Resilience in undergraduate students: The relation between personality, social support, and cortisol levels

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RESILIENCE IN UNDERGRADUATE STUDENTS:
THE RELATION BETWEEN PERSONALITY, SOCIAL SUPPORT,
AND CORTISOL LEVELS

An Abstract of a Thesis
Submitted
in Partial Fulfillment
of the Requirements for the Degree
Master of Arts

Elisheva Joy Havlik
University of Northern Iowa
December 2018
ABSTRACT

The purpose of the current study was to investigate resilience in relation to personality, social support, and cortisol levels in response to a stress induction in a sample of 174 undergraduate students. It was hypothesized that resilience would be positively related to personality traits and perceived social support, and also would predict cortisol levels at baseline, reactivity to stress induction, and recovery after stress induction. Additionally, exploratory analyses investigated the moderating effects between variables to explain the process of resilience further. Participants completed self-report questionnaires (i.e. the CD-RISC, BFI, and the MPSS), provided saliva samples via a passive drool collection test, and underwent a stress induction (i.e. the TSST). Results showed that resilience was significantly positively correlated with social support and four of the personality traits including extraversion, emotional stability, agreeableness and conscientiousness. The analyses of resilience and cortisol level yielded a more complex relation than the initial assumptions. Higher levels of extraversion and higher levels of resilience together predicted the lower levels of cortisol reactivity; however, the moderation analysis also indicated that for those low in extraversion, higher resiliency was associated with higher levels of cortisol reactivity. Further, lower levels of resilience and emotional stability predicted a lower cortisol reactivity. This indicates that the protective effect of resilience can present differently depending on the individual. For example, if the individual has maladaptive personality traits (e.g. low extraversion and low emotional stability), resilience may protect against a blunted cortisol response. Limitations and future research directions are discussed.
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This Study by: Elisheva Havlik

Entitled: Resilience in Undergraduate Students: The Relation between Personality, Social Support, and Cortisol Levels

has been approved as meeting the thesis requirement for the

Degree of Master of Arts in Psychology

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CHAPTER 1
THE IMPORTANCE OF RESILIANCE RESEARCH

Historically, clinical psychological research has been heavily focused on risk and vulnerability factors. The predominate inquiries in the literature concern the etiology and epidemiology related to the development of mental illness and the efficacious and effective means of treating mental illness. Although this area of investigation has made a profound contribution to the identification and treatment of mental illness, less attention has been allocated to what makes people well and healthy. Many people navigate life’s adversities successfully without negative mental health outcomes. A better understanding of how these positive outcomes are obtained would allow for the development of preventative interventions that promote health and, in turn, potentially avoid suffering as well as treatment in the future.

Luthar and Cicchetti (2000) advocated for resiliency research as a necessary supplement to the vulnerability literature for the following four reasons. (1) Vulnerability research alone limits a holistic understanding of the individual by emphasizing their weakness and disregarding their strength. (2) Vulnerability research is inherently focused on treatment whereas the promotion of resilience is based on prevention. A focus on prevention builds on existing strengths and strives to empower; shifting the focus from vulnerabilities to strengths provides a more empowering experience for the individual. (3) Vulnerability does not always predict negative outcomes. A better understanding of how resiliency is developed will serve as the foundation for creating and implementing effective interventions that promote positive outcomes despite adversity (Linley & Joseph, 2004; Rutter, 1985). (4) Difficult circumstances are, at times, an inevitable part of
life. Although alleviating these adversities is an ideal form of treatment, this approach is not always feasible (e.g. the loss of a loved one). Thus, it is argued that treatment outcome is optimized by compensating vulnerability reduction with resilience promotion (Linley & Joseph, 2004).

Resilience: Conceptualization and Theory

Resilience has been defined as a dynamic process which involves positive adaption in the presence of adverse circumstances (e.g. Cicchetti & Blender, 2006; Fletcher & Sarkar, 2013; Luthar & Cicchetti, 2000; Luthar, Cicchetti, & Becker, 2000). Thus, the construct is twofold, involving: (1) adversity and (2) positive adaption. Adversity is a broad construct which ranges from daily life stressors (e.g. work stressors, relationship stressors, etc.) to severe trauma (e.g. sexual assault, military combat, etc.). Such adversities, at some level, are an inevitable experience in life (Fletcher & Sarkar, 2013). Positive adaption is the achievement of successful outcomes in response to adversity. It is a developmental process that can vary depending on the adversity encountered and the internal or external resources present at the time (Luthar et al., 2000). For example, positive adaption can depend on the stressor encountered and the individual’s positive or negative emotional state at the time (Ong, Bergeman, Bisconti, & Wallace, 2006).

This conceptualization of resilience has been differentiated from a trait or attribute in the recent literature (Cicchetti & Blender, 2006; Fletcher & Sarkar, 2013; Linely & Joseph, 2004; Luthar & Cicchetti, 2000; Luthar et al., 2000; Pangallo, Zibarras, Lewis & Flaxman, 2015). Early resilience research focused on descriptions of internal
(e.g. personality) and external (e.g. social support) protective factors that predict positive outcomes (e.g. Benson, 2006; Garmezy, 1991; Rutter, 1985; Werner, 1982). Resiliency literature has shifted from identifying protective factors, also referred to as resilient qualities, to explaining how these resilient qualities contribute to the process of resiliency.

This shift was elaborated by Richardson (2002) who explained the shift by identifying two waves of resiliency literature. The first wave of literature consists of initial inquiries which attempt to explain what resilience is. This first wave of resiliency literature provides an exhaustive list of resilient qualities (e.g. traits, states, characteristics, conditions, etc.) that aid in the recovery from adversities. However, the process of how these resilient qualities were developed and utilized during encounters with adversity was not understood. This sparked the second wave of resiliency literature. The second wave of resiliency literature has sought to understand the process of resiliency. In other words, these inquiries attempt to explain how resiliency develops; thus, aiding in the formulation of an underlying theory of resiliency.

These two waves of literature provided the foundation for the proposed metatheory of resiliency. The metatheory of resiliency (Richardson, Neiger, Jensen, & Kumpfer, 1990; Richardson, 2002) describes how “biopsychospiritual homeostasis” (Richardson, 2002, p. 310; i.e. an adapted and balanced state of mind, body, and spirit) is routinely challenged by ever-changing environmental stimuli (e.g. stressors, adversity, opportunities, etc.). When biopsychospiritual homeostasis is disrupted, the individual experiences discomfort (e.g. fear, confusion, guilt, etc.) which initiates a response, also
known as the reintegrative process. Richardson (2002) elaborated on how humans cultivate resilient qualities to inhibit further disruptions to biopsychospiritual homeostasis through experience with previous disruptions. For example, something that was first disrupting, such as an individual's first day at school, becomes familiar and routine for the individual if they develop the necessary resilient qualities to adapt to their academic setting. If the individual fails to develop these resilient qualities in response to disruption, chronic stressors emerge.

Richardson (2002) identified four ways an individual can reintegrate in response to biopsychospiritual homeostasis disruptions: (1) resilient reintegration, (2) reintegration back to homeostasis, (3) reintegration with a loss, or (4) dysfunctional reintegration. Resilient reintegration, meaning an individual experiences growth or insight through the reintegration process, is ideal. Resilient reintegration is essentially the development and utilization of resilient qualities (i.e. protective factors) that aid in inhibiting disruptions in the future when encountering similar stressors. Reintegration back to homeostasis is to heal from the disruption. This response likely involves avoidance of the disruption. However, simply getting past the disruption through avoidance does not allow for growth as in resilient reintegration. Reintegration with loss occurs when an individual experiences a loss of motivation (e.g. hope, ambition, etc.) due to the disruption. Finally, dysfunctional reintegration occurs when the individual utilizes detrimental coping strategies in response to the disruption (e.g. substance abuse, disruptive behaviors, etc.). The metatheory described above provides a foundation for understanding the process of resiliency.
Early literature identifying resilient qualities contributed to our understanding of the process of resiliency (Luthar et al., 2000). When encountering adversities, an individual can utilize the resilient qualities available (e.g., psychological resources) and these qualities can be further developed through a resilient reintegration process (Richardson et al., 1990; Richardson, 2002). Thus, the relationship between resilient qualities and the process of resiliency is conceptualized as a cyclical learned process. Numerous resilient qualities have been explored in the literature such as the capacity for self-regulation and social competence (Masten & Coatsworth, 1998; Rutter, 1985). Two of the most predominate resilient qualities studied are personality and perceived social support.

**Personality as a Resilient Quality**

Personality has been studied a considerable amount in relation to resilience. Among many theories of personality, trait theory has been the predominately utilized within literature investigating the relationship between personality and resilience. Trait theory, which was initially conceptualized by Allport (1937), asserts that an individual possesses general and stable characteristics. These general and stable characteristics are known as personality traits. Personality traits are thought to be innate and able to predict situation-specific behavior to a certain degree. For example, when behavior is aggregated across multiple situations, reliable patterns of behavior emerge, providing evidence of general and stable traits (Swann & Seyle, 2005). In addition, there is modest continuity in personality from childhood through adulthood, providing further evidence of trait stability (Caspi & Roberts, 2001). Several reliable associations have been found between
personality and resilience. The strongest and most frequent associations found in the literature are resilience in relation to extraversion and emotional stability (i.e. the inverse of neuroticism).

