Exploring the autonomic responsivity of exposure to salient financial stressors within
an experimental paradigm

by

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A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Human Development and Family Studies

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The student author, whose presentation of the scholarship herein was approved by the
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Iowa State University
Ames, Iowa
2020

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ABSTRACT

Student loan debt is a form of financial stress commonly rated as a top source of stress. Credit score is a comparably impactful financial construct with far-reaching implications on financial health, yet its nebulous numerical value lacks emotional salience compared to the more intuitive monetary value of student loans. This thesis aims to delve into the physiological correlates of financial stress as an acute stressor. The biomarkers suited best to studying acute financial stressors are the autonomic nervous system (ANS), regulating bodily arousal via its parasympathetic and sympathetic branches. Its quick action matches the immediacy and intensity of brief financial stressors. Using 11 participants, four biomarkers were measured during three 4-minute conditions: baseline, student debt, and credit score. During the baseline, participants filled out questionnaires. For the two stress conditions, participants estimated their student loan debt or credit score, before being shown their true value. RM ANOVAs were conducted for each biomarker (HR, RSA, PEP, GSC) per condition, assessing whether significant reactivity patterns were across each four-minute condition. Mean values within each condition (pre and post-exposure), were compared to baseline values, and then tested for differences between stressor conditions. Significant rises in GSC reactivity was found during the baseline, suggestive of anticipatory stress, with a trend-level decline in the credit score condition persisting into the student loan condition. HR significantly declined from baseline average to credit score with an additional trend-level decline from credit score to student loan. No significant changes were found between stress conditions for any biomarker. Taken as a whole, findings suggest little autonomic stress response within the experimental conditions, but increases during baseline indicate that the anticipation of the stressor exceeded that of the stressor itself.
CHAPTER 1: GENERAL INTRODUCTION

The purpose of this thesis is to delve into a topic largely unexplored in biopsychological and financial counseling research: the physiological correlates of student loan debt as an acute stressor. The dearth of research on this topic is surprising considering that financial stressors are an exceedingly common facet of modern life and a commonly rated by people as a top source of stress [Brougham et al., 2009; APA, 2015]. The physiological implications of financial stress are generalizable to a vast number of people, exerting health [Savoy et al., 2014; Huijs et al., 2015] and economic implications [Economou et al., 2016; Cardarelli, Elekdag, & Lall, 2011].

Of these financial stressors, student loans provide one of the most pressing financial concerns facing emerging adults. As of 2017, 44.2 million debtors owe $1.48 trillion dollars in student loans, on average bachelor degree holders owed $39,400 dollars to complete their degree with a monthly statement of $351. Prior to graduation, mandatory student loan exit counseling is required of graduating seniors which provide salient details regarding upcoming financial realities of the graduated student [Andruska et al., 2014], such as loan repayment processes and establishing good credit. These sudden realizations of debt obligations can be jarring to the student, inducing feelings of stress and anxiety, a phenomenon that has not been examined from a physiological lens. Understanding the impact of financial stress and wellbeing is important because economic conditions exert a lifelong impact on individuals and families. For example, the economic conditions in which an individual grew up, such as financial hardship or growing up in poverty, have been shown
to impact stress-related physiological biomarkers for years into adulthood [Ursache, Noble, & Blair, 2015].

Contrasting with student loan debt, credit score serves as a comparably important, yet nebulous construct affecting the future financial realities and opportunities of students post-graduation. With most students being unaware or unknowledgeable about credit scores in general (with many lacking a credit score at all), this results in a critical aspect of their financial profile being lost on students mired in coursework. Credit scores are a prerequisite to access many financial products and wealth building opportunities, being used in a large amount of decisions, ranging from apartment rentals, bank loans, or hiring decisions [U.S. GAO, 2005; Bartik & Nelson, 2016, Yu & Dunn, 2016]. Despite the importance of this information, many individuals remain ignorant of their credit score, frequently overestimating their credit score’s quality or even being able to gauge what constitutes a good score [Consumer Federation of American and Providian, 2004; Perry, 2008; O’Connor et al., 2019]. This lack of immediate salience coupled with its critical importance in major financial realities provides a point of contrast with student loan debt. Learning about student loan debt may confront the individual with a salient and easily understood metric of financial stress and wellbeing in monetary figures; in contrast, while learning about credit scores may also provide information about financial stress and wellbeing, its comparatively nebulous relevance to their day-to-day life may render it insufficient at eliciting a stress response. Therefore, the current study will incorporate the credit score as an alternative stress condition to contrast with student loan debt.

This thesis will examine these financially stressful stimuli, measuring stress physiology during an experimental paradigm to better understand financial stress and provide
a unique physiological perspective to emerging theories on the experience and consequences of financial stress in an acute setting. The targeted physiological reactivity patterns include several indices of the autonomic nervous system (ANS) a system that operates on a small time scale (i.e. engaging quickly in response to stressful stimuli), lending itself well to a realistic laboratory-based financial stressor. The autonomic stress response has been shown to be predictive of cardiac [Dekker et al., 1997; Hillebrand et al., 2013] as well as mental health issues [Alvarez et al., 2016], yet it is still unknown whether this approach to measurement could yield useful information about the consequences of financial stress.

The benefits of these physiological measures are that they are non-invasive and feasibly implemented across contexts, such as during the administration of a financial stressor. This approach aims to move the field toward objective assessments of financial stress, providing insights into the potential role of ANS reactivity for motivating or stifling financial behavior change—including help seeking behavior [Choi, Bartholomae, Gudmunson, & Fox, 2016; Choi, Gudmunson, Griesdom, & Hong, 2016]. The project has two aims:

Aim 1 will examine if the two financial stressor conditions will elicit a significant response in ANS biomarkers, compared to the control condition. Four autonomic measures, described below, will be examined.

Aim 2 will more specifically examine whether there is stronger reactivity to the student loan condition compared to the credit score condition.
CHAPTER 2: STRESS AND THE ADAPTIVE CALIBRATION MODEL

Stress Definition and Research History

At the center of this project is the construct of stress: a word used in everyday language to convey a sense of unpleasantness (varying from minor irritation to acute distress) an individual experience stemming from a specific stimulus or just referring to the general sense of unease one feels when they feel overexerted. This wide-ranging definition is due to the fact that stress is a multidimensional construct, comprised of numerous elements each of which imparts a unique property to a specific source of stress. A major distinction when classifying types of stress is whether it is either objective or perceived. The main distinction between these two constructs is that unlike objective stress (e.g. physiological stress), perceived stress incorporates a cognitive component modulating the way in which the properties of the stressor are appraised [Cohen, Kamarck, & Mermelstein, 1983; Epel, McEwen, & Ickovics, 1998]. Examples of such properties are severity (acuteness of stress), novelty (whether the source of stress is new or familiar), and duration (the length of time at which an individual is exposed to the stressor). Further affecting the experience of stress, and explaining some of the variance in the way in which people respond to a particular stressor are contextual factors relevant to the person, such as emotional saliency (whether the stressor resonates with a person on an emotional level) and personal relevance (the degree to which the stressor is related to the person experiencing the stressor) [Lazarus, 1966].

