THE ROLE OF SELF-COMPASSION IN THE RELATIONSHIPS AMONG PERSONALITY TRAITS, HEALTH BEHAVIORS, AND DAILY MOOD

by

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DEDICATION

This dissertation is dedicated to my mother, Cristina Lameira, who has always inspired me to be inquisitive and without whom, I would not have had the courage to embark on this journey.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF EQUATIONS

ABSTRACT

THE ROLE OF SELF-COMPASSION IN THE RELATIONSHIPS AMONG PERSONALITY TRAITS, HEALTH BEHAVIORS, AND DAILY MOOD

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Two studies examined the daily and longitudinal interrelationships among personality traits, self-compassion, sleep quality, positive and negative mood, and exercise. One-hundred-three college students completed a pre-test, daily reports for 8 days, and two follow-up surveys two weeks apart. Study 1 examined trait self-compassion as a mediator of the relationship between personality traits and health behaviors and perceptions. There were significant indirect relationships through trait self-compassion, specifically from extraversion to sleep quality cross-sectionally and from extraversion and neuroticism to exercise satisfaction longitudinally. Neuroticism was negatively related to vigorous exercise longitudinally while both neuroticism and extraversion were positively related to moderate exercise cross-sectionally. Study 2 examined daily self-compassion as a moderator of the relationship between health behaviors and mood. Self-reported moderate and vigorous exercise were related to more evening positive mood.

Additionally, self-reported sleep satisfaction and duration were related to more positive mood and less negative mood the next morning. Daily self-compassion was a moderator of the relationship between self-reported moderate and vigorous exercise and evening negative mood, such that individuals who were lower in their personal average of self-compassion showed the greatest mood improvements following moderate and vigorous exercise while individuals who were high in their personal average of self-compassion showed increases in negative mood as they engaged in more intense exercise. Nonetheless, individuals who were high in their personal average of self-compassion showed the lowest negative mood. The results suggest that it may be particularly helpful for college students who experience daily high negative mood and who are high on neuroticism, to increase self-compassion. Practicing daily self-compassion could help improve daily mood, and overtime, increase exercise satisfaction and improve sleep quality.

CHAPTER ONE: INTRODUCTION

Over the past decade, the percentage of college students with mental health diagnoses increased from 22% in 2007 to 36% in 2017 (Lattie, Lipson, & Eisenberg, 2019). College students face many challenges including pressure to succeed, difficulty making new friends, and worries about post-graduation plans (Beiter et al., 2015; Buote et al., 2007). Non-traditional college students often are employed full-time, older, and have dependents outside of their spouse (Arnett, 2000). In these contexts, college students may experience the persistence, exacerbation, or first onset of mental health problems. Thus, it may benefit students to identify ways to increase their psychological well-being.

Psychological well-being is a multi-dimensional construct that has two important facets: "hedonic" well-being and "eudaimonic" well-being (e.g., Diener, 1984; Lyubomirsky & Lepper, 1999; Ryff, 1989). Hedonic well-being encompasses the experience of more positive affect and less negative affect. Both positive and negative affect are valid indicators and predictors of depression and anxiety (Clark & Watson, 1991; Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008; Lee & Rebok, 2002). Thus, they may be potential targets for prevention of these psychological disorders (Lyubomirsky, King, & Diener, 2005; Mayer & Gaschke, 1988). Among college students, adequate sleep and physical activity are the strongest predictors of hedonic well-being (Lund, Reider,

Whiting, & Prichard, 2010; Ridner et al., 2016). Exercise increases serotonin and norepinephrine, which boost mood (Meeusen & De Meirleir, 1995). Sleep helps regulate daily emotions and behaviors, and facilitates optimal mental health (Dahl & Lewin, 2002).

Over the last decade, day-level studies have evaluated the temporal precedence of exercise, sleep, and affect to help provide insight into how sleep and exercise may lead to vulnerability of psychological disorders or protect against their development. Various studies have found a bi-directional relationship between exercise and positive affect on a daily level (Schöndube, Kanning, & Fuchs, 2016; Schwerdtfeger, Eberhardt, Chmiortz, & Schaller, 2010) in addition to positive affect and sleep (Konjarski, Murray, Lee, & Jackson, 2018). However, these daily findings for exercise, sleep and affect have been inconsistent (Konjarski et al., 2018; Liao, Shonkoff, & Dunton, 2015), suggesting the need for further research into possible third variables that may strengthen their relationships.

While affect, exercise, and sleep can vary on a daily level, an individual's personality traits are a key stable factor that influence health behaviors (e.g., Smith, 2006). Extraversion, conscientiousness, and neuroticism are the traits with the strongest relationships with physical activity and sleep quality (Rhodes & Smith, 2006; Stephan, Sutin, Bayard, Krizan, & Terracciano, 2018; Wilson & Dishman, 2015). However, the process by which this occurs is not well understood. Having a better understanding of the potential mediators of the relationship between personality traits and health behaviors can

inform interventions for college students that could set them on a long-term path to health.

For my dissertation, I will address the limitations of current research in two studies with undergraduate George Mason University students. I will test self-compassion as a third variable that can explain the relationship between personality traits and health behaviors (study 1) and improve the relationships between daily health behaviors and affect (study 2). Self-compassion involves "being kind to oneself (self-kindness); perceiving one's experiences as part of the larger human experience (common humanity); and holding painful thoughts and feelings in balanced awareness'' (mindfulness; Neff, 2003a, p. 85). Self-compassion is associated with increases in psychological well-being (Zessin, Dickhauser, & Garbade, 2015), exercise (Magnus, Kowalski, & McHugh, 2010), and sleep quality (Butz & Stahlberg, 2018) among college students. If trait self-compassion helps explain the relationship between personality traits and health behaviors, and daily self-compassion enhances daily well-being, this would demonstrate the importance of practicing daily self-compassion to improve daily mood, and over time, help increase long-term adherence of health behaviors.

CHAPTER TWO: DOES SELF-COMPASSION HELP EXPLAIN THE RELATIONSHIP BETWEEN PERSONALITY TRAITS AND HEALTH BEHAVIORS AND PERCEPTIONS?

It is well-documented that personality traits influence exercise participation and sleep quality (Rhodes & Smith, 2006; Stephan et al., 2018; Wilson & Dishman, 2015). Most of the research on personality and health behaviors has used the Five Factor Model of personality (Costa & McCrae, 1992) which states that there are five broad and relatively stable personality traits: neuroticism (e.g., anxious and insecure), extraversion (e.g., sociable and fun-loving), agreeableness (e.g., kind and sympathetic), openness to experience (e.g., curious and open-minded), and conscientiousness (e.g., self-disciplined and achievement-seeking). According to meta-analyses of cross-sectional and prospective/longitudinal studies that include college students, extraversion, conscientiousness, and neuroticism are the strongest correlates of physical activity and sleep quality (Rhodes & Smith, 2006; Stephan et al., 2018; Wilson & Dishman, 2015).

Relationship Between Personality Traits and Exercise

Conscientiousness and extraversion independently have positive associations with physical activity (Rhodes & Smith, 2006; Wilson & Dishman, 2015). High extraversion has the strongest negative association with inactivity (Sutin et al., 2016). For every standard deviation increase in extraversion, there was nearly a 30% reduced risk of being inactive (Sutin et al., 2016). Similarly, a 40-year longitudinal trial that followed children into adulthood showed that higher extraversion and lower neuroticism were related to higher levels of physical activity at age 29 (Kern, Reynolds, & Friedman, 2010).

Individuals who are high in extraversion engage in more sensation-seeking which may prompt them to try different types of physical activity (Whiteside & Lynam, 2001). They may participate in more intense and vigorous exercise than mild or moderate exercise given their high energy levels and tendency to keep busy (Costa & McCrae, 1992; Wilson & Dishman, 2015). Additionally, conscientious individuals are characterized as disciplined and deliberate, which facilitates following through on exercise plans (Bogg & Roberts, 2004). In contrast, individuals who are high on neuroticism tend to be unhappy, worried, and self-conscious (Wilson & Dishman, 2015). Thus, they may be more concerned about what others think about their appearance which may inhibit their physically activity.

Personality traits also influence individuals' perceptions about exercise, specifically how satisfied they feel with their exercise. Experiencing satisfaction involves experiencing joy and pleasure during a behavior (Dacey et al., 2008). When an individual is not satisfied with a behavior, it may lead to boredom, disinterest, and drop-out (Teixeira et al., 2018). Extraversion is the best predictor of sports satisfaction which in turn, contributes to overall life satisfaction (Baudin, Aluja, Rolland, & Blanch, 2011). Individuals who are extraverted are sensitive to rewards and more attuned to aspects of their environment that make them happy (Smillie, Wilt, Kabbani, Garratt, & Revelle, 2015), which likely helps promote satisfaction with exercise. Less is known about how conscientiousness and neuroticism influence satisfaction with exercise. Conscientiousness could predict increased exercise satisfaction if individuals tend to feel

a sense of personal accomplishment when completing goals while neuroticism could predict decreased exercise satisfaction if individuals tend to experience negative mood.

Relationship Between Personality Traits and Sleep

Like physical activity, traits of extraversion, conscientiousness, and neuroticism have the strongest relationships to sleep quality (Stephan et al., 2018). In a recent meta-analysis of concurrent and longitudinal associations between personality traits and sleep with over 22,000 adults, neuroticism was most consistently associated with sleep difficulties concurrently and with larger declines in sleep quality at follow-up over 4-10 years. Higher extraversion was related to better sleep quality at baseline and fewer sleeping difficulties over time. Higher conscientiousness was related to better sleep quality at baseline while low conscientiousness was associated with a worsening of sleep quality over time. Like this meta-analysis, a study with college students showed that low conscientiousness and high neuroticism were the best predictors of poor sleep (Duggan, Friedman, McDevitt, & Mednick, 2014). In fact, high neuroticism and low conscientiousness explained approximately 19% of the variance in sleep quality. Overall, these studies suggest that high extraversion and conscientiousness are related to better sleep quality while high neuroticism and low conscientiousness are strong predictors of poor sleep quality.

Researchers have offered insights into how neuroticism, extraversion, and conscientiousness relate to sleep quality and duration. Individuals who are high in neuroticism tend to experience distress and anxiety and have difficulty shutting off thoughts, which may lead to insomnia (Espie, Inglis, Tessier, & Harvey, 2001).

Relatedly, neuroticism is associated with higher stress sensitivity (Friedman & Kern, 2014; Leger, Charles, Turiano, & D'Almeida, 2016), which can disrupt sleep quality. In contrast, extraverted and conscientious individuals have lower reactivity to stressors (Leger et al., 2016), which may lead to better sleep quality.

Possible Mediators of the Relationship Between Personality Traits and Health Behaviors and Perceptions

While previous studies have found that personality traits influence physical activity and sleep, the process by which this occurs is not well understood. Identification and understanding of the mediators of these relationships may lead to more effective interventions to help college students gain long-term health.

Affect is a possible mediator of the relationship between physical activity and sleep. In one study, affect mediated the relationship between personality traits and sleep difficulties such that individuals who were higher in neuroticism experienced more negative affect, which led to poorer sleep quality (Allen, Magee, & Vella, 2016). In contrast, extraversion was associated with experiencing more positive affect, which then led to better sleep quality. However, given that affect is a broad construct and could be enhanced with different interventions, this does not explain how the possible mediating factors between personality traits and sleep quality work.

Additionally, a meta-analysis examined mediators of the relationship between personality and physical activity using the theory of planned behavior (Ajzen, 1991). According to this theory, intentions precede behavior. Intentions are determined by attitude (overall assessment of the behavior), subjective norms (perceived social pressure

to complete the behavior), and behavioral control (perceived capability to conduct the behavior). A meta-analysis by Rhodes and Pfaeffli (2012), however, only found that these constructs were mediators in 2 out of 17 studies on personality and physical activity. Thus, it appears that intentions do not provide a satisfying explanation for the relationship between personality traits and physical activity. It may be that individuals intend to engage in health behaviors, but their efforts are disrupted by negative reactions to minor failures toward attaining health goals (e.g., Sirois, & Giguère, 2013).

Self-Compassion as a Mediator of the Relationship Between Personality Traits and Health Behaviors and Perceptions

Research has highlighted the role of self-compassion, defined as taking a kind and compassionate view of oneself, for predicting health behaviors (Neff, 2003a; Sirois, Kitner, & Hirsch, 2015). A meta-analysis that included 15 undergraduate and community adult samples and more than 3,000 participants found that individuals high in self-compassion reported more frequent practice of health promoting behaviors (average r = .25) including regular exercise and healthy sleep hygiene with low variability across these associations (Sirois, Kitner, & Hirsch, 2015). This suggests that college students who develop self-compassion may increase their participation in exercise and gain adequate sleep.

Self-compassion involves using adaptive emotion regulation strategies, such as acceptance and positive reappraisal (Finlay-Jones, 2017), which may explain how self-compassion can increase health behaviors. Cognitive reappraisal is reframing a situation to change the way one responds (Gross, 1998) while acceptance is becoming aware of

one's emotions without evaluating them (Linehan et al., 2006). These emotion regulation strategies make it less likely that individuals engage in activities that delay bedtime (e.g., watch TV; Sirois, Nauts, & Molnar, 2019). In turn, people feel more rested and sleep longer (Kroese et al., 2014). By contrast, individuals who do not use adaptive emotion regulation strategies will delay bedtime in order to repair their mood (Sirois, Nauts, & Molnar, 2019). In turn, they do not receive adequate sleep and wake up fatigued (Reinecke. Hartman, & Eden, 2014). Over time, this cycle can make people feel worse and increase the need for more short-term mood repair. These findings suggest the importance of self-compassion in adaptive emotion regulation, which in turn, helps predict longer and more restful sleep.

Self-compassion appears more beneficial for improving mood than the use of emotion regulation skills alone (Ehret, Joorman, & Berking, 2018). In an experimental study with both depressed and non-depressed individuals, self-compassion helped reduce negative mood above and beyond the use of acceptance and reappraisal skills. Negative affect could make it more difficult for individuals to practice acceptance and cognitive reappraisal (e.g., having positive thoughts). In contrast, the components of self-compassion that focus on responses to one's pain and suffering helps individuals learn to self-soothe and reduces sympathetic nervous system activity (Arch et al., 2014). Thus, compared to other adaptive emotion regulation techniques, one can more easily use self-compassion to reduce negative emotions given its self-soothing properties.