Resilience has been positively associated with the personality trait of extraversion and extraversion serves as a positive predictor for resilience (Hsieh, Chang, & Wang, 2017; Nakaya, Oshio, & Kaneko, 2006; Palma-Garcia & Hombrados-Mendieta, 2017; Womble, Labbe, & Cochran, 2013; Zeb, Naqvi, & Zonach, 2013). Further, constructs comparable to extraversion (i.e. agentic and communal traits) relate to resilience in the same fashion (Gonzalez, Bockting, Beckman, & Duran, 2012). This positive association has been attributed to the idea that extroverted individuals tend to have a more positive emotional style, engage in more social activities, and tend to seek the support of others more frequently relative to introverted individuals (Foumani, Salehi, Maryam, & Babakhani, 2015).

Resilience has been positively associated with emotional stability (i.e. the inverse of neuroticism) and emotional stability serves as a positive predictor of resilience (Hsieh et al., 2017; Nakaya et al., 2006; Shi, Liu, Wang, & Wang, 2015; Palma-Garcia & Hombrados-Mendieta, 2017; Womble et al., 2013; Zeb et al., 2013). Further, constructs comparable to neuroticism, such as Type D personality, relate to resilience in the same fashion (Cho & Kang, 2017). If an individual is emotionally stable, adversities may be less disrupting and allow the individual to more objectively work through the life’s adversity successfully.
The associations between resilience and the personality traits of extraversion and emotional stability have been reliably replicated across a wide range of demographics. From samples of undergraduate students (Nakaya et al., 2006; Womble et al., 2013), to abused nurses (Hsieh et al., 2017), social workers (Palma-Garcia & Hombrados-Mendieta, 2017), and soldiers (Zeb et al., 2013) higher levels of extroversion and neuroticism consistently predict higher levels of resilience.

Additionally, although notably weaker, associations between resilience and personality traits are reliably found throughout the literature. Resilience has been positively associated with conscientiousness (Nakaya et al., 2006; Palma-Garcia & Hombrados-Mendieta, 2017; Shi et al., 2015; Womble et al., 2013; Zeb et al., 2013), openness (Nakaya et al., 2006; Palma-Garcia & Hombrados-Mendieta, 2017; Shi et al., 2015; Zeb et al, 2013), and agreeableness (Shi et al., 2015; Womble et al, 2013; Zeb et al., 2013). High levels of these traits are protective such that the processing these qualities are useful when encountering and overcoming adversity; for example high conscientiousness often involves engaging in goal-oriented behavior, those high in agreeableness likely have an optimistic view of human nature, and those high in openness are less likely to be timid or avoidant of unfamiliar situations.

Furthermore, resilience is positively associated with generally well-adjusted personality profiles which include high levels of extraversion and emotional stability (Friborg, Barlaug, Martinussen, Rosenvinge, & Hjemdal, 2005). Resilience also has been shown to buffer the relationship between maladjusted personality profiles and negative
mental health outcomes, specifically anxiety symptoms (Shi et al., 2015) and post-traumatic stress disorder symptoms (Cho & Kang, 2017).

While there have been associations found between personality and resiliency, studies have shown the constructs of personality and resilience are clearly differentiated. A qualitative review (Reyes, Andrusyszyn, Iwasiw, Forchuk, & Babenko-Mould, 2015), provided evidence of resiliency as a unique construct, differentiated from a personality trait, as participants described their own experience with resilience as a dynamic contextual process that can be learned and developed rather than a static personality trait or characteristic. Similarly, Hjemdal, Friborg, and Stiles (2012) found further evidence supporting resilience as a unique construct; resilience predicted additional variance in hopelessness after accounting for personality.

As indicated above, there are replicable findings in the literature which identify the association between personality and resiliency, illustrating that personality traits can reliably predict resiliency, and differentiate the construct of personality traits from resiliency. These findings are in line with the second wave of resiliency literature which asserts that personality serves as an internal resilient quality which can be utilized when faced with adversity and contribute to the process of resiliency (Richardson et al., 1990; Richardson, 2002).

**Social Support as a Resilient Quality**

While personality is an internal resilient quality, social support has been conceptualized as an external resilient quality that promotes resilient reintegration when faced with adverse circumstance (Richardson et al., 1990; Richardson, 2002). The
important contribution of social support is further evidenced in the empirical literature (e.g. Jaffee, Caspi, Moffitt, Polo-Tomas, & Taylor, 2007).

Social support has been positively related to resilience (e.g. Wilks & Croom, 2008). Several studies indicate that perceived social support partially mediates the relationship between resilience and outcomes (e.g. Ong et al., 2006; Swanson, Geller, DeMartini, Fernandez, & Fehon, 2018; Yuan, Xu, Liu, & An, 2018). Further, perceived social support has been shown to buffer the relationship between risk factors and negative outcomes (e.g. Panagioti, Gooding, Taylor, & Tarrier, 2014).

These findings are in line with the theoretical expectations asserting that perceived social support serves as an external resilient quality when an individual is faced with adversity which contributes to the resiliency process (Richardson et al., 1990; Richardson, 2002).

**Neuroendocrine Mechanisms in Relation to Resilience**

Although there have been numerous studies investigating psychosocial resilient qualities, as in the studies investigating the relationship between personality and social support in relation to resilience described above, less attention has been allocated to biological processes that underlie resilience. Recent advances in technology have enabled the study of biological processes that underlie resilience including measurement of neurochemical, neuroendocrine and neural systems (Charney, 2004; Feder, Nestler, & Charney, 2009; Cicchetti & Blender, 2006).

Biological processes involved in psychobiological responses to stress can inform the understanding of the process of resilience. The current literature examining resilient
psychosocial qualities can be supplemented and enhanced with further investigation of these biological processes (Luthar et al., 2000). Specifically, understanding healthy biological responses to stress and investigating whether these responses link as expected to the current conceptualization of the resiliency process would sure up the psychosocial research of resiliency.

Further, given that biological responses to stress can have major health consequences such as an increased risk of developing conditions like heart disease and obesity (McEwen & Stellar, 1993), investigating whether resilience could assist in producing healthy biological stress responses could be of great value in practice. If resilience can predict a healthy biological response to stress, preventative interventions could be designed and implemented in practice to promote resilience and, thus, produce healthier biological responses to stress.

**Cortisol**

One measure of a psychobiological response to stress is the release of cortisol (Charney, 2004). The release of cortisol begins with the hypothalamus releasing corticotropin-releasing hormone (CRH) in response to stress which leads to the activation of the HPA axis and the release of cortisol. The short-term actions of cortisol promote adaption and are protective because they aid in effectively dealing with the presenting stressor. By mobilizing and replenishing energy stores, cortisol contributes to increased arousal, vigilance, focused attention, and memory formation (Feder et al., 2010). In addition, cortisol inhibits growth, inhibits reproductive systems, and contains the immune response. Excessive and prolonged levels of cortisol can lead to negative health outcomes...
such as hypertension and immunosuppression. Thus, it has been argued that an adaptive cortisol response involves a constraint of the release of cortisol through a complex a negative feedback system (Charney, 2004).

This parallel between resilience and an attenuated HPA axis response has been explored in animal studies. In a rat study conducted by Pfau and Russo (2015), pups who received an increased amount of maternal care were more likely to have an attenuated HPA axis response to stress and an attenuated response to subsequent stress (Pfau & Russo, 2015). However, the empirical literature clarifying this link in humans is lacking.

The adaptive cortisol response, in relation to resilience described above, is in line with theoretical expectations of the resiliency process. The metatheory of resilience asserts that resilience is a developmental process through which resilient qualities are learned and acquired through the reintegration process, providing more available resources to the individual when faced with adversity and inhibiting the development of chronic stressors (Richardson et al., 1990; Richardson, 2002). Therefore, resiliency theoretically involves the inhibition of prolonged excessive levels of cortisol and a constrained cortisol response; however, while cortisol regulation is central to an adaptive stress response, the relationship between cortisol regulation and resilience is still unclear (Russo, Murrough, Han, Charney, & Nestler, 2012).

Current Study

The current study will provide conceptual replications of resilience in relation to personality and perceived social support. In addition, relations between resilience and neuroendocrine mechanisms will be investigated. Specifically, the relation between
resiliency and cortisol will be investigated. Thus, the current study will contribute to the understanding of biological processes that underlie resilience which is an area of the literature that is still in its infancy. Specifically, through a quasi-experimental design, the current study will investigate the following hypotheses: (1) resilience will be positively related to personality traits of extraversion, conscientiousness, openness, and agreeableness, while being negatively related to the personality trait of neuroticism, (2) resilience will be positively related to perceived social support, (3) resilience will significantly predict cortisol levels at baseline (i.e. prior to the stress induction), reactivity (i.e. the change in cortisol levels from baseline to after the stress induction), and recovery (i.e. the change in cortisol levels from after the stress induction to approximately 40 minutes after the stress induction). It is predicted that cortisol levels will be lower at baseline, there will be lower reactivity and a higher rate of recovery.

Additionally, exploratory analyses will be conducted to investigate the moderating effects between variables to explain the process of resilience further. Specifically, the following research question will be explored: Does resiliency moderate the relationship between resilient qualities (i.e. personality and perceived social support) and cortisol levels? According to the meta-theory of resilience (Richardson, 2002), resiliency should facilitate the utilization of resilient qualities when faced with adversity. Thus, resiliency should interact with resilient qualities to produce lower reactivity and a higher rate of recovery in response to the stress induction.
CHAPTER 2

METHOD

Participants

Power Analysis

Prior to conducting the study, a power analysis was done to determine the estimated number of participants required for the study to have adequate power. The power analysis was conducted utilizing the following criteria; F test, multiple linear regression, fixed model, $R^2$ increase, with alpha set at .05, beta set at .20, expected effect size of .08, and four predictor variables. A total sample size of 155 participants is needed for adequate power (Faul, Erdfelder, Buchner, & Lang, 2009).