Stress was first conceived of as a biological construct in 1936, in which Hans Seyle made the serendipitous discovery that his poor rat handling skills led to the rats developing peptic ulcers due to their anticipation of his trying to grab them (see reviews in 1956, 1973). From this discovery, the field of stress research was born, dedicated to investigating the
profound impact that accumulating everyday stressors on physical and mental health. From his research, Seyle codified these ideas into a system he called General Adaption Syndrome (GAS), meant to describe the short and long-term physiological changes occurring in response to stress. Controlled by both the nervous and endocrine systems in the body, he classified GAS as being comprised of three distinct, sequential stages: alarm, resistance, and exhaustion. The alarm stage occurs as an immediate response to a stressor, preparing the body for physical activity. The response to continuation of the stressor, called the resistance stage, is characterized by the body’s adaption to the stressor (such as a reduction in physical activity during starvation). If the stress continues for a longer period of time, then the body begins to experience the exhaustion stage and the detrimental effects of the prolonged stress response begin to take hold, such as immune system suppression and high blood pressure. Unusually for the time, Seyle did not view “stress” as inherently negative, instead describing it as a necessary part of life and tied into emotional experience.

A similar idea developed contemporaneously with Seyle’s GAS was that of homeostasis, a term coined by Walter Cannon describing the tendency of an organism to auto-regulate its physiology to return to a stable state or set point in contrast to environmental influences [Cannon, 1926; 1932]. This concept possessed a broad enough definition to encompass a wide array of physiological phenomena (examples: body temperature, pH balance, physiological arousal, etc.). The set point at which homeostasis was achieved was defined as being relatively static, always returning to the same value after physiological changes the way in which an air condition thermostat works to maintain the air temperature to its setting.
While useful, homeostasis failed to account for the reality that the environmental milieu of an organism experiences is fickle. Because the mercurial nature of everyday experience necessitates a dynamic response to sudden environmental challenges and opportunities, a more comprehensive and dynamic description of homeostasis was required which allowed the optimal set-point for an organism to be in flux and subject to change. Addressing this was the concept of *allostatic load* [Sterling & Eyer, 1988], which describes the proactive regulation and allocation of bodily resources summoned to respond to physiological or behavioral change. Unlike homeostasis’s static set-point, allostasis accounts for the resources required, calibrating this set point to the context of what resources the current environmental challenges require. If homeostasis is the thermostat maintaining its set temperature, then allostasis is the miserly roommate changing its setting to save money during the summer and winter.

**Adaptive Calibration Model: Overview**

Building on these definitions of stress, homeostasis and allostasis, the Adaptive Calibration Model (ACM) of stress responsivity aims to address and integrate the incredible variance of individual stress response patterns into a larger developmentally-oriented framework [Del Giudice, Ellis, & Shirtcliff, 2011]. Integrating much of the framework of evolutionary life history theory [Ellis et al., 2009], whose crux pertains to the way in which organisms prioritize time and energy expenditure to prolong their life cycle and succeed in passing down their genetic material through their progeny. As time is finite and resources are often scarce, concessions must often be made by the organism in allocating resources to resolve pressing concerns relevant to its environmental context. This frequently manifests in improving its environmental fitness at the cost of other life functions (such as growth and
long-term health). This concept of trade-offs between resources required to adapt to current environmental conditions versus what would otherwise be considered an ‘optimal’ development cycle (such as suppression of bodily growth to conserve energy in a food-scarce environment) lends itself well to the context of stress responsivity.

The key implication of this life history perspective, as well as the central conceit behind the ACM’s theoretical framework is the idea that there is no ‘ideal’ developmental strategy that works in all contexts. For example, developing a stress response characterized by hyper vigilance to environmental cues carries with it major long-term health implications, but the short-term benefit of avoiding danger in a hostile environment may supersede the benefits of a long-term health. Thus, short-term survival is an adaptive trait in the context of an environment in which there is a high mortality rate due to environmental dangers, despite the trade-off for a reduced overall life expectancy. Crucial to this is the degree to which an organism’s stress response system (SRS) can muster the body’s resources in a context-sensitive way.

Building off of this, variation in stress responsivity profiles (itself a consequence of the SRS) between individuals is described in the ACM as being largely the consequence of conditional adaption, or that an organism’s adaption to environmental conditions through alterations to its physiology during developmentally critical periods. This concept of conditional adaption was extrapolated in 2005 by Boyce and Ellis to pertain specifically to the changes in stress responsivity patterns, referring to it as biological sensitivity to context (BSC). According to BSC, acute stress responsivity patterns may reflect an underlying sensitivity to environmental context rather than simply being indicative of an exaggerated response to challenge. In this, it is postulated that children demonstrating pronounced
cardiovascular and endocrine response patterns show an increased receptivity to both positive and negative environmental cues, a phenomenon described in existing literature as “for better and for worse” [Belsky et al., 2007]. This thesis is guided by the ACM which builds off the concept of allostatic load in order to understand physiological measures of the SRS and incorporates elements from life history theory and the BSC into the frame work in order to understand why the environmental conditions influence the SRS. While the ACM emphasizes early life experiences and SRS development, it can also be applied to acute environmental contexts which can impact SRS functioning. This thesis examines whether financial stress is a salient acute environmental context capable of shaping the SRS.

In the context of this theory, the SRS is broadly defined as a “general interface with the environment, mediating the organism’s adjustment to both positive and negative events” [Del Giudice, Ellis, & Shirtcliff, 2011]. The ACM postulates that the SRS plays three key functions: coordinating the organism’s allostatic response to environmental challenge (either physical or psychosocial), mediating the organism’s openness to environmental cues through the encoding and filtration of environmental information (both social and physical), and regulating an organism’s physiology to enable a broad range of fitness-behaviors. The SRS accumulates resources, which then enables the organism to engage in fitness behaviors to properly respond to challenge, and aids in the organism’s appraisal of environmental cues.