Self-compassion increases participation in exercise (see Sirois et al., 2015 for a meta-analysis). Self-compassionate individuals may respond to exercise setbacks with

self-kindness and acknowledge that others also have setbacks with health goals (Homan & Sirois, 2017), which may protect against feeling intense guilt or frustration. Ultimately, self-compassionate people are less afraid of failure and more willing to take on new challenges (Neff, Hsieh, & Dejitterat, 2005). Self-compassionate individuals who miss a workout one day are more likely to continue exercising on other days than others who are self-critical about missing a workout and immersed in negative feelings (Adams & Leary, 2007).

In addition to responding to setbacks in a more adaptive manner, self-compassion helps increase intrinsic motivation for exercise. Self-compassionate exercisers are kind to their bodies and selves (Terry & Leary, 2011), and are more likely to do mindful exercise where they attend to their physical movements and sensations (Horan & Taylor, 2018; La Forge, 2005). On the other hand, non-compassionate exercisers focus on improving their appearance during exercise (Magnus, Kowalski, & McHugh, 2010). Self-compassionate individuals may perceive their exercise positively because of their internal motivation (e.g., to increase energy and improve health) whereas non-compassionate individuals may criticize how much exercise they do because of their desire for external rewards (e.g., to lose weight).

Most studies focus on self-compassion as a dispositional quality that influences health behaviors. However, some studies show that people can increase and maintain self-compassion with simple interventions (e.g., Neff & Germer, 2013), such as mindfulness meditation, practicing self-compassionate phrases, and writing a letter to oneself from the perspective of a compassionate friend. After completing self-

compassion interventions, adults have shown an increase in self-reported physical activity (d = 0.55; Horan & Taylor, 2018) and subjective sleep quality (Hedges' g = 0.48; Butz & Stahlberg, 2020). This suggests that self-compassion may help college students to improve sleep, increase exercise, and boost satisfaction with exercise.

Some research shows different relationships between personality traits and self-compassion. Self-compassion has a negative relationship with neuroticism, and positive relationships with extraversion and conscientiousness (Neff, Rude, & Kirkpatrick, 2007). Conscientiousness and extraversion are correlated with seeking support, positive reinterpretation, and growth and acceptance, which are similar to the positive components of self-compassion (common humanity, self-kindness, and mindfulness; Afshar et al., 2015). In contrast, neuroticism is negatively related to seeking support, positive reinterpretation and growth and acceptance which is like the negative components of self-compassion (isolation, self-judgment, and over-identification). Though the negative components of self-compassion overlap with neuroticism (Pfattheicher, Geiger, Hartung, Weiss, & Schindler, 2017), self-compassion is distinct from neuroticism in predicting life satisfaction and other well-being outcomes (Neff, Toth-Kiraly, & Colosimo, 2018). This supports examining neuroticism and self-compassion as two separate constructs.

Given self-compassion's relationships with personality traits and health behaviors, it is possible that it mediates the relationships between personality traits and health behaviors and perceptions. Individuals who are more conscientious and extraverted likely exhibit higher levels of self-compassion which may aid in their ability to obtain adequate sleep and satisfying exercise. However, individuals who are high in

neuroticism likely exhibit lower levels of self-compassion which results in physical inactivity and sleep difficulties.

To my knowledge, no study has examined self-compassion as a mediator of the relationship between personality traits and health behaviors. Thus far, research has found that self-compassion partially mediates the relationship between maladaptive perfectionism and depressive symptoms in college students, such that higher levels of maladaptive perfectionism are related to lower levels of self-compassion, which in turn, are related to more depressive symptoms (Mehr & Adams, 2016). Maladaptive perfectionism is like neuroticism in that it involves a tendency to worry about failures. The researchers concluded that increases in self-compassion could buffer the influence of students' maladaptive perfectionism on depressive symptoms. Self-compassion may also buffer the negative effects of maladaptive personality traits on health behaviors and perceptions.

The Current Study

While previous research has found that self-compassion partially mediates the relationship between maladaptive perfectionism and depressive symptoms (Mehr & Adams, 2016), no study has tested whether self-compassion mediates the relationship between personality traits and health behaviors (including exercise and sleep). If there is evidence of this mediating relationship, it may suggest that one should tailor self-compassion and health interventions to college students' personality traits.

The current study measured the predictor variable (personality traits) on day 1, the mediator (self-compassion) on day 15, and the outcomes (exercise and sleep) on day 29. The following hypotheses were tested:

Hypothesis 1. Those who are high on conscientiousness and extraversion on day 1 will independently report greater physical activity, increased satisfaction with exercise, and improved sleep quality on day 29. Those who are high on neuroticism will report less physical activity, less satisfaction with exercise, and lower sleep quality on day 29.

Hypothesis 2. Those who are high on conscientiousness and extraversion on day 1 will independently report more self-compassion on day 15. Those who are high on neuroticism on day 1 will report less self-compassion on day 15.

Hypothesis 3. Those who are high on self-compassion on day 15 will report greater physical activity and sleep quality on day 29. Those who are low on self-compassion on day 15 will report less physical activity and lower sleep quality on day 29.

Hypothesis 4. Self-compassion on day 15 will partially mediate the relationship between personality traits on day 1 and health behaviors and perceptions on day 29, such that the relationship from personality traits to health behaviors and perceptions will be reduced but still different from zero when self-compassion is added as a mediator.

Method

Participants

I recruited 103 undergraduate students from George Mason University (GMU) to complete the study for course credit. In order to participate in this study, students had to be at least 18-years old and speak and read English. The sample was primarily women

(72%) with a mean age of 20.1 years-old (range from 18 to 30). The distribution by class year was as follows: 39% freshmen, 25% sophomores, 24% juniors, and 12% seniors. The students reported their ethnicity and 38% of the sample identified as European American, 29% Asian American, 18% Hispanic, 11% African American, and 4% other. Sample demographics were similar to the diverse racial and ethnic make-up of GMU.

Procedure

On day 1, participants were contacted via email with an electronic link to provide consent for the study and complete a one-hour Qualtrics questionnaire that assessed demographics, personality traits, and psychological symptoms (i.e., depression and anxiety). The next day participants obtained an ActiGraph (see study 2 for more information). Later that evening, participants began completing 10- to 15-minute Qualtrics' surveys two times a day for seven consecutive days (days 2-9; see study 2 for more information). On day 15, participants completed a one-hour Qualtrics survey on psychological strengths (e.g., self-compassion). On day 29, participants completed a one-hour Qualtrics survey on health behaviors (e.g., exercise and sleep). Participants completed the surveys on their phones or computers.

Measures

Personality traits (Day 1). The Big Five Inventory (BFI; John & Srivastava, 1999) is a 44-item inventory that measures an individual on the big five dimensions of personality: extraversion (8 items), agreeableness (9 items), conscientiousness (9 items), neuroticism (8 items), and openness to experience (10 items). Each item is rated on a 5-point scale that ranges from 1 (*disagree strongly*) to 5 (*agree strongly*). Characteristics

reflecting each factor are presented after the statement "I see myself as someone who …" Example items include "is talkative" (extraversion), "does things efficiently" (conscientiousness), and "can be tense" (neuroticism). Responses to items were added, and a mean score was obtained for each personality trait. The internal consistency coefficients for the three personality traits of interest were the following at time 1: extraversion (α = .84), conscientiousness (α = .78), and neuroticism (α = .79).

Self-compassion (Day 15). I measured trait self-compassion with the 26-item Self-Compassion Scale (SCS; Neff, 2003b). The positive components include a 5-item self-kindness scale (e.g., "I'm tolerant of my own flaws and inadequacies"), a 4-item common humanity scale (e.g., "I try to see my failings as part of the human condition"), and a 4-item mindfulness scale (e.g., "When something upsets me, I try to keep my emotions in balance"). The negative components include a 5-item self-judgment scale (e.g., "When times are really difficult, I tend to be tough on myself"), 4-item isolation scale (e.g., When I fail at something that's important to me I tend to feel alone"), and a 4-item over-identification scale (e.g., "When something upsets me I get carried away with my feelings"). Responses are rated from 1 (*almost never*) to 5 (*almost always*). Research indicates that the subscales are best explained by a higher order factor of self-compassion as they are highly intercorrelated (Neff, 2003b). After reverse coding the negative items, I averaged the mean of the subscale scores in order to obtain a total self-compassion score. The scale had excellent internal consistency at time 1 (α = .93) and time 2 (α = .95).

Exercise (Day 29). Participants reported their exercise over the last 7 days (days 23-29) using the International Physical Activity Questionnaire – Short form (IPAQ; Craig

et al., 2003). Participants reported the number of minutes of vigorous exercise (e.g., heavy lifting, fast bicycling), moderate exercise (e.g., carrying light loads, bicycling at a regular pace), and mild exercise (e.g., walking) that they completed for at least 10 minutes at a time. The number of minutes were added to obtain a total exercise score. In this study, this measure had poor reliability at time 1 (α = .36) and time 3 (α = .39). Thus, each type of exercise was examined individually as an outcome.

Exercise Satisfaction (Day 29). A measure of exercise satisfaction was created for this study and assessed with the question, "How satisfied were you with your exercise for the past week?" The item was rated from 1 (*not at all*) to 5 (*extremely*).

Sleep (Day 29). Sleep was measured with 24 items from the Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds III, Monk, Berman, & Kupfer, 1989). These items were adapted to ask about the past week instead of the past month. The PSQI produces a global sleep quality score, which is created by summing each of the subscales: subjective sleep quality, sleep latency, sleep duration, efficiency, habitual sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction. Items are answered either using a 4-point rating scale from 0 to 3 or by indicating time. For 10 of the items, the rating scale is "Not during the past month" (0) to "three or more times a week" (3). For 1 item, the rating scale is "Very good" (0) to "Very bad" (3). Sample items include "During the last month, how often have you had trouble sleeping because you wake up in the middle of the night or early morning?" and "During the past month, how would you rate your sleep quality overall?" Higher scores on the PSQI indicate worse sleep quality, with a score of "0" indicating no difficulty and "21" indicating

severe difficulties in all areas. Of note, the last 5 items on the PSQI are not included in the total score because they ask whether a roommate or bedpartner has noticed problems such as snoring or twitching. With the 7 components, the scale had a low Cronbach's alpha at time 1 ($\alpha = 0.68$) and time 3 ($\alpha = 0.6$). When including each individual item to make up a total score, there was a higher Cronbach's alpha at time 1 ($\alpha = 0.75$) and time 3 ($\alpha = 0.79$). Thus, for this study, each individual item was added to obtain the total sleep quality score.

Covariates. Participant age, sex, anxiety, and depressive symptoms were included as covariates based on existing research (MacBeth & Gumley, 2012; Liao et al., 2015; Stephan et al., 2018). Depression and anxiety were measured with the Patient-Reported Outcomes Measurement Information System (PROMIS; Pilkonis, et al., 2011), which asks about anxiety and depressive symptoms over the past 7 days. There are 8 items to assess depression and 8 items assessing anxiety that are rated from 1 (*never*) to 5 (*always*). Example items include, "In the past 7 days, I felt worthless" (depression item) and "In the past 7 days, I felt fearful" (anxiety item). Responses to both depression and anxiety items were added to obtain a total score of psychological symptoms. The internal consistency of this scale at time 1 was .95.

Results

Exclusion Criteria

Significant outliers were removed for mild, moderate, vigorous, and sleep variables based on being more than three standard deviations from the mean. Additionally, based on the categories of severity for the PROMIS, I excluded 6

individuals who reported severe anxiety or depressive symptoms at time 1, which was defined as t-scores greater than two standard deviations from the mean (Cella et al., 2010; Rothrock et al., 2010).

Descriptive Results

To explore the strength of the relationships among constructs within and between time points, bivariate correlations were computed among all variables using SPSS version 19. Means of all variables and their correlations were consistent with expectations and can be seen in Tables 1 and 2. Correlations between constructs across time points demonstrated small to medium effects. At time 1, the strongest relationships were between neuroticism and self-compassion (r = -.62), and self-compassion and sleep quality (r = -.47). Across time points, the strongest relationships were between neuroticism at time 1 and self-compassion at time 2 (r = -.49) followed by neuroticism at time 1 and sleep quality at time 3 (r = .41).

