present psychosocial treatment, present use of psychotropic medication, current use of non-psychotropic medication, and time between baseline and the start of high school. None of the variables were significantly associated with negative affect levels at baseline, with the linear slope, or with the quadratic slope, \( ps > .05 \). The predictor variable, self-compassion, was included in all Level 2 equations to determine if self-compassion was associated with individual differences in negative affect:

\[
\text{Baseline Negative Affect: } \pi_{0j} = B_{00} + B_{01}(\text{self-compassion}) + r_0
\]
\[
\text{Negative Affect Linear Slope: } \pi_{1j} = B_{10} + B_{11}(\text{self-compassion}) + r_1
\]
\[
\text{Negative Affect Quadratic Slope: } \pi_{2j} = B_{20} + B_{21}(\text{self-compassion}) + r_2
\]

\textbf{Modelling Cortisol.} Based on visual inspection of the data and preliminary analyses, we compared a linear, quadratic, and piecewise model. The piecewise model consisted of the value of cortisol at baseline (S1; immediately after waking), the cortisol awakening response (S1 to S2; the slope of cortisol from waking to 30 minutes later), and the diurnal cortisol slope (S2-S4; the
slope of cortisol from 30 minutes after waking to evening). For cortisol, the piecewise model (AIC = 526.73) fit the data significantly better than the linear model (AIC = 554.86; \( p < .001 \)), and the quadratic model (AIC = 555.10; \( p < .001 \)). Thus, the following Level 1 model was specified:

\[
\text{Cortisol} = \pi_{0j}(\text{baseline}) + \pi_{1j}(\text{cortisol awakening response}) + \pi_{2j}(\text{diurnal cortisol slope}) + e_{ij}
\]

In this equation, \( \pi_{0j} \) represents the level of cortisol for participant \( j \) at baseline, \( \pi_{1j} \) represents the slope of change for the cortisol awakening response for participant \( j \) (with positive values indicating an increase in cortisol and higher values indicating a steeper slope), \( \pi_{2j} \) represents the slope of change for the diurnal cortisol slope for participant \( j \) (with negative values indicating a decrease in cortisol from morning to evening and lower values indicating a greater decrease), and \( e_{ij} \) represents the within-person random effect for participant \( j \).

The following potential covariates were then tested: age, sex, pubertal stage, past or current DSM-5 diagnosis, past and present psychosocial treatment, present use of psychotropic medication, current use of non-psychotropic medication, time between baseline and the start of high school, use of nicotine, caffeine consumption, or eating/drinking in the 2 hours prior to the experiment, exercise in the 2 hours before one or more saliva sample, BMI, and number of minutes between midnight and the first saliva sample (Minutes from Midnight. None of the variables tested were significantly associated with cortisol levels at baseline, the cortisol awakening response, or the diurnal cortisol slope, \( ps > .05 \). Thus, no covariates were included in the corresponding Level 2 model. The predictor variable, self-compassion, was included in all Level 2 equations to determine if self-compassion was associated with individual differences in cortisol responses:
Baseline Cortisol: \( \pi_{0j} = B_{00} + B_{01}(self-compassion) + r_0 \)

Cortisol Awakening Response: \( \pi_{1j} = B_{10} + B_{11}(self-compassion) + r_1 \)

Diurnal Cortisol Slope: \( \pi_{2j} = B_{20} + B_{21}(self-compassion) + r_2 \)

Results

Demographic Characteristics

Participants included 76 preadolescent youth between the ages of 12.70 and 13.82 years at the time of the study (\( M = 13.21, SD = 0.29 \)) with an average Tanner stage of 3.10 (\( SD = 1.06 \)). Just over half (53%) of participants identified their sex assigned at birth as male and all participants identified as cisgender. In terms of race/ethnicity, 61% of the sample identified as European Canadian, 18% identified as Chinese, 4% identified as Latinx, 4% identified as South Asian, 4% identified as Korean Canadian, 3% identified as Indigenous Canadian, and the remaining 6% identified as more than one category (West Asian, Japanese Canadian, Chinese & Japanese, Chinese & Korean, European Canadian & West Asian, and South Asian & Latinx). Nine participants (12%) met criteria for one or more current or past DSM-5 disorders: one participant met criteria for persistent depressive disorder, social anxiety disorder, and unspecified depressive disorder, current; two participants met criteria for social anxiety disorder, current; one participant met criteria for social anxiety disorder and specific phobia, current; one participant met criteria for specific phobia and unspecified anxiety disorder, current; one participant met criteria for obsessive-compulsive disorder in partial remission; one participant met criteria for major depressive disorder with insufficient symptoms, social anxiety disorder with insufficient symptoms, and generalized anxiety disorder, current; one participant met criteria for unspecified anxiety disorder, current; and one participant met criteria for separation anxiety disorder, current. At the time of study participation, 5% of youth were taking current psychotropic medication; no
other participants reported taking psychotropic medications in the past. In terms of non-pharmacological treatment, 4% of participants reported current participation in psychological treatment and an additional 30% reported past participation in psychological treatment. Demographic characteristics are presented in Table 2.
### Table 2

*Participant Characteristics for Chapter 2*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Time between T1 and start of high school</td>
<td>131.92 days (87.18)</td>
</tr>
<tr>
<td>Age at start of high school, $M(SD)$</td>
<td>13.21 (0.29)</td>
</tr>
<tr>
<td>SCS score, $M(SD)$</td>
<td>3.24 (0.57)</td>
</tr>
<tr>
<td>Sex (% Male)</td>
<td>53%</td>
</tr>
<tr>
<td>Gender, %</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>53%</td>
</tr>
<tr>
<td>Female</td>
<td>47%</td>
</tr>
<tr>
<td>Non-binary/other</td>
<td>0%</td>
</tr>
<tr>
<td>Pubertal Stage, $M(SD)$</td>
<td>3.10 (1.06)</td>
</tr>
<tr>
<td>Current or past DSM-5 diagnosis, %</td>
<td>12%</td>
</tr>
<tr>
<td>Household Income</td>
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<tr>
<td>$20,000-$39,999</td>
<td>4%</td>
</tr>
<tr>
<td>$40,000-$59,999</td>
<td>5%</td>
</tr>
<tr>
<td>$60,000-$79,999</td>
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<td>$180,000-$199,999</td>
<td>7%</td>
</tr>
<tr>
<td>Variable</td>
<td>%</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>$200,000 and over</td>
<td>16%</td>
</tr>
<tr>
<td>Prefer Not to Answer</td>
<td>7%</td>
</tr>
<tr>
<td><strong>Racial Identity</strong></td>
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<tr>
<td>European Canadian</td>
<td>61%</td>
</tr>
<tr>
<td>Chinese</td>
<td>18%</td>
</tr>
<tr>
<td>Indigenous Canadian</td>
<td>3%</td>
</tr>
<tr>
<td>Korean Canadian</td>
<td>4%</td>
</tr>
<tr>
<td>Latinx</td>
<td>4%</td>
</tr>
<tr>
<td>South Asian</td>
<td>4%</td>
</tr>
<tr>
<td>Another specified race*</td>
<td>7%</td>
</tr>
<tr>
<td><strong>Psychiatric Intervention, %</strong></td>
<td></td>
</tr>
<tr>
<td>Current Psychotropic Meds</td>
<td>5%</td>
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<tr>
<td>Past Psychotropic Meds</td>
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</tr>
<tr>
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<td>95%</td>
</tr>
<tr>
<td>Current Psychosocial Treatment</td>
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<tr>
<td>Past Psychosocial Treatment</td>
<td>30%</td>
</tr>
<tr>
<td>Never Psychosocial Treatment</td>
<td>72%</td>
</tr>
<tr>
<td><strong>BMI, M(SD)</strong></td>
<td>19.21 (3.67)</td>
</tr>
<tr>
<td>2 hours prior to any saliva sample:</td>
<td></td>
</tr>
<tr>
<td>Drank or Ate</td>
<td>87%</td>
</tr>
<tr>
<td>Caffeine</td>
<td>20%</td>
</tr>
<tr>
<td>Nicotine</td>
<td>0%</td>
</tr>
</tbody>
</table>
Exercised 65%

15 minutes prior to any saliva sample:

Brushed teeth 37%

Note. SCS = Self Compassion Scale


**data available for 44 participants

Preliminary Analysis of Stress

In order to test whether the transition to high school was indeed stressful for adolescents, a paired samples t-test was conducted to compare levels of self-reported perceived stress at baseline (the Chapter 1 timepoint in the year prior to starting high school) and during the first two days of high school. Results indicated a significant increase from levels of perceived stress from baseline to the transition to high school, \( t_{paired}(69) = 4.15, p < .001 \).

Effect of Self-Compassion on Total Positive Affect, Negative Affect, and Cortisol across the First Two Days of High School combined.

Positive Affect. Three participants are missing affect at one or more timepoints and thus are not used in the total positive affect (i.e., AUCg) analysis. A hierarchical linear regression was conducted with significant covariates (entered in Block 1) and self-compassion (entered in Block 2) predicting positive affect AUCg. Significant covariates included in the model were age and time between baseline and start of high school, \( R^2 = 0.14, F(2,70) = 5.81, p = .005 \). Specifically, older age was positively associated with greater positive affect AUCg, \( \beta = 0.22, t(72) = 2.05, p = .044 \). Longer time between baseline and the start of high school was associated with greater
positive affect, $\beta = 0.30, t(72) = 2.75, p = .008$. When self-compassion was entered in Block 2, it explained a significant proportion of the variability in positive affect AUCg, $R^2_{\text{change}} = 0.07$, $F(3, 69) = 6.07, p = .001$, and the overall model remained significant, $R = 0.457, p = .019$. The $R^2_{\text{change}}$ value of .07 represents a small, approaching medium, effect size and indicates that 7% of the variance in positive affect can be explained by self-compassion, after accounting for the impact of age and time between baseline and start of high school. Specifically, greater self-compassion was associated with greater positive affect across the first two days of high school, $\beta = 0.26, t(70) = 2.40, p = .019$ (see Figure 14).
Negative Affect. Three participants are missing affect at one or more timepoints and thus are not used in the total negative affect (AUCg) analysis. None of the potential covariates were significant, thus a linear regression was conducted with self-compassion predicting negative affect AUCg. Self-compassion explained a significant proportion of the variability in negative affect AUCg, $R^2_{\text{change}} = 0.22$, $F(1,71) = 19.66, p < .001$, and the overall model was significant, $R = 0.466, p < .001$. The $R^2_{\text{change}}$ value of .22 represents a medium, approaching large, effect size and indicates that 22% of the variance in negative affect can be explained by self-compassion.
Specifically, greater self-compassion was associated with less negative affect across the first two days of high school, $\beta = -0.47$, $t(71) = -4.44$, $p < .001$ (see Figure 15).