Building on the idea that there is no stress responsivity pattern that perfectly fits in all contexts is the description of four separate responsivity patterns occurring as a consequence of early environmental requirements (such as avoiding unpleasant outcomes or identifying positive opportunities): sensitive, buffered, vigilant, and unemotional [Del Giudice, Hinnant, Ellis, & El-Sheikh, 2011]. The first responsivity pattern: sensitive (type I) refers to the
adapted stress response found in people who growing up in an environment characterized by low stress exposure, such as in children growing up in affluent environments characterized by little stress and ample resources. The consequences for developing under these conditions results in a pronounced stress reactivity pattern, as the incidences of stress in such an environment are likely to be sporadic and short in duration. In type I individuals, they tend to stay in a much more relaxed state at baseline with a pronounced increase in arousal level when exposed to a stressful stimulus. Building on this, the potential health implications for having such a stress response comprising an enormous range between relaxation and arousal is mitigated by the infrequency by which this system is engaged, making for an effective trade-off. In fact this responsivity pattern benefits the individual by making them more receptive to capitalizing on positive opportunities. In sum, a high reactivity pattern is a double-edged sword in which there are considerable benefits to aiding in navigating social environments at the cost of long-term health effects, and in low stress environments these costs are mitigated somewhat making high responsivity an effective strategy.

Whereas the sensitive profile is buttressed by abundant resources and lacking sources of chronic and sustained stress, the buffered responsivity pattern (type II) develops in environments with moderate levels of stress, showing a moderate responsivity pattern. The type of strong stress response pattern beneficial in low-stress environments would no longer be adaptive in moderately stressful environments as the high arousal levels of the SRS would incur a cost in long-term health. It is for this reason that the trade-off made in those developing in this type of environment shift to a more moderate response pattern. The buffered responsivity pattern is frequently characterized in extant literature as serving as a “protective factor” for the development of anxiety and aggression when compared to the
vigilant and unemotional profiles (described below), when in the context of environments outside the unique milieu of sensitive environments.

When developing in environments in which individuals are exposed to high amounts of danger and threat (being either physical or social), a degree of constant vigilance to environmental danger becomes required, reflected in the vigilant pattern (type III). As a consequence of this danger, individuals demonstrating this type of stress response show a higher degree of arousal during baseline, along with a strong increase in arousal when exposed to stress. While this lack of relaxation and over-engagement of the stress response possesses detrimental long-term health effects, this trade-off is advantageous as the benefit of avoiding ever-present danger outweighs the detrimental effects long-term. The takeaway from this is that in living in environments in which everyday life is punctuated by high amounts of danger and stress, it becomes adaptive to restrict one’s ability to relax (allowing for a heightened situational awareness) and enhance the ability to quickly muster the resources needed to respond to a high level threat immediately.

The final stress pattern is unemotional (type IV), which in many ways is the polar opposite of sensitive, as its reactivity profile is blunted to the point of non-responsivity compared to the hyperactive response shown by the sensitive profile. As a consequence of this lack of responsivity, information regarding danger and threats are filtered out enabling an increase in risk-taking behaviors as compared to that demonstrated in other profiles. However this blunted reactivity pattern isn’t shown across the board, as increases in arousal level do occur when the stressor is physical in nature (such as life endangerment or physical challenge from another person). Interestingly, during aggressive confrontation, the individual maintains a cool-headed approach to aggressive behavior.
Application

This theoretical framework described above lends itself well to the examining of the mechanistic underpinnings of the physiological response to financial debt (a chronic stressor). As the developmental experience of financial stress as well as financial literacy varies considerably between individuals, these developmental differences serve as a compelling angle to examine differences in stress reactivity within this context. The influence of financial stress and wellbeing in the family as individuals were growing up can, in theory, be mapped onto the circumstances in which the four stress profiles emerge. For instance, children who grow up in an environment without financial stress in which the child had free access to any costly recreational item or service they wish (such as video game consoles or dance lessons), might develop the sensitive SRS profile. Children might be expected to develop a buffered response pattern if basic food and resources were easily and consistently accessible, but non-essential items and services are not freely obtained (requiring work on the part of the child to access). Conversely, children who grow up in environments in which access to food or resources is either restricted or inconsistently available might develop the vigilant or unemotional SRS profiles depending on whether their adversity chronic or intermittent. Due to the necessity of financial resources society (discussed in chapter 4), financial struggle is intertwined with a variety of environmental stressors that can adversely impact the development of children (such as food insecurity, family instability, social stigma, etc.). It is for this reason that the ACM is provides uniquely dynamic framework that accounts for the diverse effects financial adversity has one’s developmental environment.
Before the impact of early adversity stemming from financial stress as a moderator of the development of the SRS can be examined, it is first necessary to establish whether financial stress impacts the SRS responsivity. The ACM postulates that access to resources are key regulators of the SRS because it contains life history relevant information about the stability of the environment, but this aspect of the ACM theory has not yet been tested (to my knowledge). This thesis seeks to establish that the financial information provided by the credit score and student loan debt will operate as an acute financial stressor which is personally relevant to the participant and the resources in their environment. If true, then the financial information will be expected to stimulate a physiological response in the SRS. As described below, this thesis will consider the autonomic nervous system as measures of the SRS.
CHAPTER 3: AUTONOMIC NERVOUS SYSTEM

Stress Response System (SRS): Components and Function

With the theoretical framework of the ACM in mind, the question for the reader then becomes, “What are the mechanisms behind this, and how do they function in practice?” The previous chapter described the stress response system in broad terms such as “arousal” and “relaxation.” This chapter will break down the SRS into the mechanisms underlying this complex physiological process. The SRS is comprised of three integrated neural systems: the sympathetic and parasympathetic nervous systems along with the hypothalamic-pituitary adrenal (HPA) axis [Kemeny, 2003]. These systems are organized in a hierarchical fashion in which the order for activation (or withdrawal in the case of the parasympathetic branch) typically occurs in the same sequential order. The activation of the following branch is contingent on whether environmental influences require a continued activation of the stress system. A way to conceptualize this order and operation is to equate it to driving a car. Before being able to start it, first the parking brake must be released (analogous to the sudden increase in arousal from the withdrawal of the parasympathetic branch’s inhibitory control), allowing the car to be able to move. To increase the speed of the vehicle, the gas pedal is pressed (similar to the way that the sympathetic branch activates shortly after the withdrawal of the parasympathetic branch), and shifting up a gear to further increase the car’s speed (similar to the way sustained environmental stress requires the activation of the HPA axis’s release of cortisol).