Recruitment and Inclusion Criteria

Undergraduate students were recruited from introductory psychology courses at a Midwestern university through an electronic participant pool sign-up system (SONA). Students received credit towards their research requirement in exchange for their participation. Participation was voluntary; participants elected to participate in the current study among several alternative study options as well as an alternative assignment option.

In order to ensure an accurate assay assessment, the following inclusion criteria were elaborated within the SONA recruitment description: (1) participants should not drink alcohol or exercise 24 hours prior to participation, (2) participants should not consume coffee or acidic food or drink and should not smoke two hours prior to participation, (3) participation should not eat a full meal one hour prior to participation, and (4) participants should not consume sugar, acidic foods, caffeine, or dairy products.
immediately prior to participation. Additionally, participants were required to be between the ages of 18 and 25 years old as there may be fluctuations in resilience across the lifespan (Southwick, Litz, Charney, & Friedman, 2011).

Demographics

The resulting sample initially consisted of 175 undergraduate students; however, one participant was excluded from analysis due to withdrawing from the experiment during the stress induction. The final sample included in further analysis consisted of 174 undergraduate participants; 63.8% (N = 111) identified as biologically female, 81.6% (N = 142) identified as White, and participants ranged from age 18 to 25 years old with 76.7% (N = 132) being age 18 or 19 years old.

Measures

The Connor-Davidson Resilience Scale

The Connor-Davidson Resilience Scale (CD-RISC: Connor & Davidson, 2003) was utilized to assess resilience. Based on the metatheory of resilience (Richardson et al., 1990; Richardson, 2002), the CD-RISC conceptualizes resilience as the ability to cope with stress. The CD-RISC consists of 25 items on a 5-point scale (0 = not at all true, 4 = true nearly all of the time) with higher scores indicating greater resilience. Participants rate items based on how they have felt within the past month. An example item of this scale is “When things look hopeless, I don’t give up.”

In the initial psychometrics evaluation, the CD-RISC yielded Cronbach’s alpha of .89 and total item correlations of .30 to .70. in a general community sample of 577 participants and test-retest reliability of .87 in a clinical sample of 24 participants. The
CD-RISC demonstrated convergent validity when correlated with measures of hardiness, perceived stress, stresses vulnerability, desirability, and social support. Further, the CD-RISC demonstrated discriminate validity when correlated with a sexual experience measure (Connor & Davidson, 2003). In the current study, the overall CD-RISC yielded strong reliability (Cronbach’s $\alpha = .90$).

Since the development of the CD-RISC, the scale has become widely utilized (e.g. Brown, 2008; Connor, Davidson, & Lee, 2003; Pietrzak et al., 2010; Steinhardt & Dolbier, 2008), and numerous studies have further evidenced the sound psychometric properties of the CD-RISC in diverse samples. The factor structure, however, has been found unstable, ranging from two to six factors (e.g. Green et al., 2014; Jorgensen & Seedat, 2008; Karaırmak, 2010; Singh & Yu, 2017; Wu, Tan, & Liu, 2017), depending on the sample.

**The Big Five Personality Inventory**

The Big Five Personality Inventory (BFI: John, Naumann, & Soto, 2008) consists of 44 items on a 5-point rating scale on which the participant rates the extent to which each item applies to them (1 = disagree strongly, and 5 = agree strongly). The BFI consists of five-factors (i.e. Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness) which are conceptualized as personality traits: Extraversion is an energetic approach towards social and other interactions (e.g. “you are someone who is full of energy”). Agreeableness is described as a prosocial and communal orientation (e.g. “you are someone who is helpful and unselfish with others”). Conscientiousness is socially prescribed impulse control (e.g. “you are someone who
does a thorough job”). Neuroticism is described as negative emotionality (e.g. you are someone who worries a lot). Lastly, openness involves openness to mental and experiential life (e.g. “you are someone who is curious about many different things”).

In the initial psychometrics evaluation, the BFI had good internal consistency (Cronbach’s α = .83) in a sample of 829 undergraduates (John et al., 2008). In the current study Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness yielded Cronbach’s alphas of .89, .77, .76, .83, and .81 respectively.

**The Multidimensional Scale of Perceived Social Support**

The Multidimensional Scale of Perceived Social Support (MPSS; Zimet, Dahlem, Zimet, & Farley, 1988) consists of 12 items on a 7-point scale on which the participant indicates how they feel about each item (1 = very strongly disagree, 7 = very strongly agree). The MPSS consists of three factors representing different sources of support: family (e.g. “my family really tries to help me”), friends (e.g. “I can count on my friends when things go wrong”), and significant other (e.g. “I have a special person who is a real source of comfort to me”).

Zimet et al. (1988) reported that the three subscales and the total scale of the MPSS had good internal consistency in a sample of 275 (Cronbach’s alpha .85-.91). In the current study, the MPSS demonstrated good reliability yielding a Cronbach’s alpha of .90. In addition, the family, friends, and significant other subscales also demonstrated good reliability with the Cronbach’s alpha of .89, .94, and .95 respectively.
Salivary Assays

Salivary assays have been deemed a valid and reliable method of estimating hormone levels, including cortisol and testosterone (e.g. Gozansky, Lynn, Laudenslager, & Kohrt, 2005; Granger, Schwarz, Booth, & Arentz, 1999). In the current study, saliva samples were collected to assess cortisol via a non-invasive passive drool test in accordance with the Salimetrics protocol. Salimetrics is a leading salivary bioscience company which provides standardized collection methods, proper storage and handling techniques, assay, and validated testing protocols (Salimetrics & SaliviaBio, 2011).

Graduate researchers collected salivary samples and conducted cortisol assay analysis under faculty supervision. The collection procedure consists of ensuring the participant meets criteria prior to collection, collecting a recommended 75 microliters of salvia or more if possible and ensuring the proper documentation and aftercare of the sample is conducted. Diurnal cortisol curves illustrate that cortisol levels are most consistent on an intraindividual basis during the afternoon and early evening hours. Thus, the collection of salivary samples was constricted to between 1:30 pm and 7:30 pm (Salimetrics & SaliviaBio, 2011).

Three saliva samples were collected per participant: baseline (time 1), reactivity to stress (time 2), and recovery from stress (time 3). These samples coincided with a stress induction described in further detail below in the procedure section. There is an approximate 20-minute delay for exposure to stressful stimuli to be reflected in cortisol levels in saliva (Kalman & Grahn, 2004). Therefore, a baseline cortisol measure was taken prior to stress induction following a short introduction to the experimental setting.
Approximately 20 minutes after the stress induction, the reactivity sample was collected. Approximately 20 minutes after the reactivity sample was collected, the recovery measure was collected.

For confidentiality purposes, all samples were labeled with the participant number and void of any personally identifying information. The saliva itself is a personal identifier, so it was kept in a locked freezer which is in a locked laboratory. The samples were analyzed then packaged for storage. Upon expiration of the storage period, the samples will be discarded in accordance with the procedures specified by the UNI Environmental Health and Safety Office Manager.

Demographic Questionnaire

Participants completed a demographic questionnaire to determine the basic characteristics of the sample such as age, race, and gender. In addition, questions regarded variables that could potentially affect cortisol levels that are not of interest to the current study (e.g. medication, anxiety disorders, sleep schedule, etc.). This information was utilized in statistical analyses to examine whether these variables created systematic differences in the data to eliminate potential confounds.

Stress Induction Checks

Given that the experimental design involves a stress induction, described in further detail below in the procedure section, induction checks were utilized to ensure that the induction had the desired effect. Three different induction checks were utilized: (1) a self-report measure of stress (i.e. the participant is asked by the researcher “on a scale of one to seven, how stressed are you feeling right now?”), (2) blood pressure (i.e.
systolic and diastolic measured in mmHg), and (3) heart rate (i.e. bpm). Each induction check was utilized three times throughout the experiment; at the beginning of the experiment following a short introduction to the experimental setting, immediately following the stress induction, and at the end of the experiment. In addition, saliva samples were tested for cortisol levels to determine if the stress induction had the desired effect.

**Procedure**

The experiment took approximately 90 minutes per participant to complete. Upon arrival to the experiment, the participant is welcomed by the graduate researcher and briefly introduced to the experimental setting. Inclusion criteria are briefly reviewed with the participant to ensure that it is appropriate to continue with the experiment. If the inclusion criteria are met, the experiment proceeds with informed consent (see Appendix E).

The participant is provided with a copy of the informed consent to read and instructed to ask any questions they may have. If the participant consents to participation, the experiment proceeds with an introduction to the study which provides an overview of the study and a brief review of participant rights and expectations. The participant is then instructed to rinse their mouths out with water to ensure clean saliva samples.

The first induction check then takes place, and the following procedure ensues. The researcher verbally indicates they will be collecting some basic information concerning the participants’ current stress level. The participant is asked, “On a scale from one to seven, one being definitely not stressed and seven being very stressed, how
stressed are you feeling right now?” Next, the participant’s blood pressure and heart rate are measured by the graduate researcher via an arm cuff.