Table 1 Descriptive Statistics

	N	Mean	SD	Min	Max
Time 1					
1. Neuroticism	96	2.93	.712	1.50	4.75
2. Extraversion	96	3.04	.758	1.13	4.75
3. Conscientiousness	96	3.61	.623	2.11	4.89
4. Self-Compassion	96	3.16	.69	1.69	4.77
5. Mild Exercise	91	213.52	192.5	0	900
6. Moderate Exercise	92	132.29	119.49	0	540
7. Vigorous Exercise	92	124.18	139.38	0	510
8. Exercise Satisfaction	86	2.52	1.23	1	5
9. Sleep Quality Index	89	12.36	6.63	0	27
Time 2					
10. Self-Compassion	93	3.26	.722	1.35	4.92
Time 3					
11. Mild Exercise	89	308.68	345.83	0	1800
12. Moderate Exercise	87	146.36	164.64	0	720
13. Vigorous Exercise	88	72.72	98.92	0	480
14. Exercise Satisfaction	84	2.92	1.20	1	5
15. Sleep Quality Index	86	10.9	6.8	1	30

Table 2 Bivariate Relations Within and Across Time Points

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Time 1														
1. Neuroticism	-													
2. Extraversion	-.25*	-												
3. Conscientiousness	-.34**	.09	-											
4. Self-Compassion	-.62**	.33**	.17	-										
5. Mild Exercise	.09	-.04	-.06	-.004	-									
6. Moderate Exercise	.23*	.26*	.06	-.06	.29*	-								
7. Vigorous Exercise	-.08	.16	-.01	-.04	-.03	.29**	-							
8. Exercise Satisfaction	-.15	.16	.15	.29**	-.14	.16	.47**	-						
9. Sleep Quality	.42**	-.11	-.13	-.47**	.11	.05	.09	-.38**	-					
Time 2														
10. Self-Compassion	-.49**	-.35**	.21*	.79**	-.03	.001	-.08	.11	.36**	-				
Time 3														
11. Mild Exercise	.21*	-.18	-.18	-.24*	.19	.09	-.08	-.09	.11	-.21	-			
12. Moderate Exercise	.17	-.08	.07	-.10	.27*	.19	.21	.08	.17	-.05	.36**	-		
13. Vigorous Exercise	-.25*	.02	.08	.09	-.05	.12	.58**	.39**	-.12	.02	.02	.08	-	
14. Exercise Satisfaction	-.25*	.12	.09	.34**	-.09	.09	.37**	.63**	-.19	.36**	-.09	.10	.49**	-
15. Sleep Quality	.41**	-.05	-.32**	-.38**	.11	-.005	-.12	-.47**	.62**	-.38**	-.02	-.03	-.28*	-.34**

Note. * $p < .05$; ** $p < .01$; *** $p < 0.001$

Path Analyses: Personality Traits, Self-Compassion, and Health Behaviors

Path models were analyzed using Mplus statistical software version 8.3 (Muthén & Muthén, 2017). Since items were obtained from widely used and standardized scales, mean scores were used for path analyses. Each outcome was analyzed in unison for each of the three personality traits resulting in three different path models (Figures 1-3). The path models controlled for time 1 anxiety and depression, gender, and age. Predictors were allowed to correlate with each other as were outcomes, which resulted in saturated models. Additionally, since normality of the dependent variables could not be assumed for exercise, I used maximum likelihood with robust standard errors for my estimation method. This approach is less dependent on the assumption of multivariate normal distribution (Muthén & Muthén, 2007). In addition to analyzing these relationships longitudinally, I examined them cross-sectionally because the associations may occur over brief periods.

Neuroticism at time 1 predicted less self-compassion at time 2 ($\beta = -.32$, $p < .01$) and less vigorous exercise at time 3 ($\beta = -.35$, $p < .01$). Extraversion at time 1 positively predicted self-compassion at time 2 ($\beta = .23$, $p < .01$). Additionally, in the extraversion model, students' self-compassion was related to better sleep quality at time 3 ($\beta = -.28$, $p < .05$). Conscientiousness at time 1 also predicted better sleep quality at time 3 ($\beta = -.28$, $p < .01$). In all longitudinal models, self-compassion positively predicted exercise satisfaction (neuroticism model: $\beta = .4$; $p < .001$; extraversion model: $\beta = .41$; $p < .001$; conscientiousness model: $\beta = .38$; $p < .001$). Neuroticism and extraversion at time 1 had

significant indirect relationships with exercise satisfaction at time 3 through self-compassion at time 2 ($\beta = -.13$, $p < .05$; $\beta = .09$, $p < .05$).

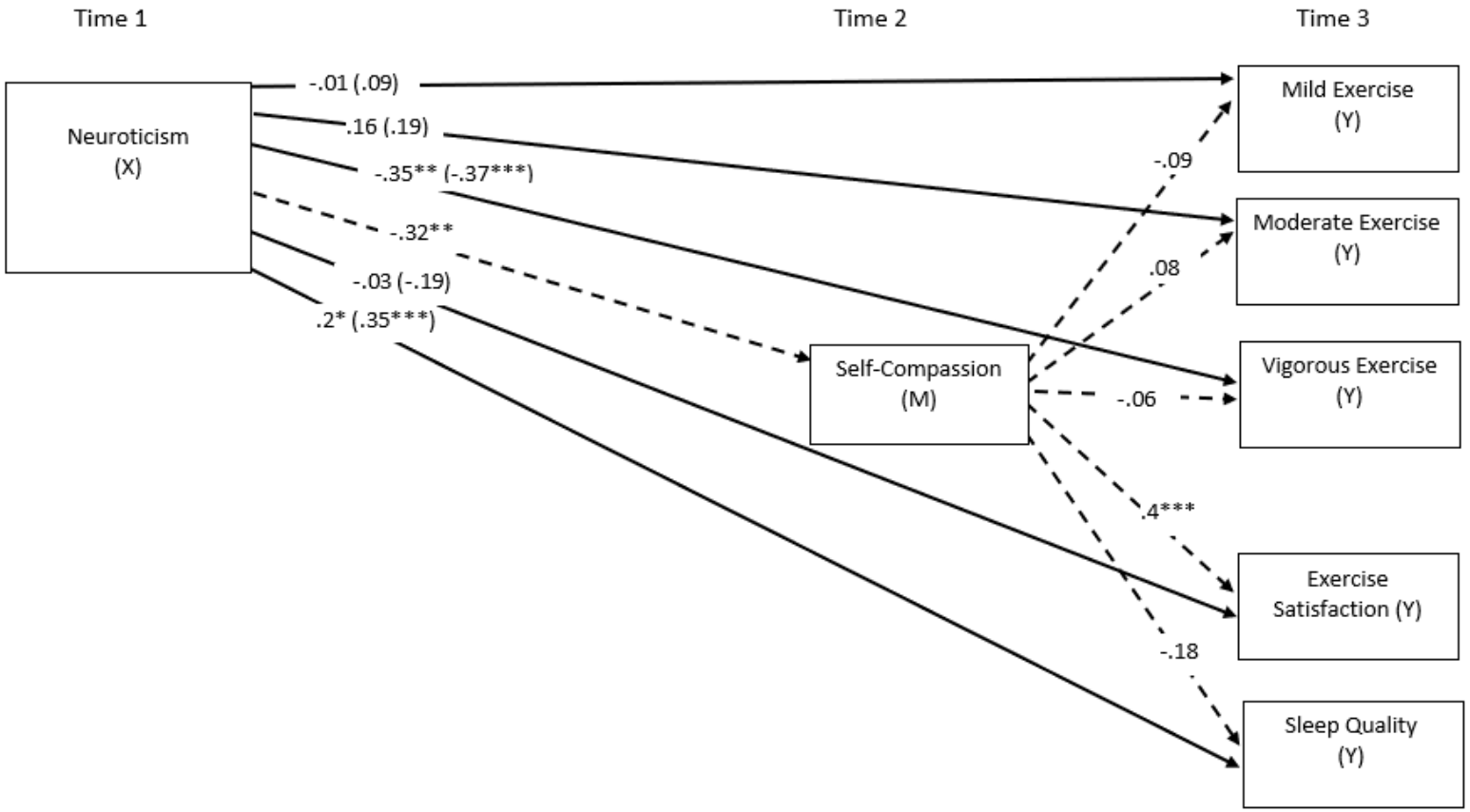

Figure 1 Neuroticism Path Model Across Timepoints. Parameter estimates are standardized. * $p < .05$; ** $p < .01$; *** $p < 0.001$
Note: Correlations among outcomes and predictors are not illustrated. Estimates for unmediated paths are in parentheses.

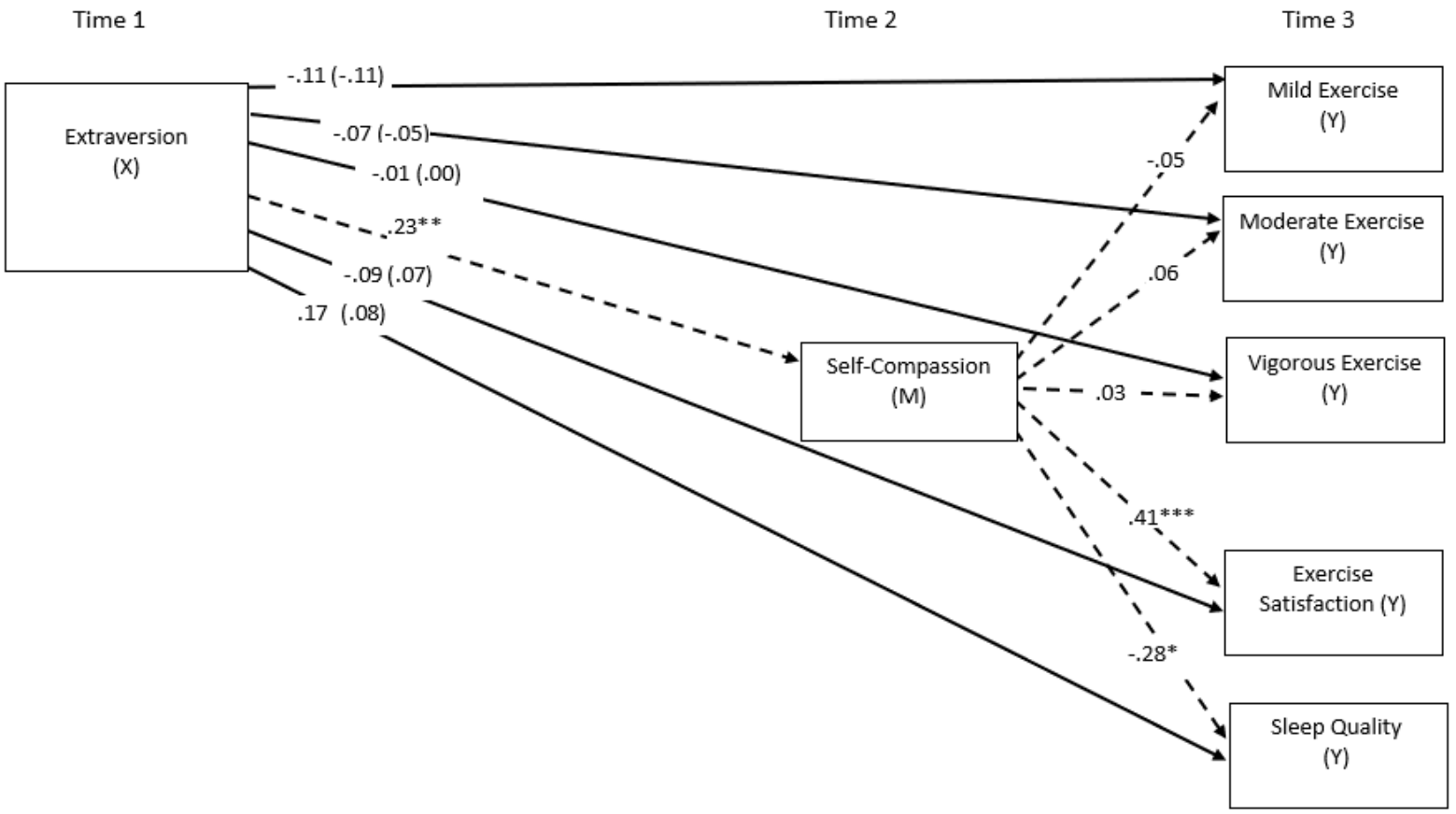

Figure 2 Extraversion Path Model Across Timepoints. Parameter estimates are standardized. * $p < .05$; ** $p < .01$; *** $p < 0.001$
Note: Correlations among outcomes and predictors are not illustrated. Estimates for unmediated paths are in parentheses.

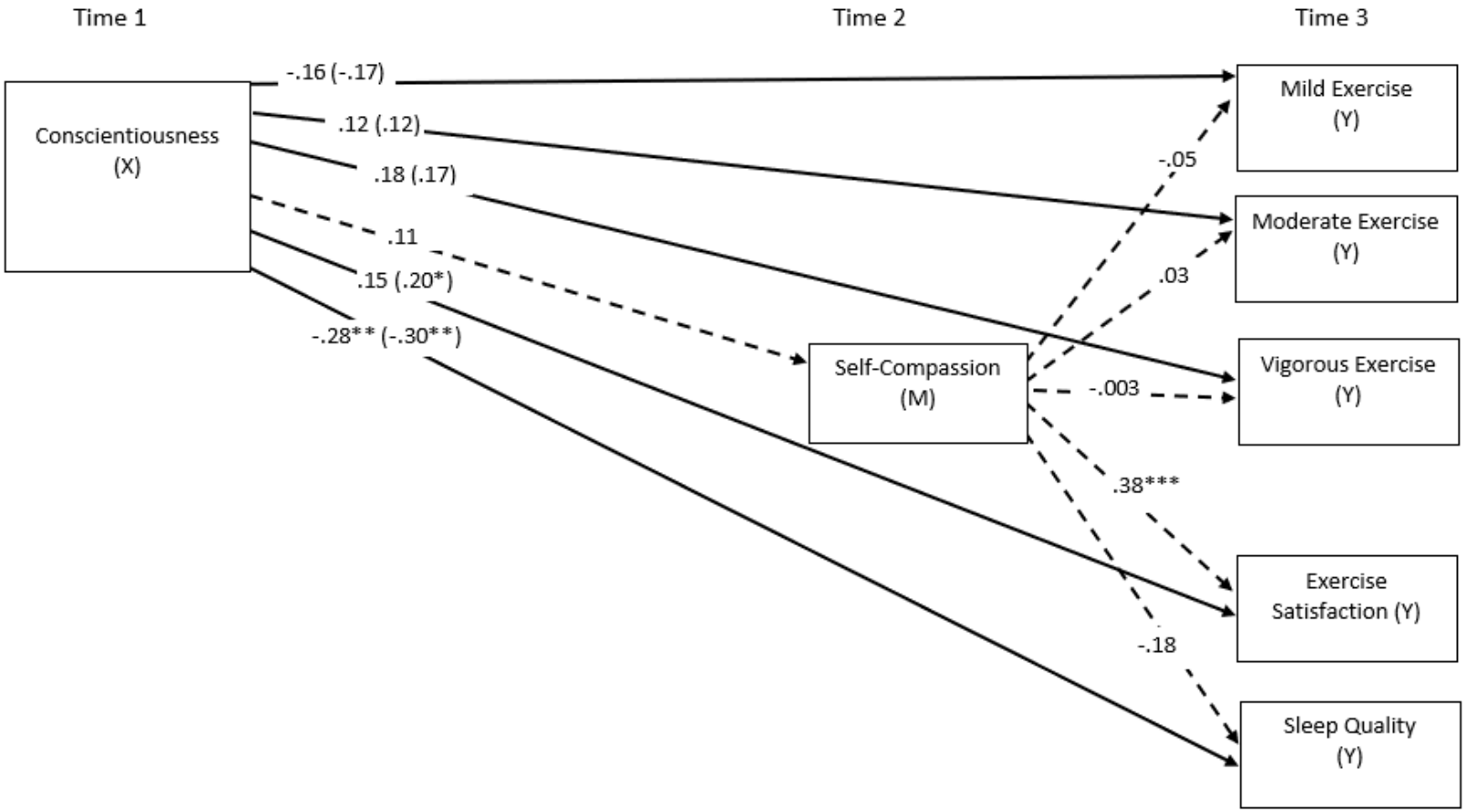

Figure 3 Conscientiousness Path Model Across Timepoints. Parameter estimates are standardized. * $p < .05$; ** $p < .01$; *** $p < 0.001$
Note: Correlations among outcomes and predictors are not illustrated. Estimates for unmediated paths are in parentheses.