Autonomic Nervous System (ANS) Overview

The autonomic nervous system (ANS) is a robust system that physiologically regulates largely unconscious biological processes (such as heart rate, respiration, and sweat
production) in order to modulate the level of arousal within the body and prioritize energy expenditure. While often referred to in common parlance as the ‘fight or flight response’ [Cannon, 1932], this does a disservice to the crucial role the ANS plays in a wide variety of bodily processes unassociated with the stereotypical fear response, such as digestion, relaxation, the sexual response cycle, as well as the aforementioned fear response [Cannon, 1929]. With this in mind, the ANS would be best thought of as being responsible for the regulation of overall bodily arousal. The interaction between the two systems comprising it (the sympathetic and parasympathetic branches) is often characterized by a relatively antagonistic relationship in which one withdraws while the other activates; a relationship described as reciprocal activation. While the idea of the ANS branches acting in a binary fashion similar to a light switch (in which one is off while the other is on) is easily conceptualized and understood, the relationship between the two branches are more nuanced that it first appears, with different bodily processes (such as the production of saliva and the sexual response cycle) showing signs of co-activation in which both branches exert an influence [Berntson, Cacioppo, & Quigley, 1991]. In sum, the ANS is an interlinked and highly responsive system of two branches working in concert to achieve Allostasis.

**Parasympathetic Nervous System (PNS)**

The first line of action of the SRS is the withdrawal of the parasympathetic nervous system (PNS), a process occurring on the order of 5-10 seconds [Porges, 2007, 2009]. This action occurs as a function of the vagus nerve (the tenth cranial nerve beginning at the nucleus ambiguus and descending down the spinal cord), responsible for regulating control of the heart, lungs, and digestive tract. As the PNS pathways via the vagus nerve are located more closely to their target organs than that of its sympathetic analog, its time of action is
much shorter. Innervating the sino-atrial (S-A) node of the heart (also known as the heart’s ‘pacemaker’), the vagus nerve regulates the interval between heart beats to proactively respond to environmental cues and determine whether to cede more cardiac influence to the SNS.

The PNS utilizes the neurotransmitter acetylcholine as its key messenger, meaning that the cells are cholinergic. While both pre-and-post ganglionic neurons both utilize acetylcholine, the pre-and-post ganglionic receptors are anatomically distinct. The pre-ganglionic neurons are called nicotinic receptors, so called because of the fact that nicotine selectively binds to them as well as acetylcholine. The post-ganglionic neurons, which innervate (neuronally link) the target organs to PNS influence, are also cholinergic. However, unlike the pre-ganglionic nicotinic receptions, it employs muscarine receptors (similarly named because of muscarine’s ability to selectively bind to it) to relay the signal from the vagus nerve to its intended destination. It is due to these receptors that the PNS operates on a quicker timeframe compared to that of the SNS branch.

As described by Porges in 2007, the vagus nerve (also called the wandering nerve due to its comprehensive reach across the body’s many systems) is a sophisticated construct containing two separate branches: the dorsal and ventral vagal complexes. According to Porges’s polyvagal theory, these branches are phylogenically organized, in that each branch has a different evolutionary antecedent where one is older than the other (a concept referred to in popular culture as the “lizard brain”). Also known as the ‘vegetative vagus’, the dorsal vagal complex is notably unmyelinated, signifying that it has the oldest evolutionary antecedent between the two branches as myelination is a more recent evolutionary development. Utilizing the post-ganglionic muscarine receptors, this branch governs the
‘freezing response’ in which an organism movement is temporarily paralyzed, observed in animals as the phenomenon of ‘playing dead’. Unlike the dorsal vagal complex, the ventral vagal complex is myelinated, leading to a speedier path of action due to myelin’s conductive properties. Known as the ‘smart vagus’, this branch notably initiates the ‘fight or flight’ response by relinquishing its inhibitory control of heart rate, causing it to suddenly increase. It is also tied into emotional responsivity through its ability to inhibit or disinhibit neural circuits in the limbic system.

**Sympathetic Nervous System (SNS)**

While the PNS and SNS both utilize acetylcholine as the primary messenger in the nicotinic receptors of the pre-ganglionic neural pathways; these pathways diverge such that the PNS continues to use cholinergic pathways through muscarine receptors (as mentioned above), but the SNS becomes adrenergic, using the neurotransmitters epinephrine and nor-epinephrine. The SNS utilizes three types of post-ganglionic adrenergic receptors to increase levels of arousal in the body: alpha, beta 1, and beta 2. Alpha receptors are located in the arteries, increasing heart contractility when stimulated with epinephrine/nor-epinephrine. Beta 1 receptors (located in the heart) possess similar contractile traits, working in conjunction with alpha receptors to increase blood pressure. Conversely, Beta 2 receptors act in dilating smaller coronary arteries to prioritize blood flow to target organs necessary to respond to the stressor (such as the smaller coronary arteries and arteries to skeletal muscle).

The SNS’s post-ganglionic shift to adrenergic pathways creates a systemic delay in the order of 20-30 seconds when compared to the quicker action of the PNS [Goldstein, 2010], as these pathways take longer to activate due to the ganglionic fibers being shorter than their PNS analogs. It is because of the contractile properties of the alpha and beta 1
receptors that the SNS possesses inotropic properties; that is, the ability to modulate the forcefulness by which the cardiac muscles contract. Thus, the PNS controls the heart’s timing (through its action on the S-A node), but the SNS largely controls the power of the heartbeat. All three of these receptors act in concert to increase blood pressure (through the alpha and beta 1 receptors) to the regions to which increased blood volume is needed (through the relaxation action of the beta 2 receptors). In sum, these receptors work together by forcefully contracting the heart and arteries to send the blood to where it needs to go, then relaxing the capillaries at the target site to allow the blood to be fully absorbed.

The autonomic nervous system works on many target organs. A noticeable effect of SNS activation that occurs outside the context of cardiac activity is in its role in the production of sweat through sweat glands in the skin, a phenomenon referenced in pop culture as ‘sweaty palms’. In the skin there are two types of sweat glands: apocrine and eccrine. Apocrine sweat glands are located in areas in which hair follicles are concentrated (such as the scalp, armpits, and pubic region). The sweat produced by the apocrine glands is thicker and comprised of proteins and fatty acids, which when exposed to the bacteria on the skin produce body odor. Eccrine sweat glands produce a sweat that is different in composition from its apocrine cousin, excreting sweat mostly comprised mostly of salt, electrolytes and water. There are two circumstances in which the SNS will initiate sweating: physical heat and emotional stress. Unlike experiencing heat, the sweating caused by emotional stress occurs only in isolated areas: the hands, armpits, soles of the feet, and occasionally forehead, rather than the rest of the body [Kamei et al., 1998]. This sympathetic response is distinct from the rest of the system as it employs the post-ganglionic cholinergic receptors (muscarine) as its mechanism of activation [Shields et al., 1987; Cacioppo,
Tassinary, & Berntson, 2007]. Due to this, the sympathetic response to emotional stress occurs on a much quicker interval akin to the speed of the PNS.