**Figure 15**

*Associations between Self-Compassion and Total Negative Affect across the First Two Days of High School*

*Cortisol.* Eight participants are missing all cortisol data because they elected to not collect saliva samples, and two participants are missing partial cortisol data. Thus, ten participants are not used in the total cortisol (AUCg) analysis. A hierarchical linear regression was conducted with significant covariates (entered in Block 1) and self-compassion (entered in
Block 2) predicting cortisol AUCg. Although current use of non-psychotropic medication, current use of psychotropic medication, and current psychosocial treatment were significantly associated with cortisol AUCg when all covariates were entered in the model, they did not explain a significant portion of variance on their own, \( ps > .05 \), or when considered together as a group, \( R^2 = 0.06, F(3,62) = 1.28, p = .287 \). When self-compassion was entered in Block 2, it did not explain a significant proportion of the variability in cortisol AUCg, \( R^2_{\text{change}} = 0.00, F(1,61) = 0.95, p = .440 \) (see Figure 16).
Effect of Self-Compassion on Patterns of Positive Affect, Negative Affect, and Cortisol Across the First Two days of High School.

Positive affect. All participants have at least some affect data and thus all 76 participants are used in the positive affect HLM analyses. Diurnal patterns of positive affect averaged across the first two days of high school is presented in Figure 17. First, in order to assess the basic pattern of positive affect across the first two days of high school, a baseline model without any predictors at Level 2 was run. This model indicated that participants’ average level of positive
affect was significantly different from zero at baseline, $B = 2.53, t(74) = 27.08, p < .001$. Levels of positive affect significantly increased from waking to 3:00 pm, $B = 0.0006, t(74) = 4.28, p < .001$. Levels of positive affect decreased slightly but not significantly from 3:00 pm to bedtime, $B = -0.0003, t(74) = -1.56, p = .123$.

**Figure 17**

*Positive Affect for All Participants across Four Time Points Averaged across First Two Days of High School*

![Graph of Positive Affect across Four Time Points](image)

Significant covariates included time between baseline and the start of high school and sex; they were then added at Level 2 as described above. Self-compassion was also added at Level 2 to examine whether individual differences in the change in levels of positive affect across the first two days of high school were explained by levels of self-compassion. The time between baseline and the start of high school was significantly associated with baseline positive affect, $B = 0.003, t(72) = 3.78, p < .001$. With the addition of self-compassion to level 2, sex was
no longer significantly associated with the slope from waking to 3:00 pm, \( B = -0.0003, t(72) = -1.33, p = .187 \). Self-compassion was a significant predictor of baseline levels of positive affect, \( B = 0.33, t(72) = 2.29, p = .025 \), such that higher levels of self-compassion were associated with higher levels of positive affect at waking. Self-compassion did not predict the slope from waking to 3:00 pm, \( B = 0.00006, t(72) = 0.03, p = .980 \), or the slope from 3:00 pm to bedtime, \( B = 0.0002, t(72) = 0.80, p = .425 \). Figure 18 depicts positive affect for participants split, for visual purposes, into low and high self-compassion groups using a median split.

**Figure 18**

*Positive Affect for Participants High and Low on Self-Compassion Displayed Using a Median Split*

![Graph showing positive affect for participants high and low on self-compassion](image)

**Negative affect.** All participants have at least some affect data and thus all 76 participants are used in the negative affect HLM analyses. Diurnal patterns of negative affect
averaged across the first two days of high school are presented in Figure 19. First, in order to assess the basic pattern of negative affect across the first two days of high school, a baseline model without any predictors at Level 2 was run. This model indicated that participants’ average level of negative affect was significantly different from zero at baseline, \( B = 1.72, t(74) = 26.83, p < .001 \). The linear slope was significant, \( B = -0.0006, t(74) = -3.81, p < .001 \), and the quadratic slope was also significant, \( B = 0.000001, t(147) = 3.09, p = .002 \).

**Figure 19**

*Negative Affect for All Participants across Four Time Points Averaged across First Two Days of High School*

There were no significant covariates, thus, level of self-compassion alone was added at Level 2 to examine whether individual differences in the change in negative affect across the first two days of high school was explained by levels of self-compassion. Self-compassion was a
significant predictor of baseline levels of negative affect, $B = -0.34$, $t(292) = -4.37$, $p < .001$, such that higher levels of self-compassion predicted lower levels of negative affect at waking. Self-compassion was not a significant predictor of the linear slope, $B = -0.0001$, $t(292) = -0.17$, $p = .863$, or the quadratic slope, $B = -0.00$, $t(292) = 0.04$, $p = .968$. Figure 20 depicts negative affect for participants split, for visual purposes, into low and high self-compassion groups using a median split.

**Figure 20**

*Negative Affect for Participants High and Low on Self-Compassion Displayed Using a Median Split*

**Cortisol.** Eight participants are missing all cortisol data because they elected to not collect saliva samples. Natural log transformed values of cortisol across the first two days of high school are presented in Figure 21. First, in order to assess the basic pattern of cortisol across the
first two days of high school, a baseline model without any predictors at Level 2 was run. This model indicated that participants’ average level of cortisol was significantly different from zero at waking, $B = 2.01$, $t(67) = 28.19$, $p < .001$. Levels of cortisol significantly increased across the cortisol awakening response, $B = 0.01$, $t(67) = 5.25$, $p < .001$, and then significantly decreased across the diurnal cortisol slope, $B = -0.004$, $t(67) = -33.96$, $p < .001$.

**Figure 21**

*Natural Log Transformed Cortisol Values (nMol/l) for All Participants across Four Time Points Averaged across First Two Days of High School*

There were no significant covariates, thus, level of self-compassion alone was added at Level 2 to examine whether individual differences in the change in levels of cortisol across the first two days of high school were explained by levels of self-compassion. Self-compassion did not predict levels of cortisol at wake, $B = 0.04$, $t(66) = 0.36$, $p = .724$, the cortisol awakening
response, $B = -0.004, t(66) = -1.24, p = .218$, or the diurnal cortisol slope, $B = -0.0001, t(66) = -0.56, p = .581$. Figure 22 depicts cortisol responses for participants split, for visual purposes, into low and high self-compassion groups using a median split.

**Figure 22**

*Natural Log Transformed Cortisol Levels (nMol/l) for Participants High and Low on Self-Compassion Displayed Using a Median Split*

![Graph showing cortisol levels for high and low self-compassion groups.]

**Discussion**

The aim of this chapter was to extend previous work by examining the association between self-compassion and markers of stress in the context of a naturalistic stressor – the transition to high school. I found that, as expected, greater self-compassion was associated with greater total positive affect and less total negative affect across the first two days of high school. Contrary to my expectations, however, self-compassion was not associated with total levels of
cortisol, nor was it associated with diurnal patterns of positive affect, negative affect, or cortisol across the first two days of high school. These findings provide insight into the degree to which trait self-compassion is associated with markers of stress during a naturalistic stressor in adolescents.

With regard to total affect, I found that participants with higher levels of self-compassion had significantly greater total positive affect and less total negative affect across the first two days of high school. This is consistent with the findings from Chapter 1 of this dissertation, in which trait self-compassion was significantly positively associated with total levels of positive affect and negatively associated with total levels of negative affect across a laboratory stressor. The current findings are also consistent with evidence from cross-sectional research linking greater self-compassion with higher levels of positive affect affect (Neff et al., 2007; Neff & Vonk, 2009; Sirois et al., 2015; Zessin et al., 2015) and lower levels of negative affect in everyday life (Barnard & Curry, 2011; Leary et al., 2007; Sirois et al., 2015). Most importantly, the findings of this chapter are consistent with findings from the only other study to examine the association between naturally occurring self-compassion in everyday life with daily affect. Krieger and colleagues found that higher levels of self-compassion were significantly associated with less negative affect and more positive affect across 14 days in a sample of adults (2015). My findings extend this work by showing that the same pattern holds in an adolescent sample.

Self-compassion was not associated with patterns of positive or negative affect across the first two days of high school. There are a number of reasons that may explain this lack of a significant relationship with patterns of affect. Research has shown that positive affect follows a reliable diurnal pattern. However, we do not have evidence to suggest that self-compassion has an impact on fluctuations in positive affect across the day or in response to a stressor. In fact, in
Chapter 1, we found that self-compassion was not associated with changes in positive affect stress reactivity or recovery. The findings of Chapter 2 are consistent and suggest that self-compassion may not be associated with patterns of positive affect across the day or during a naturalistic stressor. In contrast with positive affect, negative affect is more sensitive to the experience of stressors (Watson et al., 1999) and self-compassion is posited to be particularly important in times of high distress (Neff, 2003a). However, in Chapter 1 greater self-compassion was also not associated with negative affect reactivity or recovery. Further, negative affect does not typically follow a diurnal pattern and the fact that fluctuations in negative affect differ between individuals may have created noise that obscured any effect self-compassion may have had. The important take-away is that self-compassion may not have a specific effect during stressful moments in the day; instead, it has an overall impact on levels of affect across the day. Self-compassion is not just a way of coping with stress and perceived failure, it is a mindset and a way of viewing oneself and the world. As such, it has a more global association with affect.