When examining the data cross-sectionally at time 1 (Figures 4-6), neuroticism was related to decreased self-compassion ($\beta = -.39$; $p < .001$) while extraversion was related to increased self-compassion ($\beta = .18$; $p < .05$). Additionally, both neuroticism and extraversion were related to increased moderate exercise ($\beta = .28$; $p < .05$; $\beta = .32$; $p < .01$). Self-compassion was related to better sleep quality in all three path models (neuroticism model: $\beta = -.21$; $p < .05$; extraversion model: $\beta = -.23$; $p < .05$; conscientiousness model: $\beta = -.21$; $p < .05$). Finally, neuroticism had a significant indirect effect on sleep quality through self-compassion ($\beta = .08$; $p < .05$).

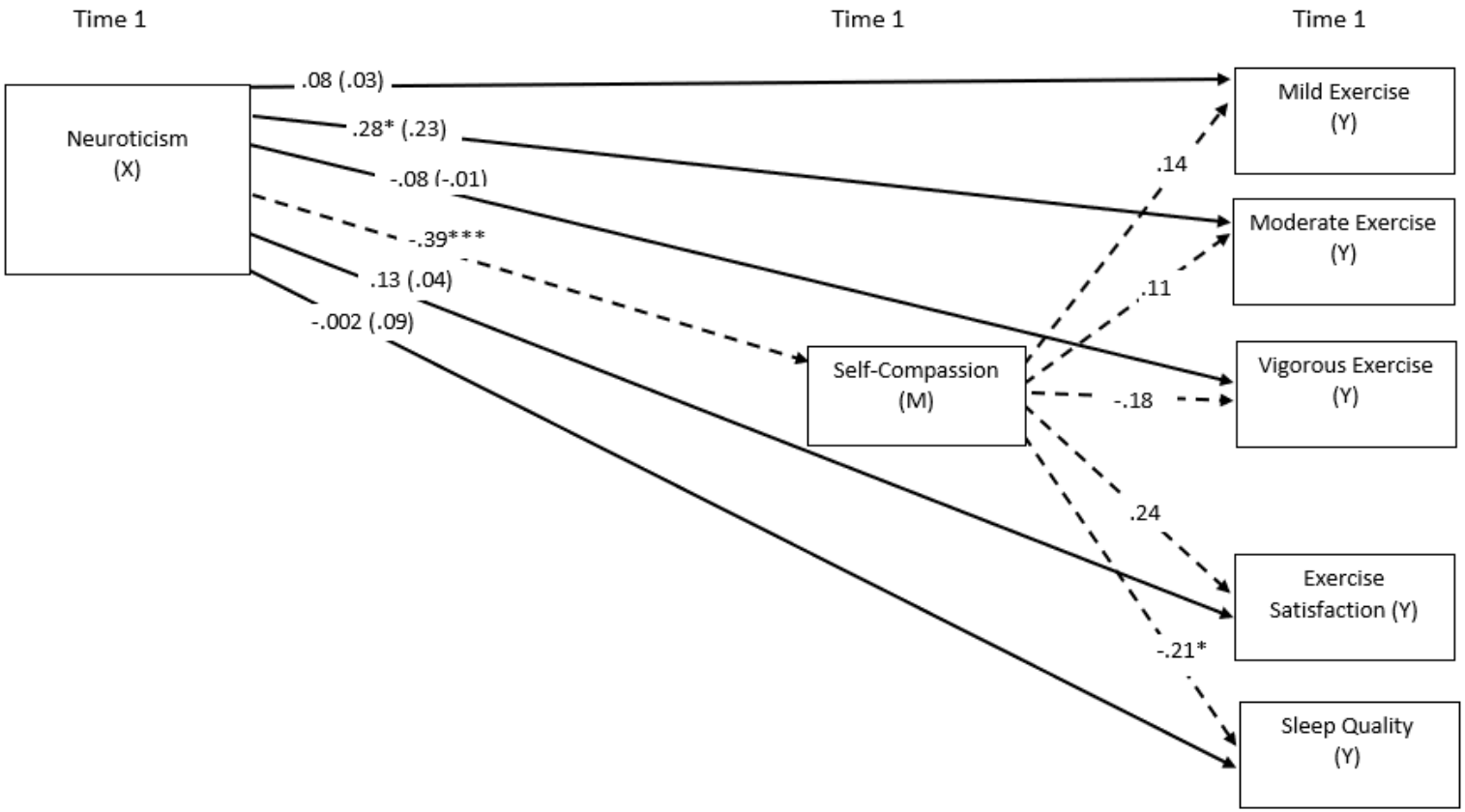

Figure 4 Cross-sectional Path Model for Neuroticism. Parameter estimates are standardized. * $p < .05$; ** $p < .01$; *** $p < 0.001$
Note: Correlations among outcomes and predictors are not illustrated. Estimates for unmediated paths are in parentheses.

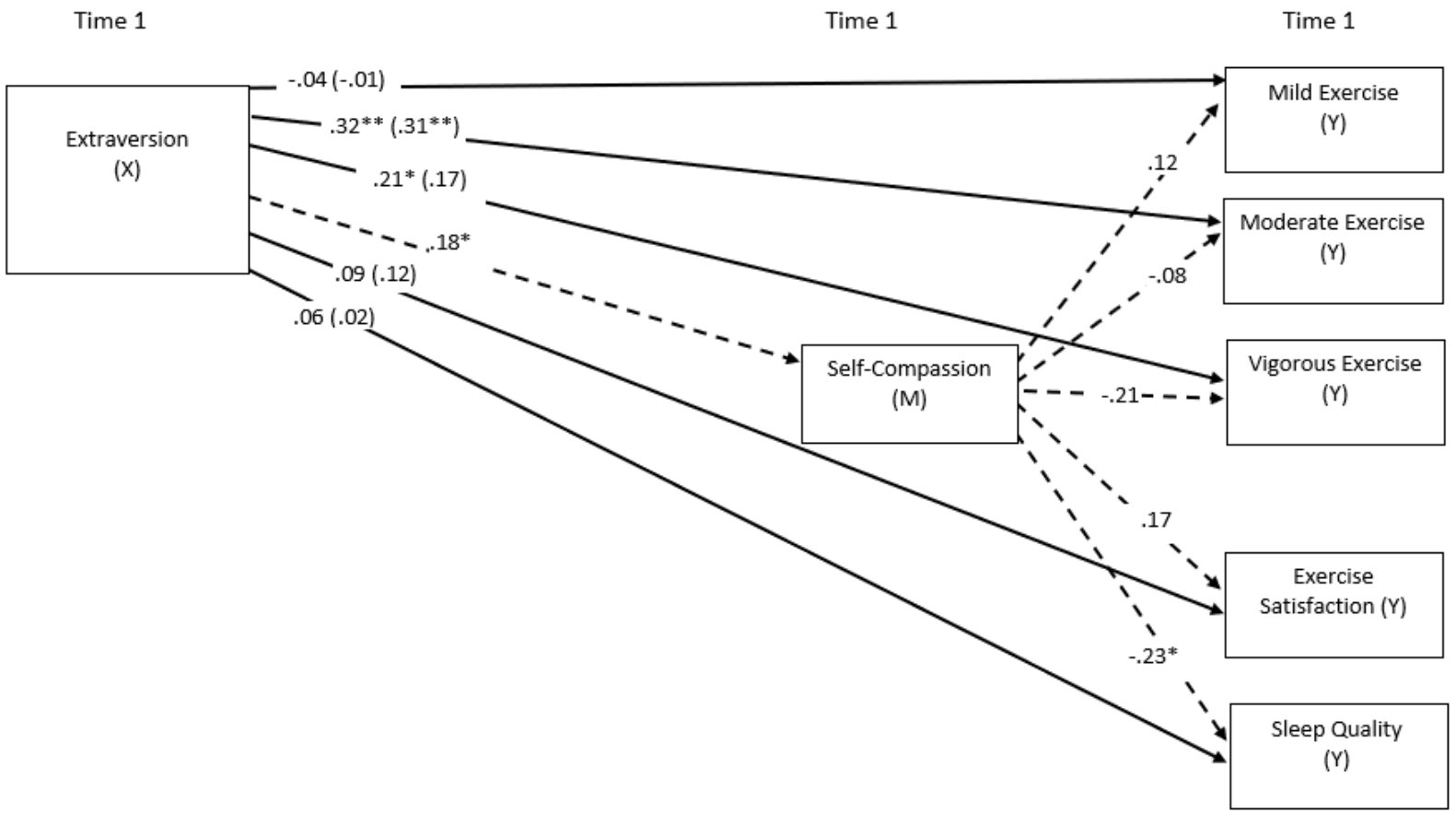

Figure 5 Cross-sectional Path Model for Extraversion. Parameter estimates are standardized. * $p < .05$; ** $p < .01$; *** $p < 0.001$
Note: Correlations among outcomes and predictors are not illustrated. Estimates for unmediated paths are in parentheses.

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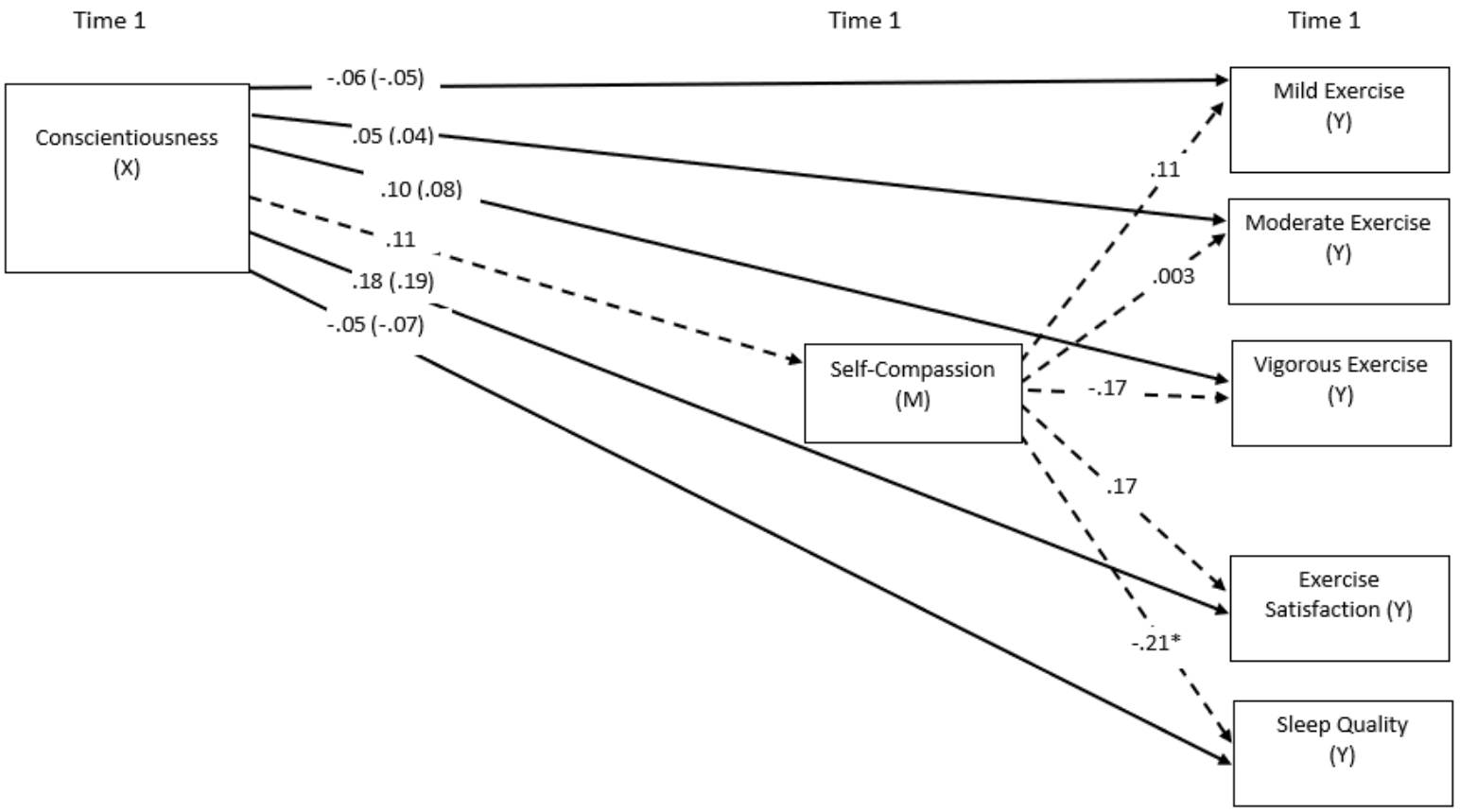

Figure 6 Cross-sectional Path Model for Conscientiousness. Parameter estimates are standardized. * $p < .05$; ** $p < .01$; *** $p < 0.001$
Note: Correlations among outcomes and predictors are not illustrated. Estimates for unmediated paths are in parentheses.

Discussion

This study examined the mediating role of young adults' trait self-compassion on the relationship between their personality traits and health behaviors. This research helps explain the processes by which self-compassion affects health behaviors and perceptions for individuals with different personality traits.