**Stress Responsivity Patterns and the ANS**

These autonomic mechanisms described above provide a clear role underlying the four stress profiles as described in the ACM can be probed more deeply. In contrasting differences between profile types, the SNS and PNS will be described separately for each. In the sensitive profile, the individual shows high levels of PNS influence at baseline, which in congruent with the non-stressful environmental context in which this profile is developed. However, when exposed to stress, the PNS strongly reacts through the vagus nerve withdrawing its cardiac influence, ‘snapping’ the individual out of their relaxed state. The SNS shows moderate influence during the baseline state, with a strong to moderate response to a stressor. Keeping with the buffered pattern’s theme of moderation, the responsivity pattern of those who’ve developed this profile reflect the balance between capitalizing on the beneficial effects of high responsivity while also mitigating the cost by blunting the responsivity pattern somewhat. This balance tilts towards more towards prioritizing PNS responsivity over SNS, which consequently has a beneficial effect in enabling a more active role in engaging with one’s social milieu. As vigilant patterns reflect a deficit in self-regulation, the PNS shows limited influence to maintain a state of vigilance through suppressing the inhibitory action of the vagus nerve. The pronounced arousal elicited when faced with threat is represented by the high basal activity along with a pronounced responsivity pattern.
Brain Areas of Importance

There are multiple brain regions which provide integral roles in the action and efficacy of both the PNS and SNS. Several of these areas demonstrate an exclusive relationship with one branch of the ANS, focusing entirely on one facet of the stress response (such as restoring homeostasis through the withdrawal of the vagus nerve or increasing arousal level through the increased contractility of the heart beat).

The nucleus ambiguus is a bundle of large motor neurons situated in the medullary reticular formation, which plays an instrumental role in the action of the PNS. Tied directly into the vagus nerve (the conduit of parasympathetic action), this region provides efferent (controlling) motor fibers that initiate muscular action in the regions controlling speech and swallowing. Most importantly it provides the crucial post-ganglionic muscarine receptors empowering the PNS’s cardio-inhibitory action [Machado & Brody, 1988].

Located in the brainstem is the sympathetic counterpart to the nucleus ambiguus, the locus coeruleus, which plays a similarly crucial role in enabling SNS activation. Unlike the inhibitory action of the nucleus ambiguus through the vagus nerve, the locus coeruleus possesses excitatory properties that extend to not just the body, but also that of the brain. It is an important information switchboard, receiving information from important brain regions (such as the hypothalamus, cerebellum, cingulate gyrus, and amygdala) via afferent nerve fibers connecting it to these regions of the brain. Due to its interconnectedness with the cingulate gyrus and the amygdala, emotional pain is able to trigger a sympathetic response [Aston-Jones et al., 1996]. Underlying its efferent connections with the brain and spinal cord is a system driven by the neurotransmitter norepinephrine. During activation, the locus coeruleus initiates arousal of the cardiovascular system via the spinal cord, providing the
mechanism behind the flow of adrenergic neurotransmitters to their targeted sites. It should also be noted that this region of the brain has a bidirectional relationship with the emotional parts of the brain, meaning that the withdrawal of sympathetic influence signals to these parts of the brain that the stressor has ended (or is not as severe it initially appeared). This relationship has been examined through the clinical effects of beta blockers have in reducing anxiety [Hayes & Schulz, 1987]. By putting an upper limit on the degree of arousal your body can reach, this sends a signal to the emotional brain regions that conditions are not as stressful as initially anticipated.

Key to both of these branches is the insular cortex, residing within the lateral sulcus, between the temporal and parietal lobes, which has been implicated in the experience of emotion, taste, procedural memory, motor responses, and interpersonal behavior. Studies conducted [Tokgözoglu et al., 1999; Cheung & Hachinski, 2000] on ischemic damage (caused by a cutoff blood supply) to the insular cortex have found strong associations with heart arrhythmias (erratic timing of the heart beat) and contralateral hyperhidrosis (excessive sweating). The presence of these symptoms in a damaged insula perfectly illustrates the degree to which this brain region exerts homeostatic control on both branches of the ANS. As mentioned above, one of the specialized roles of the PNS is its modulation heart rate timing as a consequence of changing environmental need; the malfunctioning of this process as a consequence of damage to the insula demonstrates its integration in the operation of the PNS. Similarly, as the initiation of sweating is within the purview of the SNS, its dysregulation illustrates the insula’s crucial role in sympathetic regulation. In sum, symptoms related to damage to the insula demonstrate the crucial role it plays in numerous biological processes mediated by the ANS. Of particular relevance to this study is its link to
negative emotions such as disgust [Wright, He, Shapira, Goodman, & Liu, 2004] and the anticipation of negative stimuli, both of which aid in facilitating risk aversion [Kuhnen & Knutson, 2005]. Supporting this notion is that conclusions drawn from lesion studies on this brain region have shown that individuals with insular damage are less risk-averse compared to those without this damage [Clark et al., 2008].

**Measures of the Autonomic Nervous System**

There are multiple well-validated ANS indices that will be utilized in the present study: heart rate, pre-ejection period, galvanic skin conductance, and respiratory sinus arrhythmia. No single method is a perfect means of capturing the nuances of the ANS response, but these four indices can together form a more complete picture of autonomic responsivity than they could alone.

**Heart rate** (HR) is assessed as the average number of times the ventricles contract within a minute. Due to its simplicity and availability, HR is frequently used in studies by itself or with other measures to infer changes in ANS reactivity [Allison et al., 2012; Bush, Alkon, Obradović, Stamperdahl, & Thomas Boyce, 2011; Kudielka, Schommer, Hellhammer, & Kirschbaum, 2004]. However, as the average amount of beats per minute is mediated by both the SNS and PNS, its results cannot be used to identify the discrete actions of its branches, instead forming a sort of global average for autonomic reactivity. It is anticipated that HR will slowly increase during the anticipation of both stressors (credit score and student debt) and spiking following the presentation of the stressor.

**Respiratory Sinus Arrhythmia** (RSA) refers to the naturally occurring variation in heart rate as a function of the respiratory cycle. RSA is the increasing of HR (reflected by shortened inter-beat intervals) during inhalation and the decreasing of HR (prolonged inter-
beat intervals) during exhalation [Berntson et al., 1997; Berntson, Cacioppo, & Quigley, 1993]. Increases in RSA indicate PNS control of the heart timing through the action of the vagus nerve, which corresponds to a decrease in HR. RSA serves as a reliable, non-invasive PNS indicator in which a typical stress response is reflected by a low or decreasing RSA, signifying PNS withdrawal of autonomic control on target organs.