In this chapter, self-compassion was not significantly associated with total cortisol levels, or diurnal patterns of cortisol across the first two days of high school. This is consistent with my findings from Chapter 1 and the findings from Bluth and colleagues who found that adolescents high in trait self-compassion did not differ significantly from those low in trait self-compassion on several biological markers of stress, including salivary cortisol, heart rate, blood pressure, and heart rate variability (2016). Research assessing the influence of other emotion regulation strategies on biological markers of stress have also failed to find significant effects (Campbell-Sills et al., 2006; Kuo et al., 2016). The findings of this chapter also align with a recent meta-analysis, which found only a weak correlation ($r = 0.14$) between self-compassion and stress hormones (Phillips & Hine, 2021). Thus, data from the current chapter suggest that self-
compassion is associated with affective but not biological markers of stress. It may be that individuals high in self-compassion experience a similar biological stress response to those low in self-compassion, but they appraise the stressor differently, which leads to feeling differently about the stressor. Consistent with this proposition is the finding that individuals high in self-compassion are more likely to use positive reappraisal after stressful events (Allen & Leary, 2010). Importantly, positive reappraisal, while adaptive in the long run, may be mentally taxing and result in increased cortisol output. Given that self-compassion is *inversely* linked to coping strategies that show heightened cortisol responding (e.g. rumination; Barnard & Curry, 2011) as well as *positively* linked to coping strategies that show heightened cortisol responding (e.g. positive appraisal; Chishima et al., 2018), these effects may cancel each other out. This may explain the lack of association between self-compassion and cortisol levels. It is also important to note that many studies show discordance between emotional states and cortisol responses to stress. A review by Campbell and Ehlert found that significant correlations between cortisol responses and perceived emotional stress variables were found in only approximately 25% of the studies (2012). The authors of this review point out that this desynchrony may reflect that stress reactivity is not one single system, but instead made up of independently varying components including cognitive, emotional, physiological and behavioral responses (Campbell & Ehlert, 2012). Thus, it is possible that self-compassion influences emotional responses to stress and does not impact physiological responding.

As with all research, there are limitations to the present chapter. First, my measure of trait levels of self-compassion was taken a few months before the transition to high school. While I would not expect levels of self-compassion to change substantially in that time, it would be preferable to assess self-compassion closer in time to the assessment of responses to stress.
Second, I used the Self-Compassion Scale – Short Form, which is reliable and valid and one of the commonly used measures in the field. Still, future studies would benefit from using the full-scale version of the scale, which would allow researchers to use the total SCS score, as well as the six subscale scores representing each of the facets of self-compassion. This would allow for a more in-depth examination of the mechanisms of self-compassion and determine whether any of the subscales differentially predict outcomes (Neff, 2020). It would also be interesting to supplement the self-report assessment using the SCS with multi-informant methods, perhaps having parent’s report on their child’s level of self-compassion. In addition, future research should consider employing the state version of self-compassion scale, as well as the adolescent specific version. Third, future research should assess levels of affect and cortisol across days where youth are not experiencing a stressor prior to assessing the variables during a stressor. Another limitation is the sample size, as the study was underpowered to detect a weak relationship ($r = 0.14$; Phillips & Hine, 2021) between self-compassion and cortisol. Finally, a limitation of this chapter was the short time frame of just two days. Future research should follow youth over a longer time period in order to observe longer term effects.

In summary, participants with higher levels of self-compassion had greater total positive affect and less total negative affect across the first two days of high school. Our findings support previous research showing that higher levels of self-compassion were significantly associated with less negative affect and more positive affect across 14 days in a sample of adults (Krieger et al., 2015) and it extends the literature by being the first to replicate this in adolescents. In contrast, self-compassion was not associated with individual differences in total cortisol levels, or diurnal patterns of negative affect, positive affect, or cortisol across the first two days of high school. This pattern of a significant association between self-compassion and overall levels of
affect, but not with *patterns* of affect, and not with overall or patterns of cortisol, is in line with findings from Chapter 1. This further suggests that self-compassion may not have the far-reaching benefits that were originally anticipated with regards to buffering stress.
Chapter 3

Introduction

Chapter 3 was conducted in order to replicate and extend the findings from Chapter 2 by examining the effect of self-compassion on emotional and biological markers of stress during an alternative stressor: the COVID-19 pandemic. The pandemic represented a unique opportunity to study the influence of self-compassion during a naturalistic stressor that was very different from the transition to high school. While the transition represented an introduction to a new social environment, the pandemic and the subsequent public health measures put in place to control it were characterized by isolation. The public health measures included a cessation of in-school learning, restriction of non-essential travel, and physical distancing requirements, which meant not seeing people outside of one’s immediate household. These measures, while necessary to control the spread of the virus, resulted in many challenges for youth. Social distancing and the cessation of in-person schooling and activities meant youth were isolated from their friends, were unable to engage in sports and extracurriculars, and were required to adjust to online learning (Nearchou et al., 2020). At the same time, the threat of contracting COVID-19 led many adolescents to worry about their own health and that of their loved ones (Nearchou et al., 2020).

It is worth noting that the COVID-19 pandemic does not constitute a ubiquitous stressor experienced unilaterally by all individuals. It would be remiss to say that the cancellation of in-person school and physical distancing requirements were experienced as stressful or upsetting by all adolescents. Responses to particular aspects of the pandemic likely varied by individual. At the same time, however, the societal and governmental responses to the pandemic were so wide-ranging that there were few, if any, aspects of daily life that were not in some way effected. Such complete impact on the social and physical environmental circumstances of all members of our
society means that in some way or other the adaptive capabilities and resources of individuals were challenged (Bridgland, 2021), which makes the COVID-19 pandemic consistent with the definition of a stressor (Monroe & Slavich, 2016).

During the pandemic, self-compassion could assist adolescents to cope by increasing their awareness of their struggles, reducing isolation by connecting them to the universality of their struggles in this particular moment, and bolstering their ability to be kind to themselves. Findings from Chapter 2 of this dissertation showed that greater self-compassion was associated with greater total positive affect and less total negative affect in response to the transition to high school. It was not, however, associated with diurnal patterns of affect during that time. This means that while self-compassion did not have a specific effect on stress levels during stressful moments in the day, it still had an overall impact on levels of affect. As such, Chapter 3 was designed to examine the impact of self-compassion on total levels of affect over the span of two weeks, rather than daily patterns. Chapter 3 served to address some of the noted limitations of Chapter 2, including the gap in time between assessment of self-compassion and markers of stress, and the short time frame of 2 days. Since self-compassion is not just a way of coping with stress but a mindset and a way of viewing oneself and the world, the assumption tested by Chapter 3 is that it has a more global (rather than diurnal) association with affect.

Based on past research, including Chapters 1 and 2 of this dissertation, it was unlikely that self-compassion would be associated with levels of cortisol. However, adolescents in this are older at this time period, and research has shown that as individuals progress through puberty they show greater variability in HPA axis activity (Gunnar et al., 2009; Kiess et al., 1995; Shirtcliff et al., 2012). Thus, it is still important to test whether self-compassion has a measurable impact on levels of cortisol.
With this in mind, I followed the sample of youth from Chapter 1 during the first wave of the COVID-19 pandemic (May to June 2020) and measured whether levels of self-compassion would be associated with markers of stress. Youth attended an online session during which they completed a clinical interview to assess for the presence of DSM-5 disorders and they completed the Self-Compassion Scale (Raes et al., 2011) to assess levels of self-compassion. Within four weeks of the online session, participants collected cortisol samples four times per day for two days. Also within four weeks, but on separate days from cortisol collection, participants reported on positive and negative affect once per day for fourteen days.

**Aim 1**

The first aim was to examine the association between self-compassion and total emotional and biological stress during the COVID-19 pandemic. I expect that lower levels of self-compassion will be associated with 1) less positive affect and 2) more negative affect across 14 days, and (3) greater cortisol output across 2 days.

**Aim 2**

The second aim was to examine the association between self-compassion and patterns of biological reactivity to and recovery from stress during the COVID-19 pandemic. Given the mixed findings from Chapters 1 and 2 of this dissertation, patterns were examined in an exploratory manner.

**Method**

**Participants**

A subset of participants who completed Chapter 1 were invited to provide affect and cortisol data during the COVID-19 pandemic. Eligible participants were fluent in English and had at least one parent/legal guardian who was fluent in English. Participants were not eligible
for participation if they had a history of severe head trauma, psychotic symptoms, manic/hypomanic episodes, or alcohol or substance use disorder in the past 6 months. Participants also were excluded if they were currently taking corticosteroids (including glucocorticoids), oral or inhaled steroids, or depot neuroleptics. The 83 participants who took part in Chapter 1 came from three different cohorts across three years. At the time of the COVID-19 pandemic, the first cohort \((n = 8)\) had already completed study participation, and thus they were not invited to take part in this data collection. For that reason, only participants from the second and third cohort \((n = 98)\) were invited to provide data for Chapter 3, and 68 participants did so. Of the participants invited to participate in Chapter 3, those who did versus did not participate did not differ on any clinical or demographic characteristics at baseline. It is important to note that while participants were invited to take part in affect data collection and cortisol data collection, these took place at slightly different times and involved different time commitments. For this reason, some participants contributed only affect data \((N = 34)\), other participants contributed only cortisol data \((N = 52)\), and still others contributed both affect and cortisol data \((N = 22)\); thus, the sample size varies slightly depending on the analyses, as described in each section of the results. Participants who contributed only affect data, only cortisol data, or both affect and cortisol data did not differ on clinical and demographic characteristics, \(p’s > .05\).

**Procedure**

Chapter 3 data was collected in late April to June of 2020, a time when the strictest social-distancing measures of the first wave of the COVID-19 pandemic were in place. Affect data collection occurred in late April to May of 2020. For the affect data collection, participants first completed the Self-Compassion Scale – Short Form (SCS-SF; Raes et al., 2011) to assess
trait level of self-compassion. Participants were then sent daily links to complete affect ratings for 14 days. Cortisol data collection occurred in May to June 2020. For cortisol data collection, participants first completed a clinical interview consisting of the Schedule for Affective Disorders and Schizophrenia for Kids (KSADS; Kaufman et al., 2016) and self-report questionnaires, including the SCS-SF. The interview was completed remotely using Zoom video-conference technology and the questionnaires were completed remotely via REDCap. Within four weeks of the interview and questionnaires, participants collected saliva samples on two consecutive weekdays at the same four times time points used in Chapter 2: immediately after waking up, 30 minutes after waking up, 3:00pm, and prior to bed. Participants received up to a $70 honorarium for their participation.

Measures

Clinical Interview. The parent/legal guardian completed a structured clinical interview (i.e., the parent version of the KSADS-PL; Kaufman et al., 2016) to assess the parents’ report of youth psychopathology since the last time the participant completed the clinical interview (as part of Chapter 1). Following this, youth completed the child version of the KSADS-PL to assess the presence of DSM-5 psychological disorders (Kaufman et al., 2016). All clinical interviews were adminstered by trained graduate students or advanced research assistants. Participants were deemed to meet criteria for a DSM-5 diagnosis if indicated by either youth or parent report.