Relationships between personality traits and self-compassion

As hypothesized, extraversion at time 1 positively predicted self-compassion at times 1 and 2, and neuroticism at time 1 negatively predicted self-compassion at times 1 and 2. The findings with extraversion and neuroticism are consistent with previous research (Afshar et al., 2015; Neff et al., 2007; Thurackal, Corveleyn, & Dezutter, 2016). Like those with high levels of self-compassion, extraverted individuals tend to seek support from others, are more accepting of difficult situations and emotions, and are more likely to reinterpret situations positively (Afshar et al., 2015). Extraverted individuals tend to worry less about the impression they make on other people, which might allow them to connect more easily with others (Neff, Kirkpatrick, & Rude, 2007). In turn, it may be easier for them to practice aspects of self-compassion like common humanity which involves viewing one's painful experiences as part of the larger human experience. In contrast, individuals high in neuroticism tend to isolate themselves when experiencing pain or suffering (Afshar et al., 2015), which likely makes it more challenging to practice components of self-compassion like common humanity. Thus, it may be particularly important to prioritize increasing self-compassion for individuals high in neuroticism since they may struggle more than extraverted individuals to be self-compassionate. In turn, self-compassion could help attenuate the associations between neuroticism and anxiety and depressive symptoms.

Students' conscientiousness at time 1 was not related to self-compassion at time 1 or 2. This is inconsistent with previous research on conscientiousness and its association with greater self-compassion (Neff, Kirkpatrick, & Rude, 2007). Previous research indicates that conscientious individuals are hard-working and persevering (Costa & McCrae, 1992). However, conscientiousness is also associated with personal achievement (Mount & Barrick, 1995) and high expectations for oneself (Stoeber, Otto, & Dalbert, 2009) that could lead to less self-compassion. In future studies, it would be helpful to parse out the effects of conscientiousness on self-compassion by examining different characteristics of conscientiousness (e.g., adaptive vs. maladaptive features).

Relationships between personality traits and health behaviors and perceptions

Students' reports of extraversion at time 1 were related to more moderate and vigorous exercise at time 1. The positive relationship between extraversion and exercise is consistent with previous research findings (Sutin et al., 2016; Wilson & Dishman, 2015). Extraverted individuals likely enjoy the social aspects of exercise and prefer participating in gym training and structured group exercise (Hagan & Hausenblas, 2005). In contrast, neuroticism is associated with lower frequency of physical activity and a preference to exercise alone at home (Wilson & Dishman, 2015). My findings with neuroticism are partially consistent with prior research. While neuroticism at time 1 was related to decreased vigorous exercise at time 3, it was related to increased moderate exercise at time 1. It could be the case that in the short-term, individuals who are high in neuroticism feel motivated to participate in exercise as a coping strategy to help repair their mood. Indeed, some research has suggested that health behaviors may serve as implicit emotion-regulation strategies for individuals who are experiencing distress (Sheeran, Gollwitzer, & Bargh, 2013). The relationship of neuroticism to moderate exercise could also be an artifact of the study's methods. Measures of personality and

health behaviors at time 1 were obtained at the same time, which makes it difficult to determine the directionality of time 1 relationships.

Students' reports of conscientiousness at time 1 predicted sleep quality at time 3. This finding is consistent with previous research (Duggan et al., 2014; Kim et al., 2015) and a recent meta-analysis that found that conscientiousness was one of the strongest correlates of sleep quality (Stephan et al., 2018). Unlike extraversion, the positive relationship between conscientiousness and sleep quality measured with the PSQI has been relatively consistent across studies (Stephan et al., 2018). Given that conscientious individuals are generally organized and responsible, it may be easier for them to adhere to a regular sleep routine.

Relationships between self-compassion and exercise

In all three longitudinal models, as hypothesized, self-compassion positively predicted exercise satisfaction, but not mild, moderate, or vigorous exercise. Thus, it may be the case that self-compassion plays a larger role in influencing people's perceptions about their exercise behavior as opposed to influencing physical participation in exercise. Accordingly, a recent workplace pilot study with 24 participants found that while a 10-week self-compassion intervention led to increases in participants' leisure time physical activity, participants' total physical activity did not significantly change from pre-test to post-test (Horan & Taylor, 2018). In contrast, mindful exercise, which increases awareness of one's movements and promotes exercise satisfaction, significantly increased after the self-compassion intervention. Since self-compassionate individuals are kinder to themselves and less self-critical (Neff, 2003a), they might be more likely to give themselves credit for the exercise they participate in regardless of the amount or intensity. This is consistent with previous research that has found that those who are self-compassionate tend to exercise for intrinsic (e.g., to be healthy) as opposed to extrinsic

(e.g., for weight or appearance; Neff et al., 2005) reasons. It would be helpful for future studies to investigate how self-compassionate people, compared to non-compassionate people, define exercise behaviors. Self-compassion may be beneficial for shifting one's mindset about exercise to find exercise more satisfying.

Additionally, it could be the case that self-compassion did not predict exercise behavior because I measured exercise broadly using three different intensities. Future studies could examine how self-compassion predicts specific types of exercise (e.g., yoga, running) since this allows for more precise measurement of exercise activities and a more nuanced approach.

Relationship between self-compassion and sleep

Students' self-compassion was related to better sleep quality at time 1 and 3. This is consistent with previous research that found that self-compassionate individuals tend to have better sleep hygiene habits due to more adaptive emotion regulation strategies that help prevent bedtime procrastination (Sirois, Kitner, & Hirsch, 2015). Individuals high in self-compassion tend to cognitively reappraise or reframe situations in ways that allow them to perceive challenges and potential stressors as less upsetting (Finlay-Jones, 2017). This reduces the need to delay bedtime to repair mood, and in turn, they feel more well-rested (Sirois, Nauts, & Molnar, 2019). In contrast, individuals low in self-compassion tend to use less cognitive reappraisal and experience higher negative affect. In turn, they are more likely to do activities that delay bedtime (e.g., watching tv or surfing on the internet) to repair their higher level of negative mood and replenish positive emotions (Sirois et al., 2019).

Self-compassion as a mediator of the relationship between personality traits and health behaviors and perceptions

There were significant indirect effects through self-compassion at time 2 on the relationships between extraversion and neuroticism at time 1 and exercise satisfaction at time 3. Extraversion predicted more self-compassion, which in turn predicted increased exercise satisfaction. Less neuroticism predicted more self-compassion, which in turn predicted increased exercise satisfaction. As discussed earlier, for individuals high in extraversion and low in neuroticism, it may be easier to practice self-compassion, which in turn, leads to positive perceptions about one's exercise behavior. Individuals who are self-compassionate may be less self-critical about their exercise, and more likely to praise themselves for the exercise they were able to do. For example, they could have more encouraging thoughts after engaging in exercise (e.g., "you did your best," and "I'm proud of you"). These findings suggest the importance of increasing self-compassion to increase one's satisfaction with exercise. Exercise satisfaction may be important for predicting greater adherence to an exercise routine overtime. Those who are less satisfied with their exercise may be less motivated to continue a regular exercise regimen (Teixeira et al., 2018). Of note, exercise satisfaction had a significant association with vigorous exercise at time 1 (r = .47) and time 3 (r = .49) but not with mild or moderate exercise at either timepoint, suggesting that increased satisfaction with exercise is related to more participation in intense exercise.

Cross-sectionally, there was a significant indirect effect through self-compassion on the relationship between neuroticism at time 1 and sleep quality at time 1, such that less neuroticism was related to increased self-compassion, which in turn, was related to better sleep quality. In addition to less bedtime procrastination (Sirois et al., 2019), self-compassionate individuals might prioritize self-care activities prior to going to sleep that

reduce sleep latency (i.e., the time it takes to fall asleep). For example, they might be more likely to take a warm bath, listen to relaxing music, or engage in mindfulness meditation prior to going to sleep. Accordingly, in a study with undergraduate students, mindfulness was associated with a range of healthy sleep behaviors including less pre-sleep arousal (Howell et al., 2010). Given the cross-sectional data, it is challenging to know the directionality of the relationship between neuroticism and sleep quality. It may be the case that improved sleep quality increases self-compassion given sleep's role in the processing and regulation of emotional information (Tempesta, Socci, De Gennaro, & Ferrara, 2018).

Strengths, Limitations, and Future Directions

The strengths of this study include that I investigated concurrent and longitudinal associations among young adults' personality traits, self-compassion, and health behaviors and perceptions. To my knowledge, this is the first study that examined self-compassion as a possible mediator of the relationship between personality traits and health behaviors. This better informs how one may tailor self-compassion interventions to individuals' personality traits when trying to promote health behaviors.

Despite the strengths, there are limitations with the design of the study. The results were obtained using self-reports of sleep and exercise. On self-reports, due to a social desirability bias, people tend to overestimate their amount of exercise (Prince et al., 2008). There may also be issues with recall such that people may have an inaccurate memory of their exercise or sleep patterns (Prince et al., 2008). This poses a problem in terms of self-reports' reliability and validity (Shephard, 2003). Thus, future studies should examine these relationships using both subjective and objective measures of sleep and exercise.

Additionally, given that I was studying health behaviors, there could have been some self-selection during the recruitment process. For example, participants who signed up for the study could have been more active and motivated to engage in health behaviors than the general college population. Furthermore, I did not include self-esteem as a covariate in my study. Extraverted and conscientious individuals could have reported higher self-compassion due to high self-esteem (Robins et al., 2001). Thus, future studies should include self-esteem as a covariate to determine if personality traits predict self-compassion after accounting for self-esteem. Furthermore, there may be a tendency for extraverts to describe themselves more positively on psychological measures than individuals high in neuroticism do regardless of the construct (Uziel, 2006), which could explain their relationships with self-compassion. Finally, my study included a community-based sample, so it is unclear whether these findings generalize to patients with psychological disorders.

Conclusions

My findings suggest that increasing students' self-compassion could lead to more satisfying exercise and better sleep quality. Young adults who are high on neuroticism could benefit the most from increased self-compassion since they are prone to self-criticism, isolation, and non-acceptance of emotions. In contrast, it may be easier for extraverted individuals to be self-compassionate because they tend to connect easily with others. Accordingly, recent research has found that individuals who increase extraverted behavior experience greater positive affect and well-being (Margolis & Lyubomirsky, 2020). My study suggests that increases in extraversion could increase college students' participation in intense exercise and increase self-compassion. Thus, school counselors and support staff ought to prioritize increasing college students' extraverted behavior (e.g., setting goal to talk to roommate), which could result in more opportunities for

students to be physically active and socially connect with peers. Overtime, the increases in extraversion could help promote self-compassion, and help buffer the negative effects of neuroticism on health behaviors.

CHAPTER THREE: HOW DOES DAILY SELF-COMPASSION IMPACT THE RELATIONSHIP BETWEEN DAILY HEALTH BEHAVIORS AND DAILY POSITIVE AND NEGATIVE AFFECT?

The benefits of health behaviors including exercise and sleep are well-documented for adults. Several meta-analyses of cross-sectional studies have concluded that exercise and sleep increase positive affect and decrease negative affect (Reed & Ones, 2006; Reed & Buck, 2009; Rethorst et al., 2009). Individuals with high positive affect tend to be more social and energetic whereas individuals with high negative affect tend to be in a constant state of distress and dwell on their failures (Watson & Pennebaker, 1989). Anxiety has been defined by high negative affect while depression is characterized by high negative affect and low positive affect (Clark & Watson, 1991).

Affect can also help predict the occurrence of future depressive episodes. Experimental research found that an increase in positive emotions decreased depressive symptoms over 9 weeks with adults (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008), and a study with pre-teen children found that high negative affect and low positive affect predicted depression three years later (Lee & Rebok, 2002). Since positive and negative affect can be valid indicators and predictors of depression and anxiety, they may be potential targets for prevention of these psychological disorders (Lyubomirsky, King, & Diener, 2005; Mayer & Gaschke, 1988).

The Relationship Between Daily Physical Activity and Affect

More recently, studies have begun to examine the daily relationships among exercise and affect in order to better understand how the day-to-day fluctuations in mood and exercise may predispose individuals to more severe psychopathology.

There is currently inconclusive evidence for the presence and directionality of the relationship between exercise intensity and mood (Meyer, Koltyn, Stegner, Kim, & Cook, 2016). A seven-day study with primarily college students found that an additional hour of activity compared with average activity levels was associated with lower negative affect over the same day but not with increased positive affect (Aggio et al., 2017). In contrast, other studies with college students have found a positive association between acute physical activity and increased daily positive affect but not decreased negative affect (see Liao et al., 2015 for a meta-analysis).

There may be a dose-response relationship between intensity of exercise and improvement in affect, such that higher intensities of exercise are related to greater positive mood (Dunn, Trivedi, & O'Neal, 2001; Mata et al., 2012). In a within-person study where participants self-reported on exercise patterns, moderate intensity exercise, rather than low intensity, contributed to mood enhancement throughout the day (Carels, Coit, Young, & Berger, 2007). Similarly, in a study that measured exercise with actigraphs, higher intensity exercise, defined as moderate and vigorous exercise, was related to greater positive affect over 12 hours compared to light activity (Schwerdtfeger, Eberhardt, & Chmitorz, 2008). Accordingly, moderate and vigorous exercise show the strongest impact on decreasing depressive symptoms (Brunet, Burke, & Sabiston, 2013;

Teychenne, Ball, & Salmon, 2008). An individual may feel a greater sense of accomplishment after completing more intense exercise, resulting in larger mood improvements.

Studies have also examined the role of daily affect in predicting daily physical activity but have had mixed findings. While some studies have found that positive affect relates to initiating exercise within the same day (Dunton et al., 2004; Schwerdtfeger et al., 2010), a recent meta-analysis that included mostly college students found that this positive relationship did not always reach significance (Liao et al., 2015). Another study found that negative mood was related to less exercise throughout the day (Carels et al., 2007), though the meta-analysis did not find a significant relationship between negative affect and subsequent physical activity (Liao et al., 2015). Identification of a third variable could help strengthen the relationships between daily physical activity and affect.