**Pre-ejection Period (PEP)** is the time interval from ventricular depolarization to the opening of the aortic valve. As the SNS modulates the contractility of the heart, PEP serves as a relatively selective SNS index such that decreases in PEP reflect SNS activation [Berntson, Lozano, Chen, & Cacioppo, 2004; Bush et al., 2011; Newlin & Levenson, 1979]. Thus, during stress, low or declining PEP is expected as a signal of fast depolarization along with an increase in the strength of the heart beat itself.

**Galvanic Skin Conductance (GSC)** measures the electrical conductance of the skin. Due to the SNS innervation of the eccrine sweat glands in the skin, GSC also serves as an indirect SNS measure [Fowles et al., 1981]. Sympathetic activation causes the hands to sweat, with the sweat itself possessing conductive properties, reducing the skin’s electrical resistance. To measure this, a constant electrical current is typically passed between two electrodes placed on the palm of the hand. When the skin becomes damp from sweat the voltage of the current increases, indicating a galvanic skin response (GSR) and thus GSC typically increases during a stressor. Regarding GSRs, there are two types of skin response: non-specific (NS-GSR) and event-related (ER-GSR). The distinction between the two is that ER-GSRs refer to skin responses occur as a consequence of experiencing an environmental stressor, whereas the responsivity shown from NS-GSRs do not have a specific event tied to
it (occurring as either a natural variation in skin conductivity or in relation to a stressful stimulus unaccounted for).

The purpose of this chapter was to provide an in-depth examination of the physiological mechanisms of the SRS targeted in this thesis, specifically the autonomic nervous system. The ANS has been shown to be a sophisticated construct in which the two parallel systems comprising it (the PNS and SNS) are in a continual tug-of-war, in which both are vying for increased influence based on current environmental context. These physiological mechanisms occur on a fast time frame that allows the researcher to examine discrete physiological changes occurring shortly after an event occurs. This unique property allows for a close examination of the changes that occur as a consequence of exposure to a stressor through the use of the ANS indices described above (HR, RSA, PEP, and GSC). Drawing from the ACM theoretical framework and an understanding of the physiology of the autonomic nervous system, I will now try to establish that the context of financial stress exposure should calibrate physiological reactivity of the autonomic nervous system.
CHAPTER 4: FINANCIAL STRESS

Financial Strain and Anxiety

Money is a stressful topic to discuss or even think about due to it being an inherently finite resource, thus one’s finances are frequently examined from a deficit mentality (i.e. focusing on the money they lose rather than gain). Adverse economic conditions exacerbate these issues, making a monetary loss mindset much more salient than its monetary gain counterpart. Due to its interconnectedness with the availability of resources needed for survival and security, financial difficulties have a cascading effect in creating additional stressors (such as food insecurity and housing instability) that cumulatively increase the allostatic load in the individual.

At the core of these issues is the concept of financial strain, a term defined by Conger and colleagues in 1990 as “the judgment that resources are inadequate to meet family needs”. In this study, they examined the way in which financial strain is associated with marital quality and instability using a sample of 76 white, middle class couples. As take home income on its own is an ineffective metric to assess the degree to which these families are impacted by financial strain (due to varied family size and cost of living), their economic status was examined using an income-to-needs ratio, an adjustment of family income derived from incorporating all forms of family income (such as earning, interest, dividends, governmental support, etc.) and dividing this by a poverty line figure provided by the U.S. Census Bureau based on family size. Comparing this to measures of marital quality and instability found significant path coefficients between financial strain and husband hostility (.33) which in turn was significantly associated with marital instability (.25) (pg. 651).
While used in the context of marital relationships, the construct financial strain also lends itself well to examining the individual. These issues with financial strain show a profound impact on the physical, mental, and social well-being of individuals. In 2014, Savoy and colleagues sought to investigate this relationship using a sample of 1341 African-American adults. Comprised of two waves, the first wave collected baseline values of self-rated health, financial strain, perceived stress, depressive symptoms, along with basic demographic information, while the second collected this information on year later. It was found that greater degrees of financial strain were “significantly associated with poorer self-reported health over and above the influence of age, sex, partner status, income, education, and employment status.” The findings described above provide a clear example of the profound ways in which feelings of financial strain erode an individual’s well-being, tying this to known environmental stressors that impact the development trajectory of a child’s SRS as described in the ACM.

While the construct of financial strain provides an objective assessment of financial circumstance, it is unable to probe the way in which the individual appraises their financial circumstance. Further complicating matters is that individuals process and appraise stressors in myriad ways, as early environmental influences affect the developmental trajectory of individuals and their appraisal of different kinds of stressors. To that end Archuleta, Dale, and Spann (2013) developed the Financial Anxiety Scale (FAS) to assess the degree of anxiety a person feels regarding their financial circumstance. This additional dimension to the study of financial stress allows for the assessment of one’s subjective experience regarding their appraisal of their financial circumstance. Underlying each of these and complicating matters is the lack of understanding an individual has for both their own
finances as well as finance in general, a construct described in existing finance research as financial literacy [Huston, 2010]. The way in which financial literacy ties into the financial stressors explored in this paper will be described below.

**Student Debt as a Stressor**

This section will describe student debt as a unique financial stressor. In addition to defining student debt, I contend that the stress of learning about one’s student loan debt may include three elements of stress: (a) the shock about amount of money owed, (b) learning about the nature of interest and compound interest may further exacerbate the stress of paying back the loans, and (c) discovery of the imminent deadline for payments in addition to other new responsibilities such as finding stable employment.

Student loans have become infamous for their severity and rapid accumulation, with 44.2 million debtors owe $1.48 trillion dollars in student loans, making it currently the second-largest source of household debt (after housing) [Federal Reserve Bank of New York, 2018]. An average bachelor degree holder owes $39,400 dollars to complete their degree with a monthly statement of $351. Defaulting (or failing to meet the legal obligations of a loan) is a major issue with student debt, with 1 million students per year going into default on their loans and 22% of borrowers going into default. For the more recent cohorts, this number is far higher with 28-29% of borrowers defaulting within 12 years of entering college (or 5 years after beginning to pay them) [Yannelis, 2015; Miller, 2017]. This number is expected to continue rising, by 2023 nearly 40% of student loan borrowers are expected to default on their student loans [Scott, 2018]. Defaulting on these loans have devastating consequences on financial well-being, which in turn will tank one’s credit score (causing a
drop between 50 and 90 points) and inflate the balance on the loan by as much as 10% [Blagg, 2018].