Self-Compassion. Participants completed the Self-Compassion Scale – Short Form (SCS-SF; Raes et al., 2011) to assess trait level of self-compassion. The SCS-SF assesses all three facets of self-compassion, along with their negative counterparts: self-kindness versus self-judgement, common humanity versus isolation, and mindfulness versus over-identification. The SCS-SF assesses how participants typically act towards themselves, with responses on a Likert
scale ranging from 1 \textit{(almost never)} to 5 \textit{(almost always)}. The total SCS-SF-trait score was computed by first reverse scoring the negative subscale items and then taking the average of all items. The SCS-SF scale showed good internal reliability with this sample, \( \alpha = .867 \).

\textbf{Positive and Negative Affect.} Self-reported affect was assessed using items from the Positive and Negative Affect Scale for Children (PANAS-C; Laurent et al., 1999). Each day at 7:00 PM, participants received a reminder to complete the PANAS while reflecting on how they felt on that day. Participants responded to items using a 5-point Likert scale ranging from 1 \textit{(Very Slightly or Not at All)} to 5 \textit{(Extremely)}. A positive affect composite measure was calculated by taking the sum of happy, excited, proud, and calm affect scores each day and averaging across 14 days. A negative affect composite measure was calculated by taking the sum of stressed, upset, nervous, and ashamed affect scores each day and averaging across 14 days. For positive affect, between-person reliability was \( R_{kf} = .98 \) and within-person reliability was \( R_c = .47 \) (Cranford et al., 2006). For negative affect, between-person reliability was \( R_{kf} = .99 \) and within-person reliability was \( R_c = .62 \) (Cranford et al., 2006). Note that within-person reliabilities calculated for short scales administered on a frequent basis are expected to have lower values than classical reliability measures (Nezlek, 2017).

\textbf{Salivary Cortisol.} Participants collected saliva samples on two consecutive weekdays to assess diurnal cortisol. Participants and their parents were given detailed instructions regarding saliva collection during the online Zoom session, as well as written instructions given to them when saliva collection materials were dropped off at their houses. Participants were asked to refrain from eating or drinking anything besides water, smoking or vaping, and brushing their teeth, and exercising in the two hours prior to collection. Saliva was collected using Salivette vials (Sarstedt, Germany). Participants recorded the collection times on the vials and then stored
them in their freezer until they could be picked up. Biochemical analysis of cortisol from saliva samples was performed at Dresden LabService in Dresden, Germany. The inter and intraassay coefficient of variance were both below 9%. Raw cortisol measurements from all eight time points were positively skewed, which is typical in the literature (Granger et al., 2012). There were also eleven outliers across the eight time points. In order to normalize the data, a natural logarithmic (In) transformation was applied, as is common in the literature (e.g., Shrout et al., 2020; Sin et al., 2017), and the natural log-transformed values, measured in nanomoles per litre (nMol/l), were used in all reported analyses.

**Covariates.** Participants completed questionnaires to assess variables known to affect cortisol levels or responses to stress. Specifically, participants provided information on age, biological sex, past and present psychosocial and pharmacological treatment, height and weight (used to calculate BMI), and pubertal status (Hibel et al., 2007; Kajantie & Phillips, 2006; Martin et al., 2012). At each saliva collection timepoint, participants also reported on health-related variables known to affect the response of the HPA axis, including whether or not they ate or drank anything besides water, consumed caffeine, smoked or vaped, brushed their teeth, or exercised in the 2 hours prior to saliva collection (Garde et al., 2009).

**Data Analytic Approach**

**Preliminary Analysis of Stress**

In order to test whether the COVID-19 pandemic period when data was collected was indeed stressful for adolescents, a paired samples t-test was conducted to compare levels of self-reported perceived stress at baseline (the Chapter 1 timepoint in the year prior to starting high school) and during the COVID-19 pandemic. For all participants, perceived stress at baseline was assessed at the beginning of the second laboratory session. For participants who contributed
affect data, perceived stress during the pandemic was assessed by taking the average of the “stressed” items from the PANAS that was completed daily for two weeks. For participants who contributed cortisol data, perceived stress during the pandemic was assessed by a single item asking participants how stressed they felt, as part of the online questionnaires they completed.

*Aim 1*

The first aim was to examine the association between self-compassion and average positive affect and negative affect across 14 days and total cortisol across two days of the COVID-19 pandemic. In order to quantify total biological stress across the two days, I calculated area under the curve to ground (AUCg) using trapezoidal integration for cortisol (Pruessner et al., 2003). I then conducted three hierarchical linear regression analyses with self-compassion predicting average positive affect, average negative affect, and cortisol AUCg, respectively. All variables described in the *Covariates* section above were tested as potential covariates and were included in Block 1 of the regression analyses if significant. Self-compassion was added in Block 2. For all regression analyses, effect sizes are reported as $R^2$ or the coefficient of determination. $R^2$ represents the amount of variance in the outcome variable explained by the predictor variable. $R^2$ values of 0.01, 0.09, and 0.25 represent small, medium, and large effects, respectively (Foster et al., 2018).

*Aim 2*

The second aim was to test the association of self-compassion and *diurnal patterns* of biological responses over two days of the COVID-19 pandemic. A hierarchical linear modeling (HLM) approach was used as time is nested within participants (Raudenbush & Bryk, 2002). At Level 1 repeated measurements of cortisol were modelled within individuals as a function of time. Linear, quadratic, and piecewise models were evaluated and the model that best fit the data
was selected. Next, potential covariates were tested at Level 2 to see if any were associated with the outcome measure – cortisol. I tested the same covariates used for Aim 1 analyses, as described above. Finally, self-compassion was added to Level 2 to examine its association with between-person variability in Level 1 parameters. All HLM analyses were run using hierarchical linear modeling software (HLM-7; Raudenbush et al., 2004). When calculating deviance estimates and AIC for model fit, full information maximum likelihood models were used. When estimating model parameters, restricted maximum likelihood models were used. Following recommendation by Raudenbush and Bryk (2002), robust standard errors were used for analyses in order to reduce bias. Two-tailed testing was used for all tests of significance. Research suggests that Level 2 sample sizes should be greater than 50 to achieve adequate power in hierarchical models (Maas & Hox, 2005) and my sample exceeds this minimum. Using HLM, the B values represent unstandardized coefficients rather than Beta coefficients and, as such, do not represent a measure of effect size. HLM is not well suited to traditional computations of effect size or proportion of variance explained, since estimates are generally biased and not directly interpretable (Carels et al., 2007; Kircanski et al., 2015; Snijders & Bosker, 2011).

**Modeling Cortisol.** Based on visual inspection of the data and preliminary analyses, I compared a linear, quadratic, and piecewise model. The piecewise model consisted of the value of cortisol at baseline (S1; immediately after waking), the cortisol awakening response (S1 to S2; the slope of cortisol from waking to 30 minutes later), and the diurnal cortisol slope (S2-S4; the slope of cortisol from 30 minutes after waking to evening). For cortisol, the piecewise model (AIC = 365.26) fit the data best as it had the smallest AIC, though it was not significantly better
than the linear model (AIC = 366.39; \( p = .057 \)) or the quadratic model (AIC = 366.39; \( p = .067 \)). Thus, the following Level 1 model was specified:

\[
\text{Cortisol} = \pi_{0j}(\text{baseline}) + \pi_{1j}(\text{cortisol awakening response}) + \pi_{2j}(\text{diurnal cortisol slope}) + e_{ij}
\]

In this equation, \( \pi_{0j} \) represents the level of cortisol for participant \( j \) at baseline, \( \pi_{1j} \) represents the slope of change for the cortisol awakening response for participant \( j \) (with positive values indicating an increase in cortisol and higher values indicating a steeper slope), \( \pi_{2j} \) represents the slope of change for the diurnal cortisol slope for participant \( j \) (with negative values indicating a decrease in cortisol from morning to evening and more negative values indicating a greater decrease), and \( e_{ij} \) represents the within-person random effect for participant \( j \).

The following covariates were then tested: age, sex, pubertal stage, past or current DSM-5 diagnosis, past and present psychosocial treatment, past and present use of psychototropic medication, current use of non-psychototropic medication, use of nicotine, caffeine consumption, eating/drinking, brushing their teeth, or exercising in the 2 hours prior to the experiment, BMI, and number of minutes between midnight and the first saliva sample (Minutes from Midnight).

Pubertal stage was significantly associated with cortisol levels at baseline, \( B = 0.22, t(28) = 2.26, p = .032 \), but not the cortisol awakening response, or the diurnal cortisol slope, \( ps > .05 \). No other variables were significantly associated with cortisol levels at baseline, the cortisol awakening response, or the diurnal cortisol slope, \( ps > .05 \). Thus, pubertal stage was included in the corresponding Level 2 model. The predictor variable, self-compassion, was included in all Level 2 equations to determine if self-compassion was associated with individual differences in cortisol responses:

\[
\text{Baseline Cortisol: } \pi_{0j} = B_{00} + B_{01}(\text{self-compassion}) + B_{02}(\text{pubertal stage}) + r_{0}
\]
Cortisol Awakening Response: $\pi_{1j} = B_{10} + B_{11}(\text{self-compassion}) + r_{1}$

Diurnal Cortisol Slope: $\pi_{2j} = B_{20} + B_{21}(\text{self-compassion}) + r_{2}$

Results

Demographic Characteristics

Participants included 68 youth between the ages of 12.63 and 14.59 years at the time of the study ($M = 13.8$, $SD = 0.4$) with an average Tanner stage of 3.5 ($SD = 0.9$). Just over half (53%) of participants identified their sex assigned at birth as male and all participants identified as cisgender. In terms of race/ethnicity, 65% of the sample identified as European Canadian, 13% identified as Chinese, 4% identified as Latinx, 3% identified as South Asian, 3% identified as Korean Canadian, 3% identified as Indigenous Canadian, and the remaining 9% identified as one of the following: West Asian, Japanese Canadian, Chinese & Japanese, Chinese & Korean, European Canadian & Chinese, and South Asian & Latinx. Twenty participants (29%) met criteria for one or more current or past DSM-5 disorders. Diagnoses included: persistent depressive disorder, unspecified depressive disorder, major depressive disorder, social anxiety disorder, specific phobia, obsessive-compulsive disorder in partial remission, separation anxiety disorder, unspecified anxiety disorder, and unspecified eating disorder. At the time of study participation, 4% of youth were taking current psychotropic medication, and 6% of participants reported taking psychotropic medications in the past. In terms of non-pharmacological treatment, 12% of participants reported current participation in psychological treatment and 32% reported past participation in psychological treatment. Demographic characteristics are presented in Table 3 for each group- those that provided affect data and those that provided cortisol data.
### Table 3