The Relationship Between Daily Sleep and Affect

In addition to exercise and affect, studies have also examined the associations among college students' daily affect and daily sleep. Specifically, a 7-day study examined the possibility of a bi-directional relationship between sleep quality and affect with 75 college students (Simor, Krietsch, Koteles, & McCrae, 2015). Upon awakening, participants reported their subjective sleep quality, and later in the afternoon (eight hours later), they reported on their positive and negative affect. On days in which participants reported poor (below their personal average) sleep quality in the morning, they also reported lower positive, and higher negative, affect 8 hours later. Daytime (afternoon)

ratings of positive and negative affect did not predict subsequent sleep quality, suggesting that there is a unidirectional relationship from sleep quality to affect. In contrast, other studies have found that greater positive affect and lower negative affect, are related to better sleep quality and longer sleep duration (Kalmbach, Pillai, Roth, & Drake, 2014; van Zundert, van Roekel, Engels, & Scholte, 2015). Like exercise, there may be a third variable involved in the relationship between daily sleep and daily affect quality that helps strengthen the relationship.

In addition to improving the daily relationships between sleep quality and affect, a third variable may help mitigate the relationship between poor sleep quality and worsened mood. In a study where students wore actigraphs over a 1-week period, reduced sleep efficiency was associated with reduced positive mood the next morning (Takano, Keisuke, Sakamoto, & Tanno, 2014). Additionally, reduced positive mood in the morning was associated with increased repetitive thought (e.g., rumination). This cycle of cognitive, emotional, and sleep problems could lead to vulnerability for psychological problems. Thus, it would be helpful to identify a third variable that would help buffer the negative influence of poor sleep quality on affect. For instance, mindfulness and acceptance-based approaches could help reduce dysfunctional cognitions such as expecting to fall asleep quickly or worrying over sleep loss (Ong, Ulmer, & Manber, 2012), which in turn, could reduce mood disturbances.

Self-Compassion as a Moderator of the Daily Relationships of Health Behaviors and Affect

Similar to exercise and sleep, it is well-documented that self-compassion is associated with lower anxiety and depression (MacBeth & Gumley, 2012) and improved psychological well-being (Zessin et al., 2015). In Zessin et al.'s meta-analysis with 79 samples (n = 16,416), they found that positive affective well-being strongly correlated with self-compassion (r = .39). This may be the case because self-compassion (self-kindness, mindfulness, common humanity) leads to positive changes in people's mindsets about their experiences, particularly setbacks or failures (Neff, 2003a). Relatedly, a more recent study found that changes in college students' self-compassion was positively related to change in positive affect and negatively related to changes in negative affect (Gunnell et al., 2017).

Although researchers often view self-compassion as a stable personality trait, there is research evidence that it can be induced as a state and influence well-being (e.g., Germer & Neff, 2013; Mantelou & Karakasidou, 2017). For example, college students who participated in a 3-week self-compassion training program showed increases in positive affect and decreases in negative affect compared to the control group who received no training in self-compassion (Mantelou & Karakasidou, 2017). People who are more self-compassionate tend to have more positive thoughts, and are better at dealing with failures, mistakes, and personal weaknesses (Arimitsu & Hofmann, 2015).

Few studies have looked at the role of self-compassion in boosting well-being outcomes following exercise and sleep. In a study with adults, those who participated in

an exercise intervention that included self-compassion, showed improvements in both life satisfaction (d = 0.59) and energy (d = 0.76; Horan & Taylor, 2017) immediately following the 10-week intervention program. This suggests that self-compassion can improve both subjective well-being and physical well-being. Exercisers who are more self-compassionate tend to pursue health goals for self-determined reasons, such as for personal growth and well-being, rather than for extrinsic reasons, such as concern about their appearance (Neff et al., 2005). In turn, it is possible that self-compassion moderates one's experience of exercise and the mood benefits one receives from being physically active. Daily diary studies and similar ecologically valid methodological approaches are needed to further clarify the interrelationships among health behaviors, self-compassion and well-being.

Trait self-compassion has been tested as a moderator in studies of other health behaviors, such as disordered eating (e.g., Stutts & Blomquist, 2018; Tylka, Russell, & Neal, 2017). One study found that self-compassion moderated the relationship of weight/shape concerns and eating pathology such that college students who were low in self-compassion had a stronger relationship between weight concerns and disordered eating whereas for individuals high in self-compassion, there was a weaker relationship between weight/shape concerns and disordered eating (Stutts & Blomquist, 2018). Essentially, self-compassion helped lower body shame and helped individuals feel better about themselves and their appearance. Similarly, with regards to exercise, self-compassion could help decrease critical thoughts about one's appearance and in turn, boost one's mood following a workout.

Researchers have also examined trait-self-compassion as a moderator of the daily relationships between perceived stress and sleep quality over a two-week period in college students. Self-compassion moderated the effect of daily stressors on sleep latency (i.e., time it takes to fall asleep; Hu et al., 2018). More specifically, trait self-compassion helped buffer the negative effect of a daily stressor on sleep latency such that the relationship between stressful daily events and sleep latency was weakened for participants with higher levels of self-compassion. Self-compassion also directly recovered sleep latency, suggesting that increasing self-compassion may improve sleep directly. Self-compassion helps calm the nervous system and soothe the individual (Gilbert & Irons, 2005), which in turn, helps the body sleep. Overall, this study supports the role of self-compassion in improving daily sleep quality.

The idea that self-compassion varies day-to-day is a relatively new focus of study. To date, there are few studies of daily self-compassion (Breines et al., 2014; Kelly & Stephen, 2016; Li, Deng, Lou, Wang, & Wang, 2019). These studies have found that about one-third of the variance of self-compassion occurred within participants (Breines et al., 2014; Kelly & Stephen, 2016). One recent study examined the relationships among daily self-compassion, perceived stress, and health behaviors such as eating and exercise over seven days with 89 Chinese adults (Li et al., 2019). They found that daily self-compassion predicted daily eating behavior through the reduction of perceived stress. Additionally, they found that daily self-compassion had a positive effect on mild exercise by decreasing perceived stress. It may be that on days when individuals treat themselves with more compassion, they feel less stressed and therefore, engage in more mild

exercise (e.g., walking). Of note, in this study, they did not find a relationship between daily self-compassion and daily exercise though they noted that few participants participated in moderate or vigorous exercise, which resulted in low numbers for the exercise data. This study measured all daily variables at the same time and relied on self-report measures of health behaviors. On self-reports, there may also be issues with recall such that participants may have an inaccurate memory of their exercise pattern (Prince et al., 2008). This poses a problem in terms of self-reports' reliability and validity. Accelerometers, on the other hand, continuously and objectively monitor exercise and sleep, increasing the validity of these assessments compared with subjective assessments (Adamo, Prince, Tricco, Conner-Gorber, & Tremblay, 2009; Prince et al., 2008).

The Current Study

To my knowledge, no study has examined daily self-compassion as a moderator of daily exercise, sleep, and affect using both subjective (i.e., self-reports) and objective measures (i.e., accelerometers). On days when individuals are more self-compassionate, the relationship between health behaviors and affect might be strengthened, such that exercise and sleep are more strongly related to positive affect. Further research is needed to examine these relationships in order to gain insight into the effectiveness of a daily self-compassion intervention to improve well-being. Although researchers have developed effective programs to increase trait self-compassion (see Wilson et al., 2019 for a review), these programs require several weeks of training. Thus, a brief self-compassion intervention that influences daily self-compassion may be more feasible. The following hypotheses were tested:

Hypothesis 1. Greater afternoon exercise will predict greater positive affect and less negative affect in the morning.

Hypothesis 2. Greater morning positive affect will predict more daytime exercise while greater morning negative affect will predict less daytime exercise.

Hypothesis 3. Greater sleep quality and longer sleep duration on the previous night will predict greater positive affect and decreased negative affect in the morning.

Hypothesis 4. Greater positive affect in the evening will predict greater sleep quality and longer sleep duration, while greater negative affect in the evening will predict decreased sleep quality and duration.

Hypothesis 5. On days in which participants report high (above their personal average) self-compassion, they will report more positive affect and less negative affect following greater sleep quality, longer sleep duration, and more exercise compared to those who report low (below their daily average) self-compassion.

Method

Participants

I recruited 103 undergraduate students from George Mason University (GMU) to complete the study for course credit. In order to participate in this study, students had to be at least 18-years old and speak and read English. The sample was primarily women (72%) with a mean age of 20.1 years-old (range from 18 to 30). The distribution by class year was as follows: 39% freshmen, 25% sophomores, 24% juniors, and 12% seniors. The students reported their ethnicity and 38% of the sample identified as European American, 29% Asian American, 18% Hispanic, 11% African American, and 4% other.

Sample demographics were similar to the diverse racial and ethnic make-up of GMU.

Procedure

The undergraduate students from GMU wore an actigraph and reported on daily measures two times a day for eight days (days 2-9). Participants obtained an ActiGraph after meeting the research team to provide consent for the study. The research team placed the ActiGraph on the wrist of the participant's non-dominant hand. Participants were instructed to wear the ActiGraph at all times. The ActiGraphs were fully charged when distributed to participants, allowing up to 8 days of continuous data collection. Participants were instructed to complete the first evening questionnaire after obtaining the ActiGraph, and thereafter, they completed two questionnaires each day (morning and evening) for a total of seven days. The evening questionnaires were distributed at 7pm via a Qualtrics link and were available until 3am. Participants were instructed to complete the evening questionnaire right before going to sleep. The morning questionnaires were distributed at 7am via a Qualtrics link and were available until 12pm. Participants were instructed to complete the morning questionnaire right after they woke up. The morning and evening questionnaires each took approximately 10- to 15-minutes and were completed on participants' phones or computers. The research team told participants how many credits they were accruing with each questionnaire.

Measures

Daily Affect (Days 2-9). I measured affect in the morning and evening with the Brief Mood Introspection Scale (BMIS; Mayer & Gaschke, 1988). The 8 positive items included lively, happy, caring, content, peppy, calm, loving, and active. The 8 negative

items included sad, tired, gloomy, jittery, drowsy, grouchy, nervous, and fed-up. The items were rated from 0 (*definitely do not feel*) to 3 (*definitely feel*). This scale had good internal consistency for both positive mood and negative mood in the morning ($\alpha = 0.86$; $\alpha = 0.81$) and evening ($\alpha = 0.85$; $\alpha = 0.83$).

Self-compassion (Days 2-9). I measured self-compassion in the evening with the short-form of the self-compassion scale (SCS-SF; Raes, Pommier, Neff, & Van Gucht, 2011). The scale is made up of 6 subscales with 2 items each. The scales included: self-kindness (e.g., "I try to be understanding and patient towards those aspects of my personality I don't like"), self-judgment (e.g., "I'm intolerant and impatient towards those aspects of my personality I don't like"), common humanity (e.g., "I try to see my failings as part of the human condition"), isolation e.g., ("When I fail at something that's important to me, I tend to feel alone in my failure"), mindfulness (e.g., "When something painful happens I try to take a balanced view of the situation"), and over identification (e.g., "When I'm feeling down I tend to obsess and fixate on everything that's wrong"). Responses are rated from 1 (*never*) to 5 (*always*). After reverse-coding negative items, mean scores on the six subscales were averaged to create an overall self-compassion score. The SCS–SF demonstrated good internal consistency ($\alpha = 0.81$) and was strongly correlated with the long form SCS at time 1 ($r = .429$; $p < 0.01$).

Health Behaviors (Days 2-9). I collected both subjective and objective measures of sleep and exercise. I used 20 ActiGraphs (version GT9X) to objectively measure sleep variables (e.g., total sleep time) and exercise variables (e.g., physical activity intensity). Specifically, using a sensory accelerometer, the ActiGraphs record high resolution raw

acceleration, which is converted to objective activity and sleep measures (Actigraph, 2020). These ActiGraphs are widely used to measure health behaviors (e.g., Hoffman et al., 2019). Participants wore the ActiGraph on the wrist of their non-dominant hand for all waking hours across 8 consecutive days. It is recommended to measure physical activity and sleep behaviors for 7 days in studies with approximately 100 adults in order to obtain adequate reliability (80-90%; Matthews et al., 2002). Since the ActiGraphs were water-resistant, participants could wear them during daily water activities (e.g., showering). The actigraphs were programmed to have a blank screen in order to minimize the impact of self-monitoring on outcomes of interest (Sullivan & Lachman, 2017). I used ActiLife v.6.13.2 (ActiGraph LLC) for accelerometer initialization and file download.

Additionally, in the morning questionnaire, participants reported on subjective measures of sleep. A measure of sleep satisfaction was created for this study and assessed with the question, "How satisfied are you with your sleep from last night?" The item was rated from 0 (*not at all*) to 3 (*very much*). A measure of sleep duration was also created for this study and assessed with the question, "How many hours of sleep did you get in the past 24 hours?" Participants were asked to report a value in hours and minutes. These items were adapted from the PSQI (Buysse, Reynolds III, Monk, Berman, & Kupfer, 1989). Furthermore, in the evening questionnaire, participants reported on subjective measures of exercise. Exercise was measured with items adapted from the IPAQ (Craig et al., 2003). Participants were asked about minutes spent in mild, moderate, and vigorous exercise. The items were modified in order to assess exercise daily.

Covariates. Participant age, sex, anxiety, and depressive symptoms were included as covariates based on existing literature (MacBeth & Gumley, 2012; Liao et al., 2015; Stephan et al., 2018). Depression and anxiety were measured with the Patient-Reported Outcomes Measurement Information System (PROMIS; Pilkonis, et al., 2011), which asks about anxiety and depressive symptoms over the past 7 days. There were 8 items to assess depression and 8 items to assess anxiety that were rated from 1 (*never*) to 5 (*always*). Example items include, "In the past 7 days, I felt worthless" (depression item) and "In the past 7 days, I felt fearful" (anxiety item). Responses to both depression and anxiety items were added to obtain a total score of psychological symptoms. The internal consistency of this scale at time 1 was .95.

Results

Exclusion Criteria

There were 8.2% of entries submitted outside the time cut-offs that were excluded from the analyses. Significant outliers were removed for mild, moderate, vigorous, and sleep variables based on being more than three standard deviations from the mean. Additionally, based on the categories of severity for the PROMIS, I excluded 6 individuals who reported severe anxiety or depressive symptoms at time 1, which was defined as t-scores greater than two standard deviations from the mean (Cella et al., 2010; Rothrock et al., 2010). In total, there were 97 participants who provided 683 valid daily diary entries.