Unlike other kinds of loans, filing either chapter 7 or 13 bankruptcy is incapable of discharging student loan debt. While the possibility exists to resolve this debt, the debtor must meet a court definition of “undue hardship” to qualify. A common standard to address this is the Brunner test in which the debtor must meet three requirements: poverty, persistence, and good faith. These individuals must be unable to maintain a minimal standard of living for themselves or their dependents if they are forced to pay the loan (poverty) that this deficit in living standards must be likely to continue for a significant part of the repayment period (persistence), and finally that the debtor has made attempts in good faith to repay their loan. However, these requirements are subject to interpretation and place a high bar for debtors to meet in order to qualify for this exemption. Exacerbating this and adding to the burden is the fact that the ballooning cost of pursuing higher education has been increasing at a higher rate than inflation, making the cost of receiving a degree much higher than in earlier generations, even after controlling for inflation [College Board, 2011].

The most common types of student loans include Direct Subsidized, Direct Unsubsidized, Subsidized Federal Stafford Loans, and Unsubsidized Stafford Loans. The distinction between subsidized loans and their unsubsidized counterparts is that the interest accrued while the student in school is paid by the US government during the student’s time in school for subsidized loans, but for unsubsidized loans the interest is burdened by the student so that the amount owed at graduation is increased via interest during their studies. Subsidized loans are typically offered only to students in financial need. Direct loans are loans in which the government acts as the lender, while for Stafford loans the government
acts as an intermediary allowing money from private lenders to make their way into the hands of students. There are two major implications of these student loan types for understanding financial stress. First, the amount of student loan debt may be opaque due to varying interest accrual rates, loan types, and time in school. Second, regardless of the student loan type, shortly after graduation, the impact of student loans will burden the college graduate. Most common types of student loans offer only a 6-month grace period before the debtor must make their initial payment [US Department of Education, 2011]. The imminent deadline to begin payments for the new graduate may create an additional layer of stress.

Existing research has demonstrated that the degree to which one is financially literate, specifically with regards to loans, plays a major role in the type and amount of loans taken by the debtor. Lusardi and Tufano (2015) examined a subtype of financial literacy, debt literacy, or the degree to which an individual understands the way in which debt repayment works. To assess debt literacy, they created a test posing scenarios for the participant to solve (such as the amount of years it would take for an owed debt amount to double based on the initial loan, payment amount, and interest rate), and compared it to the participant’s self-reported indebtedness. Results found that in the 1000 participants surveyed, those who scored low on debt literacy showed a higher likelihood of risky financial decision making (such as taking on higher cost loans with higher interest rates). Alarmingly, around one third of this sample struggled to grasp the basics of compounding interest. The implication is that an added stressor of student loan debt may, paradoxically, include learning accurate information about the extent to which one must payback interest.

The period following graduation is a very vulnerable time of life as financial circumstances are unstable as new graduates may struggle as they attempt to resettle and find
long-term means of stable employment. This widespread spread lack of basic knowledge of
debt and finance carries with it the consequences of risky financial decision making, which in
this context reflects increased student loan debt at higher interest rates. The ease at which this
debt accumulates coupled with both the inability to easily satisfy this debt and the stress
inherent in seeking steady employment create a perfect storm of financial strain and anxiety
that warrant closer examination, made all the worse by the individual’s lack of knowledge of
how interest rate work. The consequences of such debt are far-reaching and long lasting, as
the average amount of time for a debtor with a bachelor degree takes is 21 years [OWI,
2013], compared to the ten years they usually expect. Inadvertently taking on high interest
student loans only serve to exacerbate the problem.

Credit Score

While student loans represent only one type of debt (albeit a major one), credit scores
reflect all types of debt, culminating into a single value encompassing the “debt-worthiness”
(or willingness for a lender to provide a line of credit) to an individual. The most common
form of credit score used in the United States is the FICO score, which as of 2017 range in
value from 300-850, with lower values being indicative of higher credit risk (likelihood that
the debtor will become delinquent on their payments) [Board of Governors of the Federal
Reserve System (US), 2007]. This score is broken down into five categorical ranges that
represent how “good” your credit score is in comparison to the average US consumer, who
on average possesses a FICO score of 695: exceptional (800+), very good (740-799), good
(670-739), fair (580-669), and poor (< 580) (figure 1). The category one fits into possesses
everoomous implications on both present and future financial prospects, in that this assessment
is used in over 90% of lending decisions [CEB TowerGroup, 2015]. According to
myFICOscore.com, FICO scores are derived from the credit reports (comprised of one’s financial history including credit information and bank accounts) gained from the three major bureaus responsible for maintaining these financial records: Experian, TransUnion, and Equifax. Taking the information from these three sources, specific information is weighted more highly than others. To best understand how this contributes towards the final score, myFICOscore.com create a pie graph that represents the degree to which each variable is weighted towards the total (figure 2); in it, payment history represents 35% of the total score, the debt amount represents 30%, credit history length represents 15%, recent credit information represents 10%, and all other variables represent 10%.

Figure 1: FICO score creditworthiness
Figure 2: Breakdown of how FICO score is weighted

Despite the importance of credit score and its far-reaching impact, many people remain ignorant of their credit score or what the range values means for a credit score. Perry (2008) found that 32% of consumers overestimate their credit scores while a mere 4% underestimate their score. Additionally, it was found that those 32% who overestimate their credit scores tended to be financially literate; drawing what knowledge they do have from past experience. The limited knowledge many of these people have regarding the value of their credit score demonstrate its lack of salience to the individual (as in its value isn’t as easily conceptualized as that of monetary value in which its implications are immediately understood). In this study, this lack of salience will be exploited to provide a good point of
comparison between the more easily understandable monetary debt stressor and the byzantine nature of one’s credit score value. That is, whereas both the credit score and student loan debt contain information about financial health and wellbeing, the student loan debt may be more salient as a stressor because it is easier to understand how debt contributes to financial strain and stress.