Upon completion of the first induction check, the researcher collects the first saliva sample by implementing a non-invasive passive drool test in accordance with the Salimetrics protocol (Salimetrics & SaliviaBio, 2011). Next, the participant is instructed to complete surveys on the computer in a separate room. All surveys that include content in which a stress induction may affect responses (i.e. CD-RISC and the MPSS) are included during this time prior to the stress induction.

Upon completion of the surveys, the stress induction is implemented. The Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) was utilized as a stress induction or a means of inducing stress. The TSST has been shown to be an effective and ethical means of manipulating stress and has been utilized in many psychological studies (e.g. Gaab et al., 2003; Kirschbaum et al., 1993; Kudielka & Kirschbaum, 2005).

The participant entered the stress induction in which the researcher, a graduate or undergraduate confederate, and a video camera were present at the head of a conference table. The graduate researcher then instructed the participant as follows:

This interviewer (referring to the confederate) and I are here to assess how competent, well-spoken, and comfortable you are in situations in which you must project yourself as an expert. This is a type of test for projective competency. You will be given a hypothetical situation in which you will be applying for your ideal job. In this hypothetical situation, you are applying for your ideal job. You have dreamed about working in this job for as many years as you can remember. You have just seen an advertisement for this perfect job and decided to apply. After submitting your application, you have been invited for an interview. The job pays a very large salary. You are competing against a lot of other candidates, and the final selection will be made based on your ability to convince the interviewers of
how your experiences, abilities, and education make you a better candidate than the others. You will try to convince this panel of interviewers that you are the best candidate for the position. In addition, you will be asked to perform a mental math test, which will give us additional information about your working memory capacity. You will have 5 minutes to prepare a detailed speech. After the preparation time has elapsed, you will return and deliver your speech to the interviewer and I. Your speech should explain why you should get the job. Remember, you should try to perform better than all of the other participants. This examiner and I are specially trained to monitor and rate your speech for its believability and persuasiveness, and we will compare your performance to that of the others who perform this task. Also, you will be videotaped during the task so that the examiner and I can go over the videotape carefully and rate the contents of your speech as well as your nonverbal behavior. Now let us go back to your room so that you can prepare for your job interview in the given 5 minutes.

After receiving the instruction, the participant was directed to their preparation space in a separate room. They are provided a paper and pen to collect their thoughts but are instructed that they are not allowed to bring the paper out with them when they deliver their speech. After the five-minute preparation time has elapsed, the participant was prompted to come out of their preparation space, stand at the head of the table, and deliver their speech. The participant was given five minutes to complete their speech. The speech continued until the full five minutes has elapsed; the researcher prompted the participant to continue as necessary if the participant discontinued their speech prior to meeting the five-minute requirement.

After the speech was completed, instruction for the math task was given as follows: “Now we would like you to subtract number 13 from 6233 and keep subtracting 13 from the remainder until we tell you to stop. You should do the subtraction as fast and as accurately as possible.” When the participant made an error during the math task, the researcher prompted them to start again from the beginning. The participant was given
five minutes to complete the math task; the math task continued until the full five minutes had elapsed.

Throughout the induction, if the participant asks the researcher for further instructions, the researcher instructed them to do whatever they think is best or something of the like. The researcher and confederate remained neutral, made eye contact with the participant, took notes, and provided no feedback (verbal or non-verbal) concerning the participants' performance. However, if the participant appeared to be having an adverse response to the stress induction at any time (e.g. begins to cry or seems overly agitated), the researcher asked the participant if they are okay to continue or if they wish to stop. If the participant indicated that they wished to discontinue the stress induction, the research immediately discontinued and provided appropriate debriefing and resources. The participant was still granted credit for their participation even if the experiment was discontinued due to an adverse response. Several participants were prompted to ensure that they were okay to continue with the stress induction and the remainder of the study; however, only one participant chose to discontinue their participation due to an adverse response.

Immediately following the stress induction, the researcher conducted a second induction check. There was an approximate 20-minute delay for exposure to stimuli to be reflected in cortisol levels in saliva (Kalman & Grahn, 2004); therefore, the participant continued to complete surveys, which included the BFI and a number of additional filler questionnaires, prior to the collection of the second saliva sample which served as a measure of cortisol reactivity. These surveys took approximately 15 minutes to complete;
thus, given that there was a 20-minute delay, the second saliva sample reflected cortisol levels during the stress induction.

After the second saliva sample was collected, the participant completed the remaining surveys which included the demographics questionnaire. The remaining surveys took approximately 15 to 20 minutes. The final induction check was conducted. A third saliva sample was then collected which served as a measure of cortisol recovery. Finally, the participant was debriefed (see Appendix F), given the opportunity to ask any questions they may have and offered a copy of the informed consent to take with them.

Data Analysis

The Statistical Package for the Social Sciences (SPSS Version 23) was utilized to conduct statistical analyses in the current study. Analysis of the data began with data cleaning and testing of underlying assumptions in accordance with procedures specified by Mertler and Vannatta (2013). For example, prior to conducted each test the variables included were screened for outliers. If an outlier of a univariate tests yielded a z-score of ±3.29, then the outlier was deleted from the analysis. If an outlier of a multivariate test yielded a Mahalanobis distance $\chi^2$ which exceeded the critical value of $p < .001$, then the outlier was deleted from the analysis. Further, in the case of missing data, if missing data was below 5%, listwise deletion within the analysis being performed was conducted; if missing data exceeded 5%, the variable was to be excluded from further analysis.

A series of repeated measures analyses of variance (ANOVA) was conducted to determine whether the stress induction had the desired effect on self-report measures of stress, heart rate, blood pressure, and cortisol levels. Next, a correlation analysis was
conducted to determine the relationship between resilience, personality, and social support. Specifically, the following hypotheses were tested: (1) resilience is positively related to personality traits of extraversion, conscientiousness, openness, and agreeableness while being negatively related to the personality trait of neuroticism, and (2) resilience is positively related to perceived social support.

Then, a series of multiple regression analyses were conducted to determine if resilience was a significant predictor of cortisol levels. Specifically, the following hypothesis was investigated: (3) resilience significantly predicts cortisol levels at baseline (i.e. prior to the stress induction), reactivity (i.e. the change in cortisol levels from baseline to after the stress induction), and recovery (i.e. the change in cortisol levels from after the stress induction to approximately 40 minutes after the stress induction). It was predicted that cortisol levels would be lower at baseline, there would be lower reactivity, and a higher rate of recovery.

Finally, a series of moderation analyses were conducted utilizing the PROCESS macro (Hayes & Little, 2018) to explore the moderating effects of resilience in the relation between resilient qualities (i.e. extraversion, agreeableness, conscientiousness, neuroticism, openness, and social support) and cortisol levels (i.e. baseline, cortisol change from baseline to reactivity, and cortisol change from reactivity to recovery).
CHAPTER 3
RESULTS

Cortisol Data Screening and Interpretation

The immunoassay was conducted for both cortisol according to the Salimetrics protocol (Salimetrics & SaliviaBio, 2011). The standard curve ranges from 0.012 µg/dL to 3.000 µg/dL. In order to ensure reliability in test results, inter-assay and intra-assay coefficients of variability (CV) were calculated. Inter-assay and intra-assay CVs of less than 15% and 10% respectively are considered acceptable (Salimetrics & SaliviaBio, 2011). In the current study, cortisol immunoassay test results yielded inter-assay and intra-assay CVs of 9.30% and 5.25% respectively, and testosterone immunoassay test results yielded inter-assay and intra-assay CVs of 11.75% and 3.58% respectively. Thus, CVs were below acceptable values.

Baseline cortisol levels ranged from .044 µg/dL to 2.91 µg/dL with a mean of 0.225 µg/dL (SD = 0.235 µg/dL). Reactivity cortisol levels ranged from .073 µg/dL to 3.031 µg/dL with a mean of 0.415 µg/dL (SD = 0.310 µg/dL). Recovery cortisol levels ranged from .046 µg/dL to 5.542 µg/dL with a mean of 0.375 µg/dL (SD = 0.467 µg/dL).

Cortisol levels were not normally distributed: time one was significantly positively skewed (8.83, SE = .184, z = 48.00, p < .001) and kurtotic (98.54, SE = .366, z = 269.23, p < .001), time two was significantly positively skewed (3.94, SE = .185, z = 21.30, p < .001) and kurtotic (28.69, SE = .367, z = 78.17, p < .001), and time three was significantly positively skewed (8.45, SE = .184, z = 45.92, p < .001) and kurtotic (88.64, SE = .366, z = 242.19, p < .001). As a result, cortisol levels were transformed using a log
transformation. Further, after transformation, one outlier was identified in time one, another in time two, and an additional two in time three. Outliers were deleted from further analysis. After transformation and deletion of the outliers, all cortisol level distribution followed a normal distribution pattern: time one (skew = 0.47, SE = .185, \( z = 2.54, ns \); kurtosis = .25 , \( SE = .367, z = 0.68, ns \)), time two (skew = -.11, \( SE = .185, z = -0.59, ns \); kurtosis = -.50, \( SE = .368, z = -1.36, ns \)), and time three (skew = -.19, \( SE = .185, z = -1.03, ns \); kurtosis = .31, \( SE = .368, z = 0.84, ns \)).

**Stress Induction Check**

Self-report stress levels, heart rate, and blood pressure (systolic and diastolic) were utilized to assess the effectiveness of the stress induction. Furthermore, cortisol levels were also analyzed to ensure the expected effect of the stress induction was observed. Higher self-report stress levels, heart rate, blood pressure, and cortisol levels at time two relative to time one and three would provide evidence of an effective stress induction.