**Participant Characteristics for Chapter 3**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Participants with cortisol data, n = 52</th>
<th>Participants with affect data, n = 34</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, $M(SD)$</td>
<td>13.97 (0.4)</td>
<td>13.73 (0.51)</td>
</tr>
<tr>
<td>SCS score, $M(SD)$</td>
<td>3.18 (0.78)</td>
<td>3.07 (0.68)</td>
</tr>
<tr>
<td>Sex (% Male)</td>
<td>57%</td>
<td>50%</td>
</tr>
<tr>
<td>Gender, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>57%</td>
<td>50%</td>
</tr>
<tr>
<td>Female</td>
<td>43%</td>
<td>50%</td>
</tr>
<tr>
<td>Non-binary/other</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Pubertal Stage, $M(SD)$</td>
<td>3.50 (0.90)</td>
<td>3.40 (1.09)</td>
</tr>
<tr>
<td>Current or past DSM-5 diagnosis, %</td>
<td>34%</td>
<td>21%</td>
</tr>
<tr>
<td>Household Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$20,000-$39,999</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>$40,000-$59,999</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>$60,000-$79,999</td>
<td>4%</td>
<td>9%</td>
</tr>
<tr>
<td>$80,000-$99,999</td>
<td>15%</td>
<td>6%</td>
</tr>
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<td>$100,000-$119,000</td>
<td>15%</td>
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<td>$160,000-$179,999</td>
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<td>6%</td>
</tr>
<tr>
<td>$180,000-$199,999</td>
<td>6%</td>
<td>9%</td>
</tr>
<tr>
<td>Variable</td>
<td>Participants with cortisol data, ( n = 52 )</td>
<td>Participants with affect data, ( n = 34 )</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>$200,000 and over</td>
<td>13%</td>
<td>12%</td>
</tr>
<tr>
<td>Prefer Not to Answer</td>
<td>6%</td>
<td>9%</td>
</tr>
<tr>
<td>Racial Identity</td>
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<td></td>
</tr>
<tr>
<td>European Canadian</td>
<td>62%</td>
<td>62%</td>
</tr>
<tr>
<td>Chinese</td>
<td>15%</td>
<td>18%</td>
</tr>
<tr>
<td>Latinx</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Indigenous Canadian</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>Korean Canadian</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>South Asian</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Another specified race*</td>
<td>8%</td>
<td>12%</td>
</tr>
<tr>
<td>Psychiatric Intervention, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Psychotrophic Meds</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td>Past Psychotropic Meds</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Never Psychotropic Meds</td>
<td>94%</td>
<td>91%</td>
</tr>
<tr>
<td>Current Psychosocial Treatment</td>
<td>15%</td>
<td>18%</td>
</tr>
<tr>
<td>Past Psychosocial Treatment</td>
<td>36%</td>
<td>29%</td>
</tr>
<tr>
<td>Never Psychosocial Treatment</td>
<td>57%</td>
<td>62%</td>
</tr>
<tr>
<td>BMI, ( M(SD) )</td>
<td>19.79 (4.08)</td>
<td>19.93 (3.36)</td>
</tr>
<tr>
<td>2 hours prior to any saliva sample:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drank or Ate</td>
<td>69%</td>
<td>--</td>
</tr>
<tr>
<td>Caffeine</td>
<td>10%</td>
<td>--</td>
</tr>
<tr>
<td>Nicotine</td>
<td>0%</td>
<td>--</td>
</tr>
<tr>
<td>-----------</td>
<td>-----</td>
<td>----</td>
</tr>
<tr>
<td>Exercised</td>
<td>29%</td>
<td>--</td>
</tr>
</tbody>
</table>

15 minutes prior to any saliva sample:

| Brushed teeth | 46% | -- |

Note. SCS = Self Compassion Scale


**Preliminary Analysis of Stress**

In order to test whether the COVID-19 pandemic period when data was collected was indeed stressful for adolescents, a paired samples t-test was conducted to compare levels of self-reported perceived stress at baseline (the Chapter 1 timepoint in the year prior to starting high school) and during the COVID-19 pandemic. For participants who contributed affect data, results indicated a significant increase from levels of perceived stress from baseline to the pandemic, $t_{paired}(28) = 3.82, p < .001$. For participants who contributed affect data, level of perceived stress during the pandemic was not significantly greater than during the transition to high school, $t_{paired}(25) = 1.74, p = .094$. For participants who contributed cortisol data, results also indicated a significant increase from levels of perceived stress from baseline to the pandemic, $t_{paired}(47) = 4.33, p < .001$. For participants who contributed cortisol data, level of perceived stress during the pandemic was also significantly greater than during the transition to high school, $t_{paired}(52) = 3.49, p < .001$. 

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Effect of Self-Compassion on Average Positive Affect and Negative Affect over 14 Days, and Total Cortisol Over 2 Days During the COVID-19 Pandemic.

Positive Affect. None of the potential covariates were significant, thus a linear regression was conducted with self-compassion predicting average positive affect. Self-compassion did not explain a significant proportion of the variability in average positive affect, $R^2_{\text{change}} = 0.07$, $F(1,32) = 2.55, p = .120$, and the overall model was not significant, $R = 0.27, p = .120$. Specifically, greater self-compassion was not significantly associated with greater positive affect during the COVID-19 pandemic, $\beta = 0.27, t(32) = 1.60, p = .120$ (see Figure 23).
Associations Between Self-Compassion and Average Positive Affect over 14 Days of the COVID-19 Pandemic

**Negative Affect.** None of the potential covariates were significant, thus a linear regression was conducted with self-compassion predicting average negative affect. Self-compassion explained a significant proportion of the variability in average negative affect, $R^2_{\text{change}} = 0.21$, $F(1,32) = 8.55$, $p = .006$, and the overall model was significant, $R = 0.46$, $p = .006$. The $R^2_{\text{change}}$ value of .21 represents a medium, approaching large, effect size and indicates that 21% of the variance in negative affect can be explained by self-compassion. Specifically,
greater self-compassion was associated with less negative affect during the COVID-19 pandemic, $\beta = -0.46$, $t(32) = -2.92$, $p = .006$ (see Figure 24).

**Figure 24**

*Associations between Self-Compassion and Average Negative Affect over 14 days of the COVID-19 Pandemic*

Cortisol. None of the potential covariates were significant, thus a linear regression was conducted with self-compassion predicting cortisol AUCg. Self-compassion explained a significant proportion of the variability in cortisol AUCg, $R^2_{change} = 0.11$, $F(1,50) = 6.40$, $p = .015$, and the overall model was significant, $R = 0.34$, $p = .015$. The $R^2_{change}$ value of .11 represents a medium effect size and indicates that 11% of the variance in cortisol can be
explained by self-compassion. Specifically, greater self-compassion was associated with less overall cortisol during the COVID-19 pandemic, $\beta = -163.65$, $t(50) = -2.53$, $p = .015$ (see Figure 25).

**Figure 25**

*Associations between Self-Compassion and Total Natural Log Transformed Cortisol Output (AUCg, nMol/l) over 2 Days During the COVID-19 Pandemic*

**Effect of Self-Compassion on Patterns of Cortisol Across Two Days of the COVID-19 Pandemic.**

Natural log transformed values of cortisol across two days during the COVID-19 pandemic are presented in Figure 26. First, in order to assess the basic pattern of cortisol across
the two days, a baseline model without any predictors at Level 2 was run. This model indicated that participants’ average level of cortisol was significantly different from zero at baseline, $B = 1.96, t(52) = 30.75, p < .001$. Levels of cortisol did not significantly increase across the cortisol awakening response, $B = 0.002, t(52) = 0.69, p = .496$. Levels of cortisol significantly decreased across the diurnal cortisol slope, $B = -0.003, t(52) = -23.34, p < .001$.

**Figure 26**

*Natural log transformed Cortisol Values (nMol/l) for All Participants across Four Time Points Averaged across Two Days of the COVID-19 Pandemic*

The only significant covariate was pubertal status, which was added at Level 2 as described above. Level of self-compassion was then added at Level 2 to examine whether individual differences in the change in levels of cortisol across the first two days of high school
were explained by levels of self-compassion. Pubertal status was significantly associated with levels of cortisol at wake, $B = 0.20$, $t(43) = 2.98$, $p = .005$. Self-compassion did not predict levels of cortisol at wake, $B = -0.14$, $t(43) = -1.81$, $p = .078$, the cortisol awakening response, $B = 0.003$, $t(43) = 0.86$, $p = .394$, or the diurnal cortisol slope, $B = -0.002$, $t(43) = -0.82$, $p = .418$. Figure 27 depicts cortisol responses for participants split, for visual purposes, into low and high self-compassion groups using a median split.

**Figure 27**

*Natural Log Transformed Cortisol Levels (nMol/l) for Participants High and Low on Self-Compassion Displayed Using a Median Split*

![Graph showing cortisol responses for participants high and low on self-compassion displayed using a median split.]

**Discussion**

The aim of this chapter was to extend previous work by examining the association between self-compassion and markers of stress in the context of a naturalistic stressor – the
COVID-19 pandemic. I found that, as expected, greater self-compassion was associated with less negative affect across two weeks. Greater self-compassion was also significantly associated with less overall cortisol across two days of the pandemic. Contrary to my expectations, however, self-compassion was not associated with average positive affect, nor was it associated with diurnal patterns of cortisol. These findings provide insight into the degree to which trait self-compassion is associated with markers of stress during a naturalistic stressor in adolescents.