Overview of Primary Analyses

The data were conceptualized as hierarchically nested (i.e., days nested within persons) and were analyzed with multilevel models using the program HLM 7 (Raudenbush, Bryk, & Congdon, 2004). The analyses followed guidelines described by Nezlek (2011).

Descriptive Statistics

Table 3 presents the means, standard deviations, and variances of the self-compassion, mood, sleep, and exercise variables. When calculating the intra-class correlation coefficients (ICC), with the exception of self-compassion (ICC=.76), I found that within-person variability for each measure was greater than or about equal to between-person variability (morning positive mood ICC = .58, morning negative mood ICC = .56, evening positive mood ICC = .44, evening negative mood ICC = .59, self-reported mild exercise ICC = .54, self-reported moderate exercise ICC = .36, self-reported vigorous exercise ICC = .38, self-reported sleep duration ICC = .15, sleep satisfaction ICC = .20, objectively-measured mild exercise ICC = .22, objectively-measured moderate exercise ICC = .29, and objectively-measured sleep total ICC = .11). This supported the approach of running within-person analyses. Actigraph measures of mild and moderate exercise and sleep duration were uncorrelated with self-reports of each exercise and sleep measure. Five of the 20 actigraphs used in this study malfunctioned and did not download exercise and sleep data. The actigraphs did not record vigorous exercise, just mild and moderate exercise.

Table 3 Descriptive Statistics for Daily Measures

Measure	*N*	*M (SD)*	Range	Within-Person Variance	Between-Person Variance
Self-Compassion	89	3.47 (*0.73*)	1.33—5	.24	.76
Morning Positive Mood	93	2.61 (*0.63*)	1—4	.42	.58
Morning Negative mood	94	1.85 (*0.57*)	1—3.75	.44	.56
Evening Positive mood	89	2.73 (*0.58*)	1—4	.56	.44
Evening Negative mood	89	1.90 (*0.59*)	1—3.88	.41	.59
Self-Reported Mild Exercise	89	94.23 (112.86)	0—729	.46	.54
Self-Reported Moderate Exercise	85	38.65 (*65.94*)	0—510	.64	.36
Self-Reported Vigorous Exercise	83	13.31 (*31.78*)	0—180	.62	.38
Self-Reported Sleep Duration	93	446.31 (*110.33*)	0—960	.85	.15
Self-Reported Sleep Satisfaction	93	2.71 (*1.03*)	1—4	.80	.20
Objectively Reported Mild Exercise	48	484.08 (*183.93*)	0—888	.78	.22
Objectively Reported Moderate Exercise	48	158.63 (*87.45*)	0—459	.71	.29
Objectively Reported Sleep Duration	62	437.21 (*190.76*)	0—1106	.89	.11

Same-Day Relationships of Exercise and Mood

The first set of analyses examined the relationships between exercise (i.e., mild, moderate, and vigorous) and positive and negative mood (see Tables 4-5). Exercise variables were entered individually as the predictors and were group-mean centered. This meant that the coefficients described relationships between deviations from a person's mean amount of daily exercise and the outcome measures. Additionally, morning negative and positive mood were entered individually as predictors and were group-mean centered. Level-2 covariates (age and mental health symptoms) were grand-mean centered. The null hypotheses included that the mean within-person relationship between exercise and the outcome measure was 0, and that the mean within-person relationship between mood and the outcome measure was 0. This was tested by the γ_{10} in the model presented below. In these models, there were *i* days nested within *j* participants.

Equation 1 Area:

Day Level: $y_{ij} = \beta_{0j} + \beta_{1j}$ (Daily exercise or mood) + r_{ij}

Person-level intercept: $\beta_{0j} = \gamma_{00} + \gamma_{01}$ (age) + γ_{02} (sex) + γ_{03} (anxiety and depressive symptoms) + u_{0j}

Person-level slope: $\beta_{1j} = \gamma_{10}$

Does exercise predict evening mood? Daily self-reported moderate and vigorous exercise predicted evening positive mood ($\gamma_{10} = 0.001$, $t = 2.37$, $p < 0.05$; $\gamma_{10} = 0.003$, $t =$

2.80; $p < 0.01$). None of the exercise variables significantly predicted evening negative mood. The random effects of the intercepts were significant.

Does morning mood predict daytime exercise? Neither morning positive mood nor morning negative mood significantly predicted any type of exercise (mild, moderate, or vigorous). Of note, the relationship between self-report of vigorous exercise and morning positive mood approached significance ($\gamma_{10} = 2.42$, $t = 1.89$, $p = 0.059$). The random effects of the intercepts were significant.

Table 4 Relationships Between Daytime Exercise and Evening Mood

	Outcomes							
	Evening Positive Mood				Evening Negative Mood			
	Fixed Effects		Random Effects		Fixed Effects		Random Effects	
Predictors	*b*	*t*	u_0	*r*	*b*	*t*	u_0	*r*
Mild Exercise	.0003	0.93	.14***	.19	.00001	.02	.14***	.15
Moderate Exercise	.001	2.37*	.14***	.18	.00002	.04	.14***	.14
Vigorous Exercise	.003	2.8**	.14***	.19	-.001	-1.44	.15***	.14

Note. *b* = unstandardized HLM coefficient. * $p < .05$; ** $p < .01$; *** $p < 0.001$

Table 5 Relationships Between Morning Mood and Daytime Exercise

	Predictors							
	Morning Positive Mood				Morning Negative Mood			
	Fixed Effects		Random Effects		Fixed Effects		Random Effects	
Outcomes	*b*	*t*	u_0	*r*	*b*	*t*	u_0	*r*
Mild Exercise	-2.42	-.38	3930.91***	3588.98	3.9	.61	3927.13***	3588.33
Moderate Exercise	3.32	.63	744.54***	1267.38	-1.8	-.38	743.38***	1269.03
Vigorous Exercise	2.42	1.89	195.46***	253.09	-.64	-.44	194.68***	254.17

Note. *b* = unstandardized HLM coefficient. * $p < .05$; ** $p < .01$; *** $p < 0.001$

Lagged Analyses of Exercise and Mood

I examined lagged relationships between exercise and mood in order to address directionality (see Table 6). In these analyses, the previous day's evening exercise predicted positive or negative mood in the morning. In these analyses, I controlled for the outcome of interest on the previous day. Exercise and mood variables were group-mean centered while level-2 covariates (age and mental health symptoms) were grand-mean centered. The model is below.

Equation 2 Area:

Day level: $y_{ij} = \beta_{0j} + \beta_{1j}$ (Previous evening positive or negative mood) + β_{2j} (Previous evening report of exercise) + r_{ij}

Person-level intercept: $\beta_{0j} = \gamma_{00} + \gamma_{01}$ (age) + γ_{02} (sex) + γ_{03} (anxiety and depressive symptoms) + u_{0j}

Person-level slope: $\beta_{1j} = \gamma_{10}$

Person-level slope: $\beta_{2j} = \gamma_{20}$

Does exercise predict next-day mood? Previous day's mild, moderate, and vigorous exercise were not related to positive mood or negative mood the next morning. The random effects of the intercepts were significant.

Table 6 Lagged Relationships Between Exercise and Mood

	Outcomes							
	Morning Positive Mood				Morning Negative Mood			
	Fixed Effects		Random Effects		Fixed Effects		Random Effects	
Predictors	*b*	*t*	u_0	*r*	*b*	*t*	u_0	*r*
Mild Exercise	.0001	.35	.199***	.17	-.0001	-.40	.08***	.14
Moderate Exercise	.0004	.80	.2***	.18	-.0002	-.32	.08***	.14
Vigorous Exercise	.002	.22	.20***	.17	-.0001	-.08	.08***	.14

Note. b = unstandardized HLM coefficient. * $p < .05$; ** $p < .01$; *** $p < 0.001$

Relationships Between Sleep and Mood

This set of analyses examined relationships between sleep and mood (see Tables 7-8). Sleep satisfaction and sleep duration were entered individually as the predictors and were group-mean centered. Additionally, evening positive and negative mood were entered individually as predictors and were group-mean centered. Level-2 covariates (age and mental health symptoms) were grand-mean centered. The null hypotheses included that the mean within-person relationship between the sleep measure and the outcome measure was 0, and that the mean within-person relationship between the evening mood measure and the outcome measure was 0. This was tested by the γ_{10} in the model presented below. In these models, there were *i* days nested within *j* participants.

Equation 3 Area:

Day Level: $y_{ij} = \beta_{0j} + \beta_{1j}$ (Daily sleep or previous evening mood measure) + r_{ij}

Person-level intercept: $\beta_{0j} = \gamma_{00} + \gamma_{01}$ (age) + γ_{02} (sex) + γ_{03} (depressive and anxiety symptoms) + u_{0j}

Person-level slope: $\beta_{1j} = \gamma_{10}$

Does sleep satisfaction or sleep duration relate to morning mood? Sleep satisfaction and self-reported sleep duration predicted more positive mood (γ_{10} = 0.17, t = 8.5, p < 0.001; γ_{10} = 0.0007, t = 4.2, p < 0.001) and less negative mood in the morning (γ_{10} = -0.15, t = -8.01, p < 0.001; γ_{10} = -0.001, t = -4.10, p < 0.001). The random effects of the intercepts were significant.

Does evening mood predict sleep duration or sleep satisfaction? Neither positive mood nor negative mood in the evening predicted sleep satisfaction or sleep duration. The random effects of the intercepts were significant.

Table 7 Relationships Between Sleep and Morning Mood

	Outcomes							
	Morning Positive Mood				Morning Negative Mood			
	Fixed Effects		Random Effects		Fixed Effects		Random Effects	
Predictors	*b*	*t*	u_0	*r*	*b*	*t*	u_0	*r*
Sleep Satisfaction	.17	8.5***	.22***	.14	-.15	-8.01***	.08***	.12
Sleep Duration	.0007	4.2***	.21***	.16	-.001	-4.1***	.07***	.14

Note. *b* = unstandardized HLM coefficient. * $p < .05$; ** $p < .01$; *** $p < 0.001$

Table 8 Relationships Between Evening Mood and Sleep

	Outcomes							
	Sleep Satisfaction				Sleep Duration			
	Fixed Effects		Random Effects		Fixed Effects		Random Effects	
Predictors	*b*	*t*	u_0	*r*	*b*	*t*	u_0	*r*
Evening Positive Mood	-.16	-1.62	.15***	.85	-7.88	-.87	1698.77***	9778.48
Evening Negative Mood	.12	1.02	.15***	.85	2.49	.21	1700.60***	9787.81

Note. *b* = unstandardized HLM coefficient. * $p < .05$; ** $p < .01$; *** $p < 0.001$

Self-Compassion as a Moderator of Relationships between Exercise and Mood

I expected that individual differences in average self-compassion would moderate the within-person relationships between evening exercise and evening mood (see Table 9). Evening measures of self-compassion and exercise were group-mean centered, and level-2 covariates (age and mental health symptoms) were grand-mean centered. The model used for analyses is presented below.

Equation 4 Area:

Day level: $y_{ij} = \beta_{0j} + \beta_{1j}$ (Evening self-compassion) + β_{2j} (Evening exercise) + β_{3j} (Evening Self-compassion*Evening exercise) + r_{ij}

Person-level intercept: $\beta_{0j} = \gamma_{00} + \gamma_{01}$ (Age) + γ_{02} (Sex) + γ_{03} (Depressive and Anxiety Symptoms) + u_{0j}

Person-level slope: $\beta_{1j} = \gamma_{10}$

Person-level slope: $\beta_{2j} = \gamma_{20}$

Person-level slope: $\beta_{3j} = \gamma_{30}$

Does self-compassion moderate the relationship between evening exercise and evening mood? I tested whether self-compassion moderated the same-day relationship between evening exercise and evening mood. Self-compassion was a significant moderator of the relationship between self-reported moderate exercise and negative evening mood ($\gamma_{30} = .003$, $t = 2.03$, $p < 0.05$), and the relationship between self-reported vigorous exercise and negative evening mood ($\gamma_{30} = 0.006$, $t = 2.17$, $p < 0.05$). Individuals who reported higher than average self-compassion on a given day experienced increases in negative mood as they engaged in more self-reported moderate or vigorous exercise

(see Figures 7-9). In contrast, individuals who reported lower than average self-compassion on a given day showed decreases in negative mood as they engaged in more self-reported moderate or vigorous exercise. Individuals who were experiencing their average levels of self-compassion had stable negative mood. The random effects of the intercepts were significant.