The descriptive statistics associated with self-report stress levels, heart rate, blood pressure, and cortisol levels across the three collection times are reported in Table 1. The assumptions of normality were evaluated prior to conducting repeated measures ANOVA to ensure that the underlying assumptions of the test were satisfactorily met. The assumption of normality was determined to be satisfied as the distribution appeared normal based on skew and kurtosis values for self-report stress levels, heart rate, and blood pressure. Due to inaccurate readings during collection time, two participants’ time three heart rate and blood pressure measures were not included.
Table 1

*Descriptive Statistics for Stress Induction Checks*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Report Stress Levels (rating scale of 1 to 7)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time One</td>
<td>174</td>
<td>3.72</td>
<td>1.44</td>
</tr>
<tr>
<td>Time Two</td>
<td>174</td>
<td>5.45</td>
<td>1.19</td>
</tr>
<tr>
<td>Time Three</td>
<td>174</td>
<td>3.49</td>
<td>1.36</td>
</tr>
<tr>
<td><strong>Heart Rate (bpm)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time One</td>
<td>174</td>
<td>76.62</td>
<td>12.18</td>
</tr>
<tr>
<td>Time Two</td>
<td>174</td>
<td>75.11</td>
<td>11.30</td>
</tr>
<tr>
<td>Time Three</td>
<td>172</td>
<td>71.52</td>
<td>10.97</td>
</tr>
<tr>
<td><strong>Blood Pressure (Systolic: mmHg)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time One</td>
<td>174</td>
<td>118.0</td>
<td>14.61</td>
</tr>
<tr>
<td>Time Two</td>
<td>174</td>
<td>120.41</td>
<td>14.43</td>
</tr>
<tr>
<td>Time Three</td>
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<td>114.69</td>
<td>13.60</td>
</tr>
<tr>
<td><strong>Blood Pressure (Diastolic: mmHg)</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>8.96</td>
</tr>
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<td>Time Two</td>
<td>174</td>
<td>80.87</td>
<td>9.75</td>
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<tr>
<td>Time Three</td>
<td>172</td>
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<td>9.05</td>
</tr>
<tr>
<td><strong>Cortisol Levels</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Time One</td>
<td>173</td>
<td>-0.74</td>
<td>0.22</td>
</tr>
<tr>
<td>Time Two</td>
<td>172</td>
<td>-0.47</td>
<td>0.26</td>
</tr>
<tr>
<td>Time Three</td>
<td>172</td>
<td>-0.55</td>
<td>0.25</td>
</tr>
</tbody>
</table>

*Based on log transformed values of µg/dL.
The assumption of sphericity was tested utilizing Mauchly’s Test of Sphericity and the assumption was determined to be violated for self-report stress levels [$\chi^2(2) = 18.50, p < .001$], heart rate [$\chi^2(2) = 8.64, p < .05$], diastolic blood pressure [$\chi^2(2) = 11.84, p < .01$], and cortisol levels [$\chi^2(2) = 84.89, p < .001$]; thus, Greenhouse-Geisser correction was used for these variables. However, this assumption was not violated systolic blood pressure [$\chi^2(2) = .55, p = .761$]; thus, sphericity was assumed for this variable.

Repeated measure ANOVAs were conducted to determine if there was a difference in stress levels at time one, two, and three as measured by self-report, heart rate, systolic blood pressure, diastolic blood pressure and cortisol levels. The ANOVAs yielded statistically significant effects: self-report [$F(1.82, 314.00) = 211.55, p < .001, \eta^2 = .550$], heart rate [$F(1.91, 325.85) = 32.94, p < .001, \eta^2 = .161$], systolic blood pressure [$F(2, 342) = 22.18, p < .001, \eta^2 = .115$], diastolic blood pressure [$F(1.57, 268.78) = 38.18, p < .001, \eta^2 = .183$], and cortisol levels [$F(1.43, 243.75) = 124.70, p < .001, \eta^2 = .423$].

To further evaluate differences between means, follow-up Bonferroni post-hoc tests were conducted. For all except heart rate, time two was significantly higher than time one and time three ($p < .01$), indicating that the stress induction was successful. For heart rate, however, there was not a significant difference between time one and time two ($p = .053$) but time two was significantly higher than time 3 ($p < .01$). A visual depiction of the mean difference for each induction check can be found in Figure 1.
Figure 1. Stress Induction Checks – Mean Differences

- Self-report Stress Levels
- Heart Rate
- Systolic Blood Pressure
- Diastolic Blood Pressure
- Cortisol Levels

Time: 1, 2, 3
Correlational Analysis

The descriptive statistics associated with CD-RISC scores, Extraversion, Agreeableness, Conscientiousness, Neuroticism, Openness, and MPSS scores are reported in Table 2. The assumptions of normality were evaluated prior to conducting a Pearson bivariate correlation analysis to ensure that the underlying assumptions of the test were satisfactorily met. The assumption of normality was determined to be satisfied as the distribution appeared normal based on skew and kurtosis values for CD-RISC scores, Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness; however, MPSS scores were negatively skewed (-1.534, \(SE = .184, z = -8.34, p < .001\)) and kurtotic (4.453, \(SE = .366, z = 12.17, p < .001\)). Thus, a log gamma distribution transformation was conducted. Further, after the transformation, two outliers were identified and deleted from further analysis. After the transformation and deletion of outliers, the MPSS score distribution followed a normal pattern (skew = -0.47, \(SE = .185, z = -2.54, ns\); kurtosis = -0.51, \(SE = .368, z = -1.39, ns\)).

Pearson bivariate correlation analysis results revealed that CD-RISC scores were significantly positively correlated with Extraversion (\(r = .53, p < .001\)), Agreeableness (\(r = .37, p < .001\)), Conscientiousness (\(r = .45, p < .001\)) scores and negatively correlated with Neuroticism scores (\(r = -.62, p < .001\)), but did not correlate significantly with Openness scores (\(r = .10, p = .170\)). Further, CD-RISC scores were significantly positively correlated with MPSS scores (\(r = .53, p < .001\)). See Table 3 for the correlation analysis results summary.
Table 2

*Descriptive Statistics for Correlational Analysis*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>M</th>
<th>SD</th>
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<tbody>
<tr>
<td>CD-RISC</td>
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<td>0.50</td>
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<tr>
<td>Extraversion</td>
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<td>Neuroticism</td>
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<td>Openness</td>
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<td>MPSS*</td>
<td>172</td>
<td>4.82</td>
<td>1.26</td>
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</table>

*Based on ln gamma transformed values.

Table 3

*Correlational Analysis*

<table>
<thead>
<tr>
<th></th>
<th>CD-RISC</th>
<th>E</th>
<th>A</th>
<th>C</th>
<th>N</th>
<th>O</th>
<th>MPSS*</th>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>E</td>
<td>.53**</td>
<td>-</td>
<td></td>
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<td></td>
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<tr>
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<td>.23**</td>
<td>-</td>
<td></td>
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<tr>
<td>C</td>
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<td>.26**</td>
<td>.41**</td>
<td>-</td>
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<tr>
<td>N</td>
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<tr>
<td>O</td>
<td>.11</td>
<td>.19*</td>
<td>.09</td>
<td>-.10</td>
<td>-.03</td>
<td>-</td>
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<tr>
<td>MPSS*</td>
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<td>.25**</td>
<td>.35**</td>
<td>.34**</td>
<td>-.24**</td>
<td>-.07</td>
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</tr>
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</table>

*Based on ln gamma transformed values.

*p < .05, **p < .01

E = Extraversion, A = Agreeableness, C = Conscientiousness, N = Neuroticism, O = Openness
Regression Analysis

A series of three multiple linear regression analyses were conducted to determine if CD-RISC scores were a significant predictor of cortisol levels. The three models were: (1) a standard multiple regression with CD-RISC scores as the predictor of baseline levels of cortisol, (2) a stepwise linear regression analyses with CD-RISC scores as the predictor of cortisol reactivity while controlling for baseline levels of cortisol, and (3) a stepwise linear regression analyses with CD-RISC scores as the predictor of cortisol recovery while controlling for baseline and reactivity levels of cortisol.

Variables which were utilized in this analysis were already cleaned on a univariate level, however, prior to conducting regression analyses, the data were screened for multivariate outliers. For the first and second model, there were no multivariate outliers; however, one multivariate was identified in the third model and was deleted from the analysis.