With regard to negative affect, I found that participants with greater self-compassion had significantly lower average negative affect across two weeks of the pandemic. This is consistent with the findings from Chapters 1 and 2 of this dissertation and the only other study to examine the association between naturally occurring self-compassion in everyday life with daily negative affect (Krieger et al., 2015). Taken together, this provides strong support for the idea that self-compassion is associated with lower levels of negative mood. This is important as it may be the mechanism through which higher rates of self-compassion are associated with lower rates of psychopathology. In contrast, it was surprising that while in the expected direction, greater levels of self-compassion were not significantly associated with greater levels of positive affect. This particular finding is inconsistent with findings from Chapters 1 and 2 which showed that greater self-compassion produced both a decrease in negative affect and an increase in positive affect. One reason for this discrepancy may be due to the particularity of the COVID-19 pandemic. It is possible that while self-compassion during a global pandemic was a protective factor for adolescents against the most painful experiences of negative affect, the larger context of societal constriction provided youth with less access to experiences or opportunities that usually bolster or sustain a baseline level of positive affect.
One surprising finding is that greater self-compassion was also significantly associated with less overall cortisol across two days of the pandemic. While I had originally hypothesized that this would be the case for all three chapters, Chapters 1 and 2 did not support this hypothesis. Similarly, a recent study by Ho et al. (2022) conducted in an adult population found no significant effect of self-compassion on diurnal cortisol. The Chapter 3 findings are not a complete outlier, however. An association between self-compassion and total cortisol output across the day in older adults was also found by Herriot et al. (2018). There are possibly developmental reasons that an association was found between self-compassion and cortisol levels in Chapter 3 but not Chapters 1 or 2. Participants were older in Chapter 3, and research has shown that basal cortisol levels, as well as cortisol reactivity to stress, increase with age and pubertal maturation (Gunnar et al., 2009). In line with this, pubertal status was a significant predictor of cortisol levels in Chapter 3. Another possibility is that there was something specific about the pandemic, as it was a different type of stressor, that led to self-compassion having more of an impact on stress responses. The research conducted thus far has produced mixed findings and further research examining the relationship between self-compassion and overall cortisol levels is needed.

Regarding diurnal patterns of cortisol, there was no significant association with self-compassion in Chapter 3. This finding is in line with the same lack of association across 2 days of the transition to high school (Chapter 2) and with the response and recovery patterns to the TSST (Chapter 1). The findings of my dissertation are somewhat in contrast with findings from the two studies that have assessed self-compassion and diurnal cortisol in adult populations (Herriot et al., 2018; Ho et al., 2022). Herriot and colleagues did not test the association of self-compassion on its own with CAR, but found that the interaction between self-compassion and
physical health problems was a significant predictor of CAR (2018). Ho and colleagues found self-compassion did not have any significant direct effects on the diurnal cortisol slope, although it did have an indirect effect through another variable - positive affect (2022). In summary, the research examining self-compassion and patterns of diurnal cortisol is also mixed and merits further investigation. It is important to note that we did not see the expected increase in cortisol levels across the cortisol awakening response, which is well documented in many studies (Chida & Steptoe, 2009). One reason for this may be that, because adolescents in our sample did not have to attend school, many were sleeping in much later than they normally would. This meant that their first sample of the day was taken quite late in the day, sometimes in the early afternoon. Studies have shown that waking later in the day is associated a decreased CAR (Edwards et al., 2003; Kudielka & Kirschbaum, 2003) or with no significant increase in cortisol after awakening (Federenko et al., 2004). It is also important to note that while the CAR has largely been associated with the stress response, there is also evidence that the CAR is influenced by more neutral psychological states of arousal. In fact, Thorn et al. found more evidence to suggest that a greater CAR was linked to feelings of arousal (e.g., alert, active, energetic and stimulated) than feelings of stress (2009). It may be the case that participants higher in self-compassion were experiencing similar levels of arousal as those low in self-compassion (and thus did not differ in the magnitude of their CAR) while also experiencing more positive and less negative affect.

Chapter 3 shares a number of the same limitations as Chapter 2. Namely, the use of the short-form of the SCS did not allow me to examine the six subscale scores representing each of the facets of self-compassion. Future research would benefit from using the full-scale version of the scale for a more in-depth examination of the mechanisms of self-compassion and to determine whether any of the subscales differentially predict outcomes (Neff, 2020). It would
also be meaningful to supplement the self-report assessment using the SCS with multi-informant methods, perhaps having parent’s report on their child’s level of self-compassion. In addition, future research should consider employing the state version of self-compassion scale, as well as the adolescent specific version. Third, future research should assess levels of affect and cortisol across days where youth are not experiencing a stressor prior to assessing the variables during a stressor. Additional limitations of Chapter 3 include a small sample size, particularly for the affect data analyses, and the fact that Chapter 3 was carried out as an impromptu study timepoint in response to the COVID-19 pandemic, and adolescents from our original pool of participants were self-selected. As such, those participants who voluntarily self-selected into the study timepoint may differ from those that did not based on important variables that we did not measure. For example, participants who completed Chapter 3 may have been more conscientious, organized, or interested in psychology and research. They may also have been experiencing a subjectively lower level of stress and felt therefore more able to participate. On the reverse, it is also plausible that those who self-selected may have been feeling more stressed than those that did not, and therefore felt that participation in a stress study may be a valuable contribution or use of their time.

In summary, participants with higher levels of self-compassion had lower average negative affect across 14 days and lower overall cortisol output across 2 days of the COVID-19 pandemic. These findings lend credence to the theory that self-compassion buffers the impact of stress—both affective and biological—in adolescents. In contrast, self-compassion was not associated with individual differences in average levels of positive affect or diurnal patterns of cortisol during the pandemic. Taken together, these findings suggest that the effect of self-
compassion on buffering stress may affect different stress response systems differently, which would explain some of the discrepancies between affective and biological responding.
Conclusion

The strongest findings across chapters support a relationship between self-compassion and negative affect. Findings from all three chapters indicate that greater trait self-compassion is associated with less overall negative affect. There was no evidence that self-compassion was associated with patterns of negative affect in the context of a laboratory stressor or naturalistic stressor. The findings regarding self-compassion and positive affect are more mixed. Greater trait self-compassion was associated with greater overall positive affect in Chapter 1 (TSST) and Chapter 2 (transition to high school), but not in Chapter 3 (COVID-19 pandemic). There was no evidence that self-compassion was associated with patterns of positive affect in the context of a laboratory stressor or naturalistic stressor. Finally, the association between self-compassion and salivary cortisol also garnered mixed support across chapters. Greater trait self-compassion was significantly associated with lower overall cortisol output in Chapter 3 (COVID-19 pandemic), but not in Chapter 1 (TSST) or Chapter 2 (transition to high school). Further, there was no evidence that self-compassion was associated with patterns of cortisol in the context of a laboratory stressor or naturalistic stressor.

It is worth noting that Neff’s Self Compassion Scale, and her conceptualization of self-compassion in general, is not without criticism. Her most vocal critics, Muris and Otgaar, have taken particular issue with Neff’s inclusion of facets that represent uncompassionate self-responding (UCS) - judgement, isolation, overidentification (2020). These scholars have posited that the uncompassionate responding is a separate and unrelated construct to compassionate self-responding (CS) and thus a total self-compassion score should not be used. A main argument of theirs is that the UCS scales relate more strongly to psychopathology than the CS scales which they use as evidence that a total score should not be used (Muris & Otgaar, 2020). However,
Neff’s conceptualization of self-compassion is that of a multidimensional construct. It is natural that some dimensions of the scale predict certain outcomes more strongly than others, if this were not the case, the scale would be unidimensional. Neff and colleagues have provided a litany of empirical evidence to back her conceptualization of self-compassion and the use of the SCS. For example, SCS items form a global factor in psychometric analyses, experimental manipulation of self-compassion does not change state CS items more than state UCS items, and self-compassion training does not change scores on CS items more than UCS items (Neff, 2020).

This research is also subject to all of the limitations inherent to using self-report measures. Self-report data is obtained by asking participants to report on their subjective experiences. By nature, then, this kind of data will inevitably include some discrepancies—one person’s idea of what they mean when they assign a number to a sense of their own self compassion could indeed be quite different from another person’s internal understanding of the same number. What this dissertation is attempting to do, however, is to contribute to a much larger project that is assessing the role of self-compassion in mental well-being. At present, the best we can do is try to understand people’s experience of self-compassion by eliciting their subjective feedback on their internal states. Such states will never be captured in all their nuance on a numbered scale. But the hope is that in aggregate, this data will show meaningful trends and patterns that will indicate whether or not the thing that people are reporting to us as self-compassion is bolstering their resilience and wellness in the face of stress.

The reliability estimates of the SCS-SF varied across chapters, with Cronbach’s alphas of .699 for Chapter 1, .723 for Chapter 2, and .867 for Chapter 3. The SCS-SF data came from the same data collection for Chapters 1 and 2, the difference being that the sample size for Chapter 2 was slightly smaller. For Chapter 3, reliability was stronger, and this may be due to the fact that
participants were older and better able to answer the questions. Still, all reliability estimates are in the acceptable range.

As some of the first work to assess the impact of self-compassion on biological and emotional responses to stress in adolescents, findings from this research contribute to the literature in several unique ways. First, I was able to compare the effects of self-compassion on both affect and cortisol. Most research on self-compassion has focused on emotional markers of stress, and the simultaneous measurement of emotional and biological markers offers numerous advantages that can inform biopsychosocial integrated theoretical models of psychopathology (Calkins et al., 2013) and models of self-compassion (Barnard & Curry, 2011; Neff, 2011). Findings from this dissertation showed a number of discrepancies between affective and biological responding and suggest that the effect of self-compassion on buffering stress may affect different stress response systems differently.

Second, this dissertation is unique in that it examined the effects of self-compassion on stress in both laboratory and naturalistic settings. Each method offers advantages on its own, but the ability to assess both has provided insights into the degree to which responses to laboratory-based stressors reflect responses to stressors in one’s everyday life. While I found some similarities for findings across types of stressors, I also found differences. This dissertation also assessed individuals across an important developmental period.

Third, these findings support the proposition that self-compassion is associated with responses to stress and provide a springboard for future research. The strongest evidence is in support of the relationship between self-compassion and negative affect in response to stress. Specifically, future research should test a full model consistent with the framework proposed by Grant et al. (2005), in which self-compassion moderates the link between stressors and
psychopathology by modulating affective responses to stress. Establishing self-compassion as an important factor associated to individual differences in responses to stress, will justify larger programs of research that include the study of long-term outcomes including the development of psychopathology.