Table 9 Self-Compassion as a Moderator of the Same Day Relationship Between Exercise and Mood

	Outcomes							
	Evening Positive Mood				Evening Negative Mood			
	Fixed Effects		Random Effects		Fixed Effects		Random Effects	
Predictors	*b*	*t*	u_0	*r*	*b*	*t*	u_0	*r*
Mild Exercise	-.001	-0.48	.14***	.17	.0004	.45	.15***	.14
Moderate Exercise	-.002	-.03	.14***	.17	.003	2.03*	.15***	.13
Vigorous Exercise	.003	.08	.14***	.18	.006	2.17*	.15***	.13

Note. b = unstandardized HLM coefficient. * $p < .05$; ** $p < .01$; *** $p < 0.001$

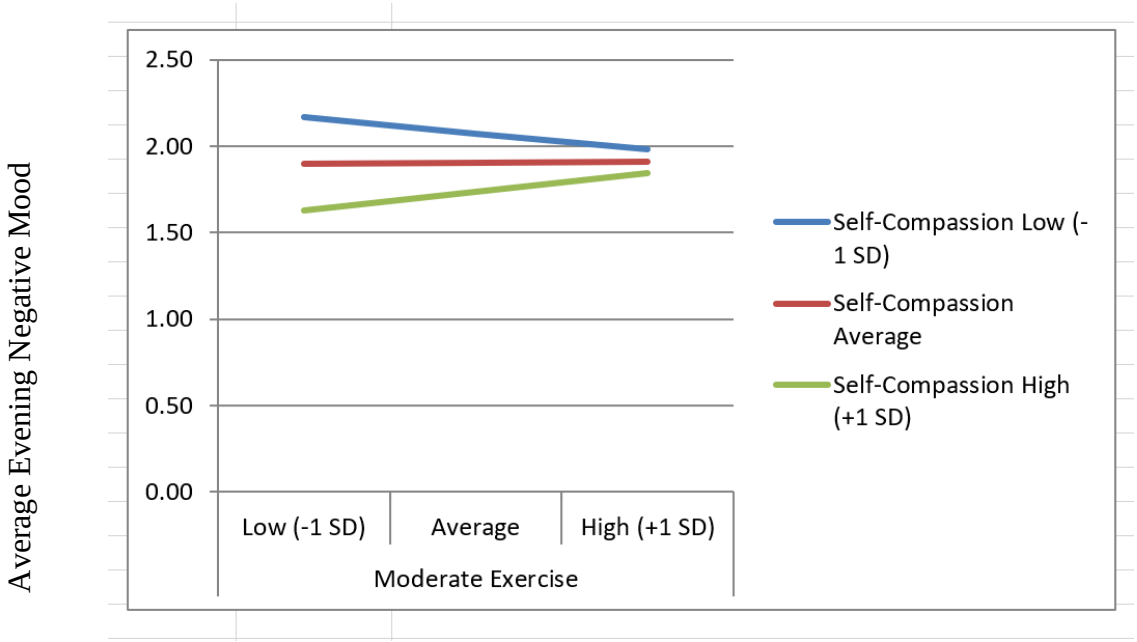

Figure 7. Self-Compassion Moderates the Moderate Exercise to Negative Mood Relationship.

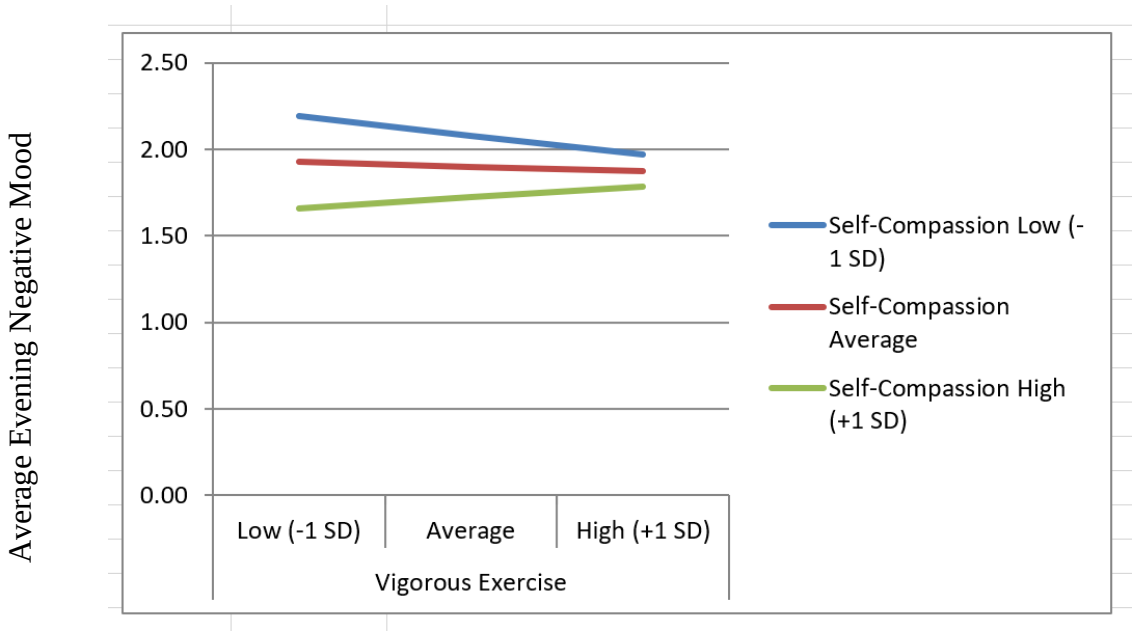

Figure 8. Self-Compassion Moderates the Vigorous Exercise to Negative Mood Relationship.

Self-Compassion as a Moderator of Relationships between Sleep and Morning Mood

I expected that individual differences in average self-compassion would moderate the within-person relationships between sleep and mood the next morning (see Table 10). In these analyses, I controlled for the outcome of interest on the previous day. Evening self-compassion, mood, and sleep measures were group-mean centered. Level-2 covariates (age, and mental health symptoms) were grand-mean centered. The model is below.

Equation 5 Area:

Day level: $y_{ij} = \beta_{0j} + \beta_{1j}$ (Previous day's evening self-compassion) + β_{2j} (Morning sleep measure) + β_{3j} (Previous day's evening affect) + β_{4j} (Previous day's evening self-compassion* Morning sleep measure) + r_{ij}

Person-level intercept: $\beta_{0j} = \gamma_{00} + \gamma_{01}$ (Age) + γ_{02} (Sex) + γ_{03} (Mental Health Symptoms) + u_{0j}

Person-level slope: $\beta_{1j} = \gamma_{10}$

Person-level slope: $\beta_{2j} = \gamma_{20}$

Person-level slope: $\beta_{3j} = \gamma_{30}$

Person-level slope: $\beta_{4j} = \gamma_{40}$

Does self-compassion moderate the relationship between sleep and morning mood? I tested whether self-compassion moderated the relationship between sleep satisfaction or sleep duration and morning mood. Self-compassion was not a significant moderator of the relationship between sleep and morning positive or negative mood. The random effects of the intercepts were significant.

Table 10 Self-Compassion as a Moderator of the Relationship between Sleep and Morning Mood

	Outcomes							
	Sleep Duration				Sleep Satisfaction			
	Fixed Effects		Random Effects		Fixed Effects		Random Effects	
Predictors	*b*	*t*	u_0	*r*	*b*	*t*	u_0	*r*
Evening Positive Mood	-.04	-.71	.21***	.15	-.009	-.19	.08***	.12
Evening Negative Mood	.0001	.12	.20***	.17	-.0003	-.85	.07***	.13

Note. *b* = unstandardized HLM coefficient. * $p < .05$; ** $p < .01$; *** $p < 0.001$

Discussion

To my knowledge, no study has examined state self-compassion as a moderator of the relationship between daily health behaviors and daily affect. Understanding these relationships is helpful for developing effective daily self-compassion interventions to improve well-being. Additionally, I examined the daily interrelationships among different intensities of exercise, sleep, and mood. While there is evidence for benefits of health behaviors including exercise and sleep on mood, few studies have included different intensities of exercise and examined how affect influences participation in health behaviors (Liao et al., 2015).

Relationships between exercise and mood

My hypothesis that there is a bi-directional relationship between exercise and mood, such that longer duration of intense exercise is related to greater positive mood on the same-day and vice versa, was partially supported. Higher intensity self-reported exercise (i.e., moderate, and vigorous exercise) in the daytime was related to evening positive mood. Self-reported exercise did not predict positive or negative mood the next morning, which suggests that mood benefits following exercise are short-term. Morning positive or negative mood also did not predict exercise on the same day. These findings provide further evidence that higher intensity of exercise helps benefit positive mood in the short-term. The benefits of moderate and vigorous exercise on affect may be the result of an increase in endorphins (Dishman & O'Connor, 2009; Thorén, Floras, Hoffmann, & Seals, 1990), increased release of serotonin (Wilson & Marsden, 1996), and increases in self-efficacy (Bodin & Martinsen, 2004) following exercise.

Relationships between sleep and mood

As hypothesized, increased sleep satisfaction and self-reported sleep duration were related to greater positive mood and decreased negative mood in the morning. These findings are consistent with those from a 7-day study with college students (Simor et al., 2015) and a recent meta-analysis (Konjarski, Murray, Lee, & Jackson, 2018). REM sleep enhances the processing of emotional information, allowing individuals to better regulate their emotions and appropriately evaluate negative stimuli the next day (Tempesta, Socci, De Gennaro, & Ferrara, 2018). The role of sleep in emotion regulation suggests the importance of promoting healthy sleep behaviors particularly for young adults who are more vulnerable to mental health problems.

Evening positive or negative mood were not related to sleep satisfaction or sleep duration. This is inconsistent with earlier research that found a bi-directional relationship between sleep and mood with university students (Galambos et al., 2009) and with adolescents (van Zundert, van Roekel, Engels, & Scholte, 2015). In my study, participants had an 8-hour window in which they reported on their mood in the evening. Thus, some individuals could have reported on their mood several hours before going to sleep, and perhaps circumstances closer to participants' bedtime affected their mood right before sleeping (e.g., a conversation with a roommate). In order to make conclusive statements about the relationship between sleep and mood, future studies should obtain mood measures right before an individual goes to sleep.

Self-compassion as a moderator of relationships among exercise, sleep, and mood

Consistent with my hypothesis, individuals who reported low daily self-compassion and low moderate or vigorous exercise reported the highest score for negative mood. These findings suggest that it may be especially important to promote higher intensity of exercise for individuals who report low scores of daily self-

compassion. Individuals who were average in self-compassion showed more stability in their reports of negative mood as they engaged in more moderate or vigorous exercise.

Additionally, as hypothesized, students who reported high daily self-compassion reported the lowest negative mood when compared with students who reported average or low daily self-compassion. However, contrary to my hypothesis, individuals with high daily self-compassion reported increases in negative mood as they increased the amount of moderate or vigorous exercise. It may be the case that higher daily self-compassion promotes a desire for calmness. The individual might prefer to engage in more self-soothing activities such as taking a warm bath or doing yoga, than those that might lead to increased arousal and put more stress on the body (e.g., moderate, and vigorous exercise). Accordingly, activating a self-compassionate state appears to resemble the physical pattern of relaxation. There is reduced sympathetic nervous system activity (Arch et al., 2014) and reduced cortisol levels (Rockliff et al., 2008). These findings suggest that increasing daily self-compassion could be especially helpful for decreasing negative affect among college students and possibly, increasing moments of relaxation.

A limitation of my study was that individuals reported on all three measures (moderate and vigorous exercise, self-compassion, and negative mood) at the same time. This makes it more challenging to parse out the timing of these relationships. In future studies, it would be helpful to obtain real-time data of individuals' daily self-compassion, exercise, and post-exercise mood.

Strengths, limitations, and future directions

The present study examined the daily interrelationships among self-compassion, exercise, sleep, and mood across 8 days. The assessment of mood and naturally occurring exercise in the real-world allowed for high ecological validity (Shiffman et al., 2008). I included multiple intensities of exercise in my study unlike most within-person studies

which typically focus on more intense exercise (e.g., moderate, and vigorous exercise). These strengths help advance our understanding of the relationships among daily health behaviors and mood, and how daily self-compassion might influence their relationships.

Despite this study's strengths, the design of the study makes it difficult to control for confounding variables. There were likely external factors that influenced participants' reports of health behaviors, mood, and self-compassion. For example, participants' workload and stress levels at the time of the evening questionnaire could have affected their report of evening mood, and a doctor's appointment could have affected their participation in exercise that day. Eight days of daily data may not best represent students' participation in health behaviors. It may be helpful to measure these relationships over a longer period though this would also increase the burden placed on participants. Additionally, a methodological limitation of my study was that normality for the dependent variables could not be assumed for moderate and vigorous exercise since they were skewed variables. Furthermore, the measure of mood in my study might overlap with sleep quality with items such as "tired," and "drowsy" to measure negative mood and "active" to measure positive mood.

A further limitation is the potential for individuals to increase their daily amount of exercise and sleep due to self-monitoring of health behaviors (Sullivan & Lachman, 2017). On self-reports, participants may overestimate their amount of exercise (Prince et al., 2008). Of note, the actigraph data I used in my study did not correlate with self-reports. There was significant missing data because 5 of the 20 actigraphs would not download participant data. The actigraphs had previously been used with children, and an inexperienced doctoral student helped us reset the measurements of exercise and sleep. Thus, it is unclear if there were accurate actigraph settings and data downloads. Lastly, this study was only conducted with university students, so the sampled population is

younger than the general U.S. population. Thus, one should exercise caution in generalizing findings to others.

Future studies should measure young adults' health behaviors (including exercise and sleep), pre-sleep affect, post-exercise affect, and self-compassion in real time when they occur to better control for external variables that may bias report of these measures at a later time. Additionally, future studies should distinguish between activated (e.g., nervous) and deactivated negative affect (e.g., tired) in order to better understand the relationships among self-compassion, health behaviors, and negative affect. It may be the case that higher self-compassion is associated with increased deactivated negative affect as an individual participates in increased moderate or vigorous exercise. It would also be helpful for future studies to measure different types of exercise (e.g., running, swimming, yoga). Self-compassion may promote participation in relaxing activities such as yoga and light walking.

Conclusions

This study highlights the importance of increasing college students' daily self-compassion to improve mood. For those who experience more self-compassion on a given day, they might desire more calmness throughout their day than people low in their daily self-compassion. In turn, they might be more inclined to participate in activities that promote relaxation than activities that increase arousal. Thus, the practice of self-compassion could be particularly helpful for college students who experience high negative mood and over-extend themselves. Self-compassion could help these individuals prioritize self-care.

CHAPTER FOUR: CONCLUSION

It may be particularly helpful for college students who experience daily high negative mood and who are high on neuroticism, to increase self-compassion through the practice of self-kindness, common humanity, and mindfulness. In the context of exercise, young adults could become more aware of the bodily sensations they experience when exercising (mindfulness), recognize they are not the only ones experiencing pain and soreness when exercising (common humanity), and praise themselves for the exercise they are able to do (self-kindness). In the context of sleep, college students who identify as poor-quality sleepers could practice being more accepting of how long it takes for them to fall asleep (mindfulness), recognize they are not the only ones who struggle with falling asleep (common humanity), and practice a self-soothing routine prior to bedtime (self-kindness). In turn, practicing self-compassion could help improve daily mood and promote self-care. After repeated practice of self-compassion, it may predict increased exercise satisfaction and better sleep quality while protecting against the development, progression, or exacerbation of mental health problems in college students.

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