Results indicated that CD-RISC scores did not significantly predict baseline cortisol levels \([R^2 = .002, R^2_{adj} = -.004, F(1, 171) = 0.338, p = .562]\), reactivity cortisol levels after controlling for baseline levels of cortisol \([R^2 = .200, R^2_{adj} = .195, F(1, 169) = 0.009, p = .925]\), or recovery levels of cortisol after controlling for baseline and recovery levels of cortisol \([R^2 = .730, R^2_{adj} = .725, F(1, 167) = 0.047, p = .829]\) (see Table 4).
Table 4

Regression Analysis

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<tr>
<th></th>
<th>$R^2$</th>
<th>$R^2_{adj}$</th>
<th>$F_{chg}$</th>
<th>$df_1$</th>
<th>$df_2$</th>
<th>$p$</th>
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<td>Baseline</td>
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<td>-.004</td>
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<td>171</td>
<td>.562</td>
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<tr>
<td>Reactivity</td>
<td>.200</td>
<td>.195</td>
<td>0.009</td>
<td>1</td>
<td>169</td>
<td>.925</td>
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<tr>
<td>Recovery</td>
<td>.730</td>
<td>.725</td>
<td>0.047</td>
<td>1</td>
<td>167</td>
<td>.829</td>
</tr>
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</table>

Table 5

Moderation Analysis

<table>
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<tr>
<th></th>
<th>$\Delta R^2$</th>
<th>$F_{chg}$</th>
<th>$df_1$</th>
<th>$df_2$</th>
<th>$p$</th>
<th>$b$</th>
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<td>CD-RISC*Extraversion</td>
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<td>.0048</td>
<td>.0729</td>
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<tr>
<td>CD-RISC*Emotional Stability</td>
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<td>1</td>
<td>167</td>
<td>.0229</td>
<td>.0956</td>
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</table>
Exploratory Moderation Analysis

The PROCESS macro (Hayes & Little, 2018) was utilized to explore moderating effects of CD-RISC scores in the relation between resilient qualities (i.e. extraversion, agreeableness, conscientiousness, emotional stability, openness, and social support) and cortisol levels (i.e. baseline, cortisol change from baseline to reactivity, and cortisol change from reactivity to recovery).

As illustrated in Figure 2 and Table 5, the exploratory analysis yielded two significant models which indicated that CD-RISC scores might interact with extraversion and emotional stability to predict lower cortisol reactivity. In the first model, extraversion served as a predictor, CD-RISC scores as a moderator, cortisol reactivity levels as an outcome, and cortisol baseline levels as a covariate. In the second model, all variables remained the same besides extraversion which was swapped out for emotional stability as the predictor. A multivariate outlier was identified in the first and second model (Mahalanobis $\chi^2(3) = 76.84, p < .001$ and Mahalanobis $\chi^2(3) = 75.13, p < .001$, respectively) and was removed from the analysis.

For the first model, results indicated that there was a significant main effect of extraversion ($b = -.065$, SE$_{b} = .023$, $p < .01$) such that, higher levels of extraversion predicted lower levels of cortisol reactivity. As noted in the regression analysis above, there was no main effect of CD-RISC scores on cortisol reactivity ($b = .048$, SE$_{b} = .035$, $p = .170$). However, the interaction between extraversion and CD-RISC significantly increased the predictive power of the model $[\Delta R^2 = .0192, F(1, 167) = 8.18, p = .0048, b = -.0729]$, indicating the CD-RISC had a significant moderation effect. At low levels of
resilience, cortisol reactivity did not differ significantly ($p = .249$); however, at high and average levels of resilience, cortisol reactivity significantly differed ($p = .005$ and $p = .000$ respectively) such at higher levels of resilience produced a lower cortisol reactivity, such that high levels of both extraversion and resilience together predicted the lowest levels of cortisol reactivity.

For the second model, results indicated that there was not a significant main effect for emotional stability ($b = 0.21$, SE$_b = .029$, $p = .462$) or CD-RISC scores ($b = -.034$, SE$_b = .037$, $p = .359$). However, the interaction between emotional stability and CD-RISC significantly increased the predictive power of the model [$\Delta R^2 = .0171$, $F(1, 167) = 5.27$, $p = .0229$, $b = .0956$], indicating the CD-RISC had a significant moderation effect; at high and average levels of resilience, cortisol levels did not significantly change ($p = .504$ and $p = .461$ respectively), however, at low levels of resilience, cortisol levels significantly differed ($p = .030$) such that lower levels of resilience yielded lower levels of cortisol reactivity.

Although the above models indicate that CD-RISC scores may serve as a significant enhancing moderator in the relation between resilient qualities and cortisol levels, several additional models found no significant effects with agreeableness, contentiousness, openness, and MPSS scores as predictor variables and cortisol reactivity and cortisol recovery as outcome variables.
Figure 2. Resilience as a Moderator

Resilience
- Low $p = .249$
- Average $p = .005$
- High $p = .000$

Resilience
- Low $p = .030$
- Average $p = .461$
- High $p = .504$
CHAPTER 4
DISCUSSION

Overview

The current study sought to investigate resilience in relation to personality, social support, and cortisol levels. Specifically, the following hypotheses were tested: (1) resilience is positively related to personality traits of extraversion, conscientiousness, openness, and agreeableness, while being negatively related to the personality trait of neuroticism, (2) resilience is positively related to perceived social support, (3) resilience significantly predicts cortisol levels at baseline, reactivity, and recovery such cortisol levels are lower at baseline, there is a lower reactivity and a higher rate of recovery. Additionally, exploratory analyses were conducted to investigate resilience as a moderator of the link between resilient qualities (i.e. personality and social support) and cortisol reactivity and recovery.

Substantial support was found for the first hypothesis which predicted that resilience would be positively related to personality traits of extraversion, emotional stability, conscientiousness, openness, and agreeableness. Resilience was significantly positively associated with extraversion, emotional stability, conscientiousness, and agreeableness; however, openness was not significantly correlated with resilience. These findings provide successful conceptual replications of previous research (e.g. Hsieh et al., 2017). Further, the second hypothesis which predicted that resilience would be positively related to perceived social support was supported. Resilience was significantly positively
correlated with social support. Similar to hypothesis one, these findings are in line with and provide conceptual replications of prior research (e.g. Wilks & Croom, 2008).

Although, no support was found for hypothesis three which predicted that resilience would significantly predict cortisol levels at baseline, reactivity, and recovery, little empirical testing of the relation between these two variables had been conducted prior to the current study. Therefore, the current study provided insight into theoretical relations between resiliency and cortisol levels (e.g. Charney, 2004; Feder et al., 2010) and indicated that they might be more complex than initially assumed.

These more complex relations were evidenced in the exploratory analyses which indicated that resilience might moderate the relation between resilient qualities (e.g. emotional stability and extraversion) and cortisol reactivity. This complex relation is reflected in the metatheory of resilience (Richardson, 2002). The theory elaborates how when encountering adversities or stressors, resilient reintegration (i.e. resiliency) involves the ability to draw on resilient qualities (e.g. emotional stability) to assist in dealing with the presenting stressor; therefore, the stressor is less disrupting to biopsychospirtual homeostasis. This decreased disruption may be reflected in the lower cortisol reactivity to the stress induction in the current study. The relationship between resilient qualities and the process of resilience is conceptualized as a cyclical learned process. As a person builds resilient qualities and successfully achieves resilient reintegration, future encounters with adversity may produce less disruption.
Support for this theory may be evidence in the moderation effect of resilience found between extraversion and cortisol reactivity in the current study such that higher levels of resilient qualities and higher levels of resilience together predicted the lower levels of cortisol reactivity. However, the moderation analysis also indicated that for those low in extraversion, higher resiliency was associated with higher levels of cortisol reactivity. Further, a second moderation effect of resilience was found in the current study between emotional stability and cortisol reactivity which, contrary to predictions, indicated that lower levels of resilience and emotional stability predicted a lower cortisol reactivity.

These contradictory findings may support the idea that low cortisol reactivity may not always be adaptive or healthy; thus, reflecting a more complex relationship between cortisol reactivity and resilience than initially assumed. For example, if the cortisol reactivity is low when an individual is faced with adversity because that individual has developed resiliency; thus, their biopsychospiritual homeostasis is not disrupted, this response is thought of as healthy and adaptive. However, if the cortisol reactivity is low when an individual is faced with adversity because that individual has developed avoidance strategies or disassociation, which is common for individuals with mental health issues such as depression and post-traumatic stress disorder, this response is thought of as unhealthy and maladaptive. This response is referred to as a blunted stress response.

A blunted stress response involves a lower levels of cortisol reactivity in response to a stressful event. There is a growing body of evidence supporting that a blunted stress
response is associated with less adaptive personality traits, particularly, low emotional stability and low extraversion. High neuroticism and low extraversion have been associated with psychopathology and blunted cortisol response to stress (O’leary, Taylor, & Eckel, 2010; Oswald et al., 2006; Pruessner et al., 1997).

**Implications**

**Practice**

The current study has implications within a clinical setting; Richardson (2002) differentiates resilience from an innate trait or attribute and emphasizes the ability of the individual to learn and develop resiliency. Thus, it is feasible to effectively promote resiliency within a clinical setting. Resiliency promotion is a strength-based approach that empowers the individual to overcome adversities that, at times, an inevitable part of life to achieve positive outcomes. Luthar and Cicchetti (2000) further elaborate the importance of incorporating resilience promotion into mental health preventative and treatment interventions.

Further, the current study indicates that learning how to utilize individual strengths when encountering adversities may reduce disrupting stress-induced biological responses. Given that biological responses to stress can have major health consequences, preventative interventions could be designed and implemented in practice to promote resilience and, thus, produce healthier biological responses to stress.

**Research**

The current study has implications for future research. First, the current study provides additional supporting evidence for past research regarding resilience in relation
to personality and social support by providing successful conceptual replications. Additionally, the current study ventured to investigate the relation between resiliency and biological processes. Specifically, the relation between resiliency and cortisol level were investigated. This is an area of research that is in its infancy. Exploratory analyses yielded promising results that should be explored in future studies. These results indicated that resiliency may moderate the relationship between resilient qualities in complex ways which require additional investigation. Further research should investigate whether this finding is replicable.