Finally, though research is needed to replicate these findings in other adolescent populations, findings from this dissertation have meaningful clinical implications. The association between self-compassion and negative affect was supported and replicated across both in-lab and at-home settings and suggest that promoting interventions that strengthen self-compassion in adolescence may contribute to emotional wellbeing, making this a worthy endeavor.
References


Scherer, K. R. (2004). Which emotions can be induced by music? What are the underlying mechanisms? And how can we measure them? *Journal of New Music Research, 33*(3), 239-251.


Sumter, S. R., Bokhorst, C. L., Miers, A. C., Van Pelt, J., & Westenberg, P. M. (2010). Age and puberty differences in stress responses during a public speaking task: do adolescents
grow more sensitive to social evaluation? *Psychoneuroendocrinology*, 35(10), 1510-1516.


chemotherapy for ovarian carcinoma. *Journal of the National Cancer Institute, 96,* 1682-1691.


Appendix A: Phone Screen Protocol

DATE: ___________________________ SCREENER: ___________________________

Initial Contact Script

Hi, this is ___________________________, calling from UBC. May I please speak with ___________________________?

[If person is not there: Leave lab phone number, but do not mention that you are calling specifically about the KIDS Study or from the Depression, Anxiety, and Stress Lab.]

I’m calling about the Transition to High School study at UBC that you had expressed interest in. May I take a few minutes to describe our study? [If NO, reschedule]

It is possible that this phone interview will be recorded for training purposes and quality assurance. Only members of our research team will have access to this recording. Are you okay with us recording this interview? [If NO, do not record]

[If not already clear] How did you find out about our study? ___________________________

[If relevant] Where was the advertisement posted? ___________________________

Great! We really appreciate your interest in helping our research. Our study is a project in the Department of Psychology at UBC. We are interested in how adolescents cope with the transition to high school. Our main goal is to gain a better understanding of the factors that may help some adolescents cope better with stress than others during this transition.

To see if you and your child are eligible for this study, we would first conduct a short phone interview. This should take 5-10 minutes. If you and your child meet our eligibility criteria, we will invite both of you to come to UBC to complete the study. The first part will consist of two laboratory sessions at UBC where we will confirm eligibility criteria and your family would be offered a $30 honorarium at the end of each session. If you are eligible to participate in the remainder of the study, you will then be invited to complete 3 additional sessions, 2 of which will be completed at home when your child starts Grade 8 and 3 months later, and 1 of which will be completed at UBC 9 months after your child starts Grade 8. Your family would be offered a $70 honorarium for completing all follow-up sessions, which could be prorated if you decide to only complete some portions of it.

For sessions conducted here at UBC, you and your child will separately complete computer tasks, and interviews and questionnaires about your child’s feelings, behaviours, thoughts, and experiences. For sessions completed at home, your child will complete questionnaires on these same topics and will provide 8 saliva samples over 2 days in order to measure the hormone cortisol.

In this interview, and in the study, you do not have to answer anything you do not want to and you have the right to withdraw from the study at any time. You should know that this study is being conducted by Dr. Joelle LeMoult at the University of British Columbia. The final decision about participation is yours. All of the information you provide—during the phone interview as well as during the in-person study—will be kept strictly confidential with two exceptions: if I have reason to believe that you are at serious and imminent risk to harm yourself or others, or if I have reason to believe that a child or elderly individual is at risk of being harmed, I may need to break confidentiality to keep you or others safe.
If you have any questions, concerns, or complaints about this study, you can let us know at any time and we will provide you contact information for the principal investigator as well as the UBC ethics board which is separate from our research team.

[If participant asks who will have access to their information] Only researchers belonging to our lab, each of whom have completed training in the principles of confidentiality, will have access to your information.

Would you be interested in finding out whether you and your child qualify for our study?
If yes: Great. Do you have time right now for our phone interview? It will take 5-10 minutes. [If yes: go to p 2.]
If no: Is there a good time for someone to call you to talk for 5-10 minutes?

Phone Screen

Thank you so much! The brief interview you are about to begin will be used solely for the purpose of determining if you and your child are a good fit for this study. You don’t have to answer anything you don’t want to.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Eligibility Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DEMOGRAPHICS AND MEDICAL HISTORY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is your child’s date of birth?</td>
<td>/</td>
<td></td>
</tr>
<tr>
<td>What grade is your child currently in? [OR if it is Summer: What grade is your child entering this September?]</td>
<td></td>
<td>In Grade 7, or going into Grade 8</td>
</tr>
<tr>
<td>Will your child be changing to a new school for Grade 8?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Yes or No – eligible either way but note down if not transitioning to new school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What was your child’s sex assigned at birth?</td>
<td>MALE</td>
<td>FEMALE</td>
</tr>
<tr>
<td>Is your child a native English speaker?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Native English speaker [or able to comfortably communicate in English]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you a native English Speaker?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Native English speaker [or able to comfortably communicate in English]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have any definite plans to move away from the Vancouver Area in the next year?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>If YES and move will interfere with scheduling participant for 6-month follow-up, INELIGIBLE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>------</td>
<td>-----</td>
</tr>
<tr>
<td>Is your child color-blind?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Does your child wear glasses?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Has your child ever been diagnosed with any learning disabilities, such as ADHD or Dyslexia?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Has your child ever received an injury or trauma to their head?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Has your child ever been diagnosed with any neurological disorder, such as Huntington's Disease or Parkinson's Disease?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Has your child ever been diagnosed with an endocrine disorder such as Addison’s Disease or Cushing’s Disease?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Does your child have a diagnosis of hypo/hyperthyroidism?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Does your child have a diagnosis of high blood pressure, hypertension, or cardiovascular disease?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Has your child ever had a stroke, hemorrhage, or brain tumour?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Has your child ever had brain/neural surgery or brain radiation treatment (e.g. for brain tumour)?</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Has your child ever had a seizure or received a diagnosis of epilepsy?</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>
### SUBSTANCE/ ALCOHOL USE & TREATMENT

<table>
<thead>
<tr>
<th>Question</th>
<th>YES</th>
<th>NO</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does your child drink alcohol?</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td><strong>If YES:</strong> How much alcohol would you say your child drinks on average, per week?</td>
<td>Estimated amount:</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>If YES:</strong> In the past six months, has your child ever had five or more drinks on one occasion?</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td><strong>If YES:</strong> Has their drinking cause problems for them or have other people comment on it?</td>
<td>YES</td>
<td>NO</td>
<td>If endorse symptoms of current substance abuse, INELIGIBLE</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the past six months has your child become dependent on a prescription medication?</td>
<td>YES</td>
<td>NO</td>
<td>If endorse symptoms of current substance abuse, INELIGIBLE</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is your child currently in treatment for the misuse of any substances (e.g., alcohol)?</td>
<td>YES</td>
<td>NO</td>
<td>If endorse symptoms of current substance abuse, INELIGIBLE</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has your child received treatment for the misuse of alcohol or substances in the past?</td>
<td>YES</td>
<td>NO</td>
<td>If endorse symptoms of current substance abuse, INELIGIBLE</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### PSYCHOTIC SYMPTOMS

Now I am going to ask you about some strange or unusual experiences people sometimes have. Has your child ever:

<table>
<thead>
<tr>
<th>Question</th>
<th>YES</th>
<th>NO</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Indicated that it seemed like people were talking about them or taking special notice of them?</td>
<td>YES</td>
<td>NO</td>
<td>Determine with further questioning if the parent expresses that their child has ever had psychotic symptoms.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>2. Indicated that they saw or heard things that other people didn’t notice?</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Details:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Indicated that they heard conversations when no one was around or received special messages?</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Details:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Indicated that they felt that other people were going out of their way to test or hurt them so that they felt that they had to be on guard constantly?</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Details:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Indicated that they believed they had special powers?</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Details:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We would not exclude if the symptoms happened just once, unless it lasted several days or more.

### MANIC SYMPTOMS

<table>
<thead>
<tr>
<th>MANIA</th>
<th>Has your child ever experienced a period of several days or more when they were feeling so good, “high,” hyper, or excited that other people thought they were not their normal self? Did anyone say they were manic? Was that more than feeling good?</th>
<th></th>
<th></th>
<th>A distinct period of abnormally and persistently elevated, expansive, or irritable mood and abnormally and persistently increased goal-directed activity or energy, lasting at least 1 week and present most of the day, nearly every</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>NO</td>
<td>Details:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IRRITABLE MANIA</td>
<td>If NO: What about a period of time when they were so irritable that they were shouting at people or starting fights or arguments? (What about with people they didn’t really know?)</td>
<td>YES</td>
<td>NO</td>
<td>day (or any duration if hospitalization is necessary). If YES to either, check how long it lasted.</td>
</tr>
<tr>
<td>DURATION</td>
<td>If YES for EITHER of above: How long did it last? Did it require hospitalization?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If endorse either mania or irritable mania **for more than 4 days**- CONTINUE

| SELF-ESTEEM | How would you say they felt about themselves at the time? Did they seem more self-confident than usual? | YES | NO | During the period of mood disturbance and increased energy or activity, three or more of the following symptoms (four if mood is only irritable) are present to a significant degree and represent a noticeable change from usual behaviour. If criteria is met for a Hypomanic or Manic Episode, INELIGIBLE. |
| ACTIVITY/RESTLESSNESS | How did they spend their time? Were they physically restless? | YES | NO |
| SLEEP | Did they need less sleep than usual? Did they seem restless after few hours of sleep? | YES | NO |
| TALKATIVE | Were they much more talkative than usual? | YES | NO |
| RACING THOUGHTS | Did they say that their thoughts were racing? | YES | NO |
| DISTRACTION | Were they easily distracted? | YES | NO |
| IMPAIRMENT | At that time, did they have serious problems at home or at school because they were (hyper/irritable)? | YES | NO | Sufficiently severe to cause marked impairment in social/school functioning or hospitalization |

FINISHING THE INTERVIEW:

**If the participant is not eligible, say:**

Thank you very much for your time and for answering these questions. I am just looking over the interview now, and unfortunately it looks as though your child is not going to be eligible for this particular study, but we really appreciate your time. If, however, you are interested in research in general,
we would love to keep your name and number for future studies done here at UBC. Would that be okay with you?