**Concluding Comments**

**Limitations**

Although the current study adds to the resiliency literature, it does have a number of limitations which could be addressed in future research. First, participants may have been stressed coming into an experimental setting; thus, their baseline measure of cortisol may have been elevated and may not be indicative of their true baseline level. However, the stress induction check indicated that baseline levels of cortisol were significantly lower than reactivity and recovery levels of cortisol indicating that this may not be a limitation. However, future research should address whether the difference between baseline and reactivity may be larger if participants are provided a relaxation period upon entering the experimental setting.

Further, the stress induction check indicated that although recovery levels of cortisol were significantly lower than reactivity levels of cortisol, baseline levels of
cortisol were significantly lower than recovery levels, indicating that participants had not yet fully recovered from the stress induction. Incorporating an additional recovery measure of cortisol after participants had sufficient time to recover would have likely produced a more meaningful recovery measure. Future research should incorporate an additional recovery measure.

Lastly, the current study utilized convenient sampling at a Midwest university which limits the generalizability of the sample. The characteristics of the current sample are not representative of the general population. Future research should investigate whether results extend beyond the current study.

**Strengths**

The current study had sound methodology. Validated and reliable measures (i.e. CD-RISC, BFI, and the MPSS) were utilized and reliability in the current study was assessed, confirmed, and reported for the current sample. A validated and reliable stress induction (i.e. the TSST) was utilized and multiple stress induction checks were investigated (i.e. self-report stress levels, heart rate, blood pressure, and cortisol levels) which confirmed that the induction had the desired effect in the current study. Validated collection and assay protocol for the measure of salivary cortisol levels were utilized (i.e. Salimetrics) and inter and intra reliability checks confirmed that the cortisol assay preformed for the current study was reliable. Further, statistical analyses conformed to Mertler and Vannatta (2013) recommendations to ensure proper data screening was conducted.
Although the current study had various limitations as described above, it provides a valuable contribution to resiliency literature by investigating the relation of resiliency to neuroendocrine measures which is an area of research that is still in its infancy. Further, it provided conceptual replications of previous research investigating the relation between resiliency and personality as well as resiliency and social support.
REFERENCES


health and resilience in liver transplant candidates. *Journal of Clinical Psychology in Medical Settings, 4*, 1-12. doi:10.1007/s10880-018-9559-6


## APPENDIX A

**CONNOR-DAVIDSON RESILIENCE SCALE 25**

### Connor-Davidson Resilience Scale 25 (CD-RISC-25) ©

For each item, please mark an "x" in the box below that best indicates how much you agree with the following statements as they apply to you over the last month. If a particular situation has not occurred recently, answer according to how you think you would have felt.

<table>
<thead>
<tr>
<th>Item</th>
<th>Not true at all</th>
<th>Rarely true</th>
<th>Sometimes true</th>
<th>Often true</th>
<th>Nearly always true</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am able to adapt when changes occur.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. I have at least one close and secure relationship that helps me when I am stressed.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. When there are no clear solutions to my problems, sometimes fate or God can help.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. I can deal with whatever comes my way.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. Past successes give me confidence in dealing with new challenges and difficulties.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. I try to see the humorous side of things when I am faced with problems.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7. Having to cope with stress can make me stronger.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8. I tend to bounce back after illness, injury, or other hardships.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9. Good or bad, I believe that most things happen for a reason.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10. I give my best effort no matter what the outcome may be.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11. I believe I can achieve my goals, even if there are obstacles.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12. Even when things look hopeless, I don't give up.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13. During times of stress/crisis, I know where to turn for help.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15. I prefer to take the lead in solving problems rather than letting others make all the decisions.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16. I am not easily discouraged by failure.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>17. I think of myself as a strong person when dealing with life's challenges and difficulties.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>18. I can make unpopular or difficult decisions that affect other people, if it is necessary.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>19. I am able to handle unpleasant or painful feelings like sadness, fear, and anger.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>20. In dealing with life's problems, sometimes you have to act on a hunch without knowing why.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>21. I have a strong sense of purpose in life.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>22. I feel in control of my life.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>23. I like challenges.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>24. I work to attain my goals no matter what roadblocks I encounter along the way.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>25. I take pride in my achievements.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Add up your score for each column**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

**Add each of the column totals to obtain CD-RISC score**

---

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APPENDIX B

BIG FIVE PERSONALITY INVENTORY

How I am in general

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who *likes to spend time with others*? Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong></td>
<td>Disagree Strongly</td>
<td>Disagree a little</td>
<td>Neither agree nor disagree</td>
<td>Agree a little</td>
<td>Agree strongly</td>
</tr>
<tr>
<td><strong>2.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**I am someone who...**

1. _____ Is talkative
2. _____ Tends to find fault with others
3. _____ Does a thorough job
4. _____ Is depressed, blue
5. _____ Is original, comes up with new ideas
6. _____ Is reserved
7. _____ Is helpful and unselfish with others
8. _____ Can be somewhat careless
9. _____ Is relaxed, handles stress well.
10. _____ Is curious about many different things
11. _____ Is full of energy
12. _____ Starts quarrels with others
13. _____ Is a reliable worker
14. _____ Can be tense
15. _____ Is ingenious, a deep thinker
16. _____ Generates a lot of enthusiasm
17. _____ Has a forgiving nature
18. _____ Tends to be disorganized
19. _____ Worries a lot
20. _____ Has an active imagination
21. _____ Tends to be quiet
22. _____ Is generally trusting
23. _____ Tends to be lazy
24. _____ Is emotionally stable, not easily upset
25. _____ Is inventive
26. _____ Has an assertive personality
27. _____ Can be cold and aloof
28. _____ Perserves until the task is finished
29. _____ Can be moody
30. _____ Values artistic, aesthetic experiences
31. _____ Is sometimes shy, inhibited
32. _____ Is considerate and kind to almost everyone
33. _____ Does things efficiently
34. _____ Remains calm in tense situations
35. _____ Prefers work that is routine
36. _____ Is outgoing, sociable
37. _____ Is sometimes rude to others
38. _____ Makes plans and follows through with them
39. _____ Gets nervous easily
40. _____ Likes to reflect, play with ideas
41. _____ Has few artistic interests
42. _____ Likes to cooperate with others
43. _____ Is easily distracted
44. _____ Is sophisticated in art, music, or literature
APPENDIX C

MULTIDIMENSIONAL SCALE OF PERCEIVED SOCIAL SUPPORT

Multidimensional Scale of Perceived Social Support (Zimet, Dahlem, Zimet & Farley, 1988)

Instructions: We are interested in how you feel about the following statements. Read each statement carefully. Indicate how you feel about each statement.

Circle the “1” if you Very Strongly Disagree
Circle the “2” if you Strongly Disagree
Circle the “3” if you Mildly Disagree
Circle the “4” if you are Neutral
Circle the “5” if you Mildly Agree
Circle the “6” if you Strongly Agree
Circle the “7” if you Very Strongly Agree

1. There is a special person who is around when I am in need. 1 2 3 4 5 6 7 SO
2. There is a special person with whom I can share my joys and sorrows. 1 2 3 4 5 6 7 SO
3. My family really tries to help me. 1 2 3 4 5 6 7 Fam
4. I get the emotional help and support I need from my family. 1 2 3 4 5 6 7 Fam
5. I have a special person who is a real source of comfort to me. 1 2 3 4 5 6 7 SO
6. My friends really try to help me. 1 2 3 4 5 6 7 Fri
7. I can count on my friends when things go wrong. 1 2 3 4 5 6 7 Fri
8. I can talk about my problems with my family. 1 2 3 4 5 6 7 Fam
9. I have friends with whom I can share my joys and sorrows. 1 2 3 4 5 6 7 Fri
10. There is a special person in my life who cares about my feelings. 1 2 3 4 5 6 7 SO
11. My family is willing to help me make decisions. 1 2 3 4 5 6 7 Fam
12. I can talk about my problems with my friends. 1 2 3 4 5 6 7 Fri

The items tended to divide into factor groups relating to the source of the social support, namely family (Fam), friends (Fri) or significant other (SO).
APPENDIX D

DEMOGRAPHICS QUESTIONNAIRE

**Instructions**: Please answer the following question honestly. Remember, your name will not be identified with your answers.

How old are you?  
______________

What is your gender identity?  
Man  
Woman  
Transgender  
Non-binary/Gender fluid/Genderqueer  
Other ______________

What is your biological sex?  
Male  
Female  
Intersex

What is your race/ethnicity?  
White or Caucasian  
Black or African American  
Hispanic/Latino  
Native American or American Indian  
Asian/pacific Islander  
Bi-racial/Multi-racial  
Other ______________

Are you in a romantic relationship?  
Yes  
No

If you are in a romantic relationship, what kind of relationship are you in?  
Casual relationship  
Serious relationship  
Engagement  
Marriage  
Other ______________  
I’m not in a relationship

If you are in a romantic relationship, are you in a long-distance relationship?  
Yes  
No

If you are in a romantic relationship, how long have you been in it?  
Years _______  
Months _______  
Weeks _______

What is your sexual orientation?  
Heterosexual  
Gay or Lesbian  
Bisexual  
Pansexual
What is the gender identity of your significant other?
- Man
- Woman
- Transgender
- Non-binary/Gender fluid/Genderqueer
- Other ___________

What is your class (year) in college?
- Freshman
- Sophomore
- Junior
- Senior
- Other ___________

What year were you born?
_____________

Do you identify as a professional athlete or a collegiate athlete?