**If participant wants more information about why they are not eligible:**

Explain that there is not any ONE thing that makes them ineligible. Say that we are looking for very specific profiles across a host of different criteria and unfortunately their profile is not a match with any of the detailed profiles that we are looking for.

*Do not give out any specific information about what makes them (or anyone) eligible or ineligible.*

**If they are not satisfied, you can always tell them that you will refer them to your supervisors.**

**In unclear cases, or until you are able to determine eligibility independently,** say:

I want to thank you very much for your time and for answering all of these questions. I will have my supervisor go over this interview, and then I will give you a call in the next week to let you know whether or not you and your child are eligible for this particular study.

**For qualifying participants, say:**

Thank you very much for answering all of these questions. I would like to invite you and your child to come to UBC to participate in more detailed interviews. Is it okay if someone contacts you soon to schedule your first session?

If participant would like to call back, give them our phone number.

**Note—For any participants who may be interested in seeking treatment or who appear distressed, give them appropriate referrals from referral list.**
Appendix B: Self-Compassion Scale – Short Form

HOW I TYPICALLY ACT TOWARDS MYSELF IN DIFFICULT TIMES

Please read each statement carefully before answering. To the left of each item, indicate how often you behave in the stated manner, using the following scale:

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Almost never</td>
</tr>
<tr>
<td>2</td>
<td>Almost never</td>
</tr>
<tr>
<td>3</td>
<td>Almost 2/3</td>
</tr>
<tr>
<td>4</td>
<td>Almost always</td>
</tr>
<tr>
<td>5</td>
<td>Always</td>
</tr>
</tbody>
</table>

1. When I fail at something important to me I become consumed by feelings of inadequacy.
2. I try to be understanding and patient towards those aspects of my personality I don’t like.
3. When something painful happens I try to take a balanced view of the situation.
4. When I’m feeling down, I tend to feel like most other people are probably happier than I am.
5. I try to see my failings as part of the human condition.
6. When I’m going through a very hard time, I give myself the caring and tenderness I need.
7. When something upsets me I try to keep my emotions in balance.
8. When I fail at something that’s important to me, I tend to feel alone in my failure.
9. When I’m feeling down I tend to obsess and fixate on everything that’s wrong.
10. When I feel inadequate in some way, I try to remind myself that feelings of inadequacy are shared by most people.
11. I’m disapproving and judgmental about my own flaws and inadequacies.
12. I’m intolerant and impatient towards those aspects of my personality I don’t like.
Appendix C: TSST-C Verbal Task Instructions

To be read to child by experimenter.

In 5 minutes, you will be asked to finish telling the story below, and will do so in front of a committee of judges. You should make the story as exciting as possible, and you should try to perform better than all the other children your age.

“Yesterday my best friend Robert and I went home from school. Suddenly, we had the idea to visit Mr. Greg who lived in the big old house located in the dark forest near our town. Mr. Greg was a crazy old man and our parents didn't like the idea that we sometimes went visiting him. There was a rumor in town that there was a mystery about the old house. When we arrived at the house we were surprised that the door was open. Suddenly we heard a strange noise and cautiously, we entered the dark hall...".

You have 5 minutes to prepare your story. You can take notes on this sheet as you prepare, however you will not be able to use your notes during your speech. Please do your best.
Appendix D: TSST-C Math Task Instructions

*To be read to child by committee member.*

“Please count back from 1023 by 13s as fast and as accurately as possible. If you make a mistake, you will have to start again at 1023”.
Appendix E: Positive and Negative Affect Scale

This scale consists of a number of words that describe different feelings and emotions. Read each item and then select the appropriate answer next to that word. Indicate to what extent you feel this way right now.

<table>
<thead>
<tr>
<th></th>
<th>1 = Very slighty</th>
<th>2 = A little</th>
<th>3 = Moderately</th>
<th>4 = Quite a Bit</th>
<th>5 = Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Stressed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Excited</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Upset</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Proud</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Nervous</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Calm</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Ashamed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Appendix F: Demographic Questionnaire

Please complete the following questionnaire. If you are uncomfortable answering any of the questions, you may leave them blank.

1. What is your birthdate? (MM/DD/YYYY)  

2. What is your biological sex?  □ Female  □ Male  □ Intersex

3. What is your gender?  □ Girl  □ Boy  □ Non-binary, please specify your gender identity:

4. What grade are you in?  □ 6th Grade  □ 7th Grade
   □ 8th Grade  □ 9th Grade

5. What is your primary language?

6. What is your ethnic background?  □ Aboriginal (i.e. First Nations, Métis, Inuit)  □ Latin American/Hispanic
   □ African  □ South Asian (i.e. Indian, Pakistani, Sri Lankan)
   □ Arabic  □ Southeast Asian (i.e. Vietnamese, Cambodian, Malaysian, Laotian)
   □ Chinese  □ West Asian (e.g. Iranian, Afghan)
   □ European-Canadian  □ Other (please specify): __________________
   □ Filipino  □ Don’t know
   □ Japanese  □ Prefer not to answer
   □ Korean

7. Do you take any medication on a daily basis? If yes, please provide the reason for taking, name of medication and dose.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Name</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8. Have you ever taken medication for an emotional or psychiatric problem? If yes, please provide the name, dose, and dates during which the medication was taken.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose</th>
<th>Dates taken</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. Have you ever had any type of psychological treatment or assessment? If yes, please provide the type and results of the treatment/assessment.

<table>
<thead>
<tr>
<th>Type</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix G: Tanner Staging Questionnaire

The following two pages contain drawings of girls at different stages of development of breasts and pubic hair.

This information will be kept strictly confidential. No one other than the researchers of the Depression, Anxiety, and Stress Lab at the University of British Columbia will see these sheets.
1. There is no pubic hair.
2. There is a little long, lightly colored hair. This hair may be straight or a little curly.
3. The hair is darker in this stage. It is coarser and more curled. It has spread out and thinly covers a larger area.
4. The hair is now as dark, curly, and coarse as that of an adult female. However, the area that the hair covers is not as large as that of an adult female. The hair has not spread out to the thighs.
5. The hair is now like that of an adult female. It also covers the same area as that of an adult female. The hair usually forms a triangular pattern as it spreads out to the thighs.
<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Stage 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>The nipple is raised a little in this stage. The rest of the breast is still not raised.</td>
<td>This is the breast bud stage. In this stage the nipple is raised more than in Stage 1. The breast is a small mount. The areola is larger than in Stage 1.</td>
<td>The areola and the breast are both larger than in Stage 2. The areola does not stick out away from the breast.</td>
<td>The areola and the nipple make up a mount that sticks above the shape of the breast. (Note: this stage may not happen at all for some girls. Some girls develop from Stage 3 to Stage 5 with no Stage 4).</td>
<td>This is the mature adult stage. The breasts are fully developed. Only the nipple sticks out in this stage. The areola has moved back to the general shape of the breast.</td>
</tr>
</tbody>
</table>
The following two pages contain drawings of boys at different stages of development of genitals and pubic hair.

This information will be kept strictly confidential. No one other than the researchers of the Depression, Anxiety, and Stress Lab at the University of British Columbia will see these sheets.
The drawings on this page show different amounts of pubic hair. A boy passes through each of the five stages shown by these drawings.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>There is no pubic hair at all.</td>
</tr>
<tr>
<td>2.</td>
<td>There is a little soft, long, lightly colored hair. Most of the hair is at the base of the penis. This hair may be straight or a little curly.</td>
</tr>
<tr>
<td>3.</td>
<td>The hair is darker in this stage. It is coarser and more curled. It has spread out and thinly covers a somewhat larger area.</td>
</tr>
<tr>
<td>4.</td>
<td>The hair is now as dark, curly, and coarse as that of an adult male. However, the area that the hair covers is not as large as that of an adult male. The hair is not spread out to the thighs.</td>
</tr>
<tr>
<td>5.</td>
<td>The hair has spread out to the thighs. The hair is now like that of an adult male. It covers the same area as that of an adult male.</td>
</tr>
</tbody>
</table>
The drawings of this page show different stages of development of the testes, scrotum, and penis. A boy passes through each of the five stages shown by these drawings.

1. The testes, scrotum and penis are about the same size and shape as they were when you were a child.

2. The testes and scrotum have gotten a little larger; the skin of the scrotum has changed; the scrotum, the sack holding the testes, has lowered a little bit. The penis has gotten only a little larger.

3. The penis has grown mainly in length. The testes and scrotum have grown and dropped lower than in Stage 2.

4. The penis has grown even larger. It is wider. The glans (the head of the penis) is bigger. The scrotum is darker than before. It is bigger because the testes have gotten bigger.

5. The penis, scrotum, and testes are the size and shape of that of an adult.
Appendix H: Health Questionnaire

Please answer the following questions. We know that some of the questions may not be relevant to you, but we need to ask them of everybody. Please remember that you may skip any question you do not wish to answer, and that all of your answers are kept secret.

Are you currently diagnosed with asthma?
Yes
No
If yes, do you take any form of asthma medication?
Yes
No
If yes, what type(s)?

Do you have any allergies?
Yes
No
If yes, please list:

Are you taking any medication to control these allergies?
Yes
No
If yes, please list:

Do you have gum disease, canker sores, or other types of infection(s) in your mouth?
Yes
No
If yes, please specify:

Do you currently have any other health conditions, illnesses, or diseases?
Yes
No
If yes, please list all:

Have you EVER had any other health conditions, illnesses, or diseases?
Yes
No
If yes, please list all conditions and dates:
Have you had any form of caffeine (e.g. tea, coffee) in the last two hours?
Yes
No
What kind?

How much caffeine did you have?
How long ago did you have the caffeine?

Have you smoked or taken nicotine in any form in the past two hours?
Yes
No
What kind?

How much?
How long ago?

Have you had anything to drink in the past two hours?
Yes
No
What did you drink, and how much did you have?

How long ago did you have something to drink?

Have you exercised in the past two hours?
Yes
No
What kind of exercise?

How much exercise?
How long ago did you exercise?

Have you had anything to eat in the past two hours?
Yes
No
What did you eat?
How much did you eat?

How long ago did you eat?

When was the last time you brushed your teeth?