Yes
No

What’s the highest level of education you’ve obtained?
- Less than a high school diploma
- High school diploma/GED
- Some college
- Associate’s degree
- Bachelor’s degree
- Master’s degree
- Doctorate degree

What is your household annual income? (Not including your parents’ income.)
- Under $10,000
- $10,001-$15,000
- $15,001-$20,000
- $20,001-$30,000
- $30,001-$50,000
- $50,001-$75,000
- Over $75,000

Have you had any traumatic events or stressful situations arise in the past week? If yes, please describe.
________________________

The following questions are important for the proper assessment of participant biological markers as measured via saliva. Please answer each question with as much detailed information as possible.

Are you currently on a form of birth control?
- Yes, oral contraceptives (“the pill”)
- Yes, an IUD
- Yes, a shot
- Yes, coitus interruptus (“withdrawal method”)
- Yes, abstinence
- Yes, other ____________
- No
Sex steroids are prescribed for any number of reasons. However, such steroids can alter the baseline concentrations of various analytes in saliva. Are you currently receiving any form of sex steroids (e.g., testosterone, estrogen, etc.)?
   Yes
   No

If you answered “Yes” to the sex steroid question above, please list sex steroids you are currently taking on a regular basis.

__________________________

Do you currently smoke or take other nicotine containing products?
   Yes
   No

If you smoke cigarettes, what brand and style do you smoke?

__________________________

On average, how many cigarettes do you smoke each day?

__________________________

If you use some other form of nicotine containing product, please list brand, type, and average use per day.

__________________________

Do you drink coffee?
   Yes
   No

On average, how many 8 oz cups of coffee do you drink each day?

__________________________

Do you drink alcohol?
   Yes
   No

If yes, on average, how many drinks (e.g., 1 beer = 1 mixed drink: both contain, on average, 1 oz of alcohol) do you consume in a week?

__________________________

Are you aware of any family history related to alcohol dependence?
   Yes
   No

Do you regularly take vitamin (or herbal) supplements? If yes, please specify which ones.

__________________________

Are you currently taking any prescription medications?
   Yes
   No

If yes, which medications?

__________________________

Did you consume alcohol last night or today?
   Yes
   No

Have you eaten a major meal within the previous 60 minutes?
   Yes
   No

Have you consumed any dairy products within the past 20 minutes?
   Yes
   No
Have you consumed any high sugar foods within the past 20 minutes?
   Yes
   No
Have you consumed any foods high in acidity (e.g., lemons) within the past 20 minutes?
   Yes
   No
Did you exercise last night or today?
   Yes
   No
Have you smoked within the past two hours?
   Yes
   No
Are you experiencing any oral diseases or problems?
   Yes
   No
On average, how many minutes of physical activity do you engage in daily (e.g., walking, running, weightlifting, sports)?

Have you had any vaccinations within the past 60 days?
   Yes
   No
   If yes, please list ______________
Do you have any of the following: Type I diabetes, an endocrine disorder, epilepsy, an autoimmune disorder, an adrenal disorder, a severe psychiatric disorder (e.g. schizophrenia)?
   Yes
   No
   If yes, please name the disorder ______________
What time did you wake up today? Please specify hour, minute, and time of day (AM or PM)
Hour __________ Minute__________ AM or PM __________
(For individuals who menstruate) When did your last menstrual period begin? Please specify month and day.
Month__________ Day____________
APPENDIX E

HUMAN PARTICIPANTS REVIEW INFORMED CONSENT

Project Title: The Impact of Attachment, Personality, Resilience, Social Support, and Sleep on Cortisol Responses.

Investigators: Kristin Rooff, Elisheva Havlik, Dilbur Arsiwalla, Ph.D., & Seong-In Choi, Ph.D.

Invitation to Participate: We invite you to participate in a novel study about your cortisol levels, relationship attachment, resilience, personality, social support, and sleep patterns at the University of Northern Iowa. This study requires you to complete several surveys, perform a verbal task, and provide saliva samples. Upon finishing this study, you will receive academic credit. All responses will remain confidential, and you can withdraw at any time. If you have any questions, please contact Elisheva Havlik at havlike@uni.edu, Kristin Rooff at krisr@uni.edu, Dr. Seong-In Choi at seongin.choi@uni.edu, or Dr. Dilbur Arsiwalla at dilbur.arsiwalla@uni.edu. Thank you for your participation!

Nature and Purpose: The purpose of this study is to: 1) examine the relationship between attachment styles, cortisol responses, and sleep patterns among undergraduate students at UNI; and 2) examine the relationship between resilience, personality, social support, and cortisol responses among undergraduate students at UNI. In order to obtain the most accurate assessment, we request that all participants:

1) Avoid alcohol or exercise the night before and day of you are scheduled to take part in the study.

2) Do not drink coffee, smoke, or ingest acidic food and drinks for two hours before testing.

3) Do not eat a major meal within 60 minutes of study participation.

4) Avoid dairy products for 20 minutes prior to study participation.

5) Avoid foods with high sugar or acidity, or high caffeine content, immediately prior to participating since they may compromise saliva collection and increase bacterial growth.

Explanation of Procedure: This study requires you to complete several surveys, perform a verbal task, and provide saliva samples. The surveys will contain questions about your relationship attachment patterns, sleep habits, perceived stress, personality, resilience, social support, physical health, and mental health. There will be three separate collections of your saliva, which will allow researchers to determine your cortisol responses at different points in time. Saliva collection is minimally invasive and only requires you to drool into a small vial. Blood pressure and heart rate measurements will be collected as well. Participation in this study should take about 90 minutes.

Discomfort and Risks: There are minimal risks to your participation in this study. You may feel slightly uncomfortable or stressed answering some of the questions or performing some of the tasks; however, your responses will not be associated with your direct identifying
information. Any physical risks (e.g., stress-induced cardiovascular issues, fatigue, sweating, oral discomfort) are unlikely; however, researchers will monitor for any severe physical distress during testing. Psychological risks (e.g., stress, boredom, embarrassment, confusion, depression, anxiety, anger, frustration) may be present during or after completion of this study; however, researchers will monitor for any severe psychological distress during testing. Researchers will provide participants with contact information of health or therapeutic services if needed. Any extended treatment at a private provider will be billed in the ordinary manner to you or your insurance company. You are free to withdraw from the study at any time.

**Benefits and Compensation:** There are no benefits to your participation other than introspection, exploration of ideas, and greater understanding of the scientific research process. You will be compensated with two SONA research credits.

**Confidentiality:** No personally identifiable information will be recorded in this study. All information and responses will be kept confidential and will not be available to anyone else. Your confidentiality will be maintained to the degree permitted by the technology used. Specifically, no guarantees can be made regarding the interception of data sent via the Internet by any third parties. The summarized findings with no identifying information may be published in an academic journal or used at research conference presentations. Your saliva samples will be handled with extreme care. Saliva samples will be collected by a member of the research team who will have training using a passive drool procedure. Saliva samples will be barcoded with a participant number that is void of any personally identifying information and placed in a locked freezer. Only key personnel will have access to this keycard entry only locked freezer, which is located within a self-locking laboratory. These samples may be used for future research purposes for up to five years.

**Right to Refuse or Withdraw:** Your participation is completely voluntary. You are free to withdraw from this study, leave out any questions, or choose not to participate without any penalties.

**Questions:** If you have any questions, or wish to have further information about your participation in this study or in the study more generally, please contact Elisheva Havlik at havlike@uni.edu, Kristin Rooff at krisr@uni.edu, Dr. Dilbur Arsiwalla at dilbur.arsiwalla@uni.edu, or Dr. Seong-In Choi at seongin.choi@uni.edu at the Department of Psychology, University of Northern Iowa. You can also contact the Office of Research and Sponsored Programs, Director of Research, at 319-273-6148 for answers to questions about rights of research participants and the participant review process. If you are feeling any form of discomfort, please contact the UNI Counseling Center: (319) 273-2676. Or, you can contact the Student Health Clinic: (319) 273-2009.
**Agreement:** Signing your name below indicates that

“I am fully aware of the nature and extent of my participation in this project as stated above and the possible risks arising from it. I hereby agree to participate in this project. I am 18 years of age or older.”

______________________________________________________________________
Signature of Participant

______________________________________________________________________
Signature of Principal Investigator

______________________________________________________________________
Signature of Participant

______________________________________________________________________
Signature of Principal Investigator
APPENDIX F

DEBRIEF

Oral Debriefing Script

“Thank you for participating in this study. This study was assessing physiological responses to psychosocial stressors and evaluating if 1) sleep habits may moderate the relationship between relationship attachment styles and cortisol responses; or 2) resilience mediates the relationship between personality and cortisol responses. You were not actually being evaluated or scored for competency or working memory. You were not actually being recorded. Your performance is not compared to other participants. We are measuring a naturally occurring stress hormone in the body called cortisol. We wanted to see what happens to this hormone in your body under stress, that’s why we have been collecting samples from you. We are sorry that we didn’t tell you the truth about everything, but if we had, the situation wouldn’t be stressful. You may withdraw your data at any time. If needed, please contact the UNI Counseling Center or the Student Health Clinic; their information is provided on your informed consent sheet. Or, if you have further questions about this study, please contact the primary investigators listed on your informed consent sheet. Please do not discuss this study with any of your classmates that could potentially be participating in our study - this is very important in regards to the validity of our study. You did a great job! Thank you for participating; we appreciate it. Do you feel okay to leave?”