Financial stressors play a pernicious role in eroding the mental and physical wellbeing of individuals [Savoy et al., 2014; Huijs et al., 2015]. This financial stress can and has been measured in both objective (in the case of financial strain) as well as subjective (in the case of financial anxiety) terms, providing metrics to use in the context of this project to supplement the physiological data obtained with financial data. Credit score and student debt are two numbers that possess far-reaching implications in one’s present and future environmental circumstance. This project offers the chance to observe how exposure to two financial stress conditions also impact physiological stress measures and engages the SRS. It is also possible; however, that a major distinction will emerge between the two types of financial stress conditions in their impact on the autonomic nervous system. Whereas the amount of one’s student loan debt carries with it an extremely salient value that can be easily conceptualized by those unfamiliar with financial matters, the value of one’s credit score carries with it no inherent value to anyone unfamiliar with the concepts of credit. This difference in stressor saliency provides fertile ground to probe the way in which two comparably important sources of financial stress differ in stress response. The next section will present how I will examine financial stress and autonomic nervous system functioning, followed by hypotheses and my data analysis plan.
CHAPTER 5: METHODS AND HYPOTHESES

Subject Population

To examining whether a financial stressor impacts autonomic functioning, we administered a financial literacy task to college students while continuously monitoring HR, PEP, RSA and GSC. The targeted subject population focuses on college students who have taken out student loans. Working with ISU enrollment services (with whom we have cooperated with in recent studies) along with using random sampling, 11 participants (3 male, 8 female) were recruited. The inclusionary criteria for these participants are that they are students who have taken out student loans, between the ages 20 and 35, without history of heart issues. To ensure a good response rate, participants were compensated with a $20 Target gift card along with the opportunity to receive additional free financial counseling (via existing student-counselor training channels) following the study’s completion.

Procedures

Full participation took place over the course of a single session, taking approximately 1.5 hours. The study’s protocol was conducted with full approval by Iowa State University’s institutional review board (see Appendix C). Upon arrival at the CAR (Cardiovascular Autonomic Reactivity) lab the experimenter aided the participant in accessing their total student loan debt (www.annualcreditreport.com) as well as their credit score via creditkarma.com, imputing the values into their corresponding ePrime event file (credit score/student loan). Following this, seven sensors in total were placed on the main body of the participant to measure three biomarkers of the cardiac cycle: heart rate (HR), respiratory sinus arrhythmia (RSA), and pre-ejection period (PEP); as well as two on the hands to measure galvanic skin conductance (GSC). Once finished, the participant was seated at a
computer to fill out an online self-report questionnaire via Qualtrics (serving as the baseline control task) until reaching the halfway point, upon which the experiment would begin. The participant experienced two similarly structured experimental blocs (4 minutes each: 2 pre-exposure, 2 post-exposure) in counterbalanced order. Regardless of condition, they were exposed to material educating them about student loans or credit score (depending on condition), before being prompted to enter their estimated credit score/student loan debt. Next, the participants were exposed to their actual credit score or student loan debt, depending on the counterbalance condition. The participant then went back to filling out questionnaires on Qualtrics for 15 minutes before the second bloc began. After the second bloc finished, the participant finished filling out the Qualtrics questionnaire before sensors were removed. At the end of the experiment, the participant was offered the opportunity to email themselves their credit report before its deletion from the computer, before signing a form indicating that they have received the $20 Target gift card.

measurement of autonomic data

Electrodes were applied to the chest, back, and face in a validated configuration for impedance cardiography (figure 3). Seven sensors in total were placed on the main body to measure three biomarkers of the cardiac cycle: HR (the average amount of beats per minute) [Willemsen et al., 1996; Cacioppo, Uchino, & Berntson, 1994], RSA (the average interval between heart beats) [Berntson, Cacioppo, & Quigley, 1991], and PEP (the average time from ventricular depolarization to the opening of the aortic valve) [Newlin& Levenson, 1979; Allen et al., 1990; Berntson et al., 2004]; as well as two on the hands to measure galvanic skin conductance (GSC) [Fowles et al., 1981]. Each of these sensors were attached by electrical leads to an ambulatory electro-impedance cardiograph (Model: 50-2303-00;
Mindware Technologies, LTD.) [Cutin, Lozano, & Allen, 2007]. This data was continuously recorded in real-time for each of the three conditions: pre-stressor, student loan task, and credit score task. To ensure quality control (to account for potential movement artifact) participants were recorded during the duration of the experiment, as the data cleaning software allows for syncing the video data to the physiological data, making it easier to discern whether an unusual value is due to movement artifact. The videos were stored on a password protected computer disconnected from the internet that is located in a locked room.

Figure 3: Sensor configuration
The Credit Score/Student Loan Conditions

The experiment was comprised of two (4 minute) experimental blocs, focusing on either credit score or student loan debt, with the participants experienced both conditions in counterbalanced order. Both entailed the participant working on the same screen, in which instructions appeared. Relevant to the condition they were experiencing, they were exposed to material educating them about either student loans or credit score. Examples of information given are what credit scores are, their range of values, what goes into determining credit score, and how they are used; student loan information included the difference between federal and Stafford loans, the distinction between subsidized and unsubsidized loans, and the average amount of time it takes to fully pay off student loans. After this educational material was presented, they were either asked to estimate their total student loan debtor their current credit score. Following their response, participants were asked to rate how they are feeling regarding six emotions: relaxed, happy, angry, surprised, scared, and stressed. The participants were then exposed to their actual and average values of either credit score or student loan debt, along with further educational material on student loan debt and credit score. After this exposure, they were again asked to rate their emotions.

Data Cleaning and Analysis of Physiological Data

ANS data was collected through the data acquisition computer using the Biolab software. From there the recorded physiological data was cleaned using Mindware analysis software programs: HRV 3.1 (HR and RSA), IMP 3.1 (PEP), and EDA 3.1 (GSC). Data cleaning entailed ensuring that the R-peaks (the top-most point of an ECG signal) were properly tagged by the software, and if necessary, adjusting the placement of the point on an overlayed ECG graph. Once cleaned, the data was written to an Excel spreadsheet showing
the average values of each biomarker throughout the task. This data was written as a series of 30-second epochs, an epoch length with a strong methodological precedent for having enough data to compensate for the occasional artifact (such as sporadic arrhythmias) [Li et al., 2009; Parnandi, Ahmed, Shipp, & Gutierrez-Osuna, 2013; Sano & Picard, 2013] to assess the change pre-and-post exposure to the stressor. Each bloc (baseline, credit score, and student loan debt) was written in the form of eight 30 second blocks, comprising 2 minutes pre-exposure and 2-minutes post exposure (figure 4).

Figure 4: Physiological data structure

**Questionnaires**

Questionnaires were administered via Qualtics at three points during the experiment: at baseline (before both experimental blocs), in between blocs, and post-experiment. The initial questionnaire session was the longest, comprised of: basic demographic information, the HBQ (assessing basic health information) [Armstrong & Goldstein, 2003], an education background questionnaire, a FICO financial literacy questionnaire, and a student loan knowledge questionnaire. Between experimental blocs the participants was administered the STAI (measuring both predisposition towards, and current experience of anxiety) [Spielberger, Gorsuch, & Lushene, 1970], locus of control (measuring the degree to which an
individual attributes outcomes as a function of internal or external sources) [Rotter, 1966], and the CISS (measuring coping strategies) [Endler & Parker, 1990]. Following the final experimental bloc, the participant completed further questionnaires including financial self-reports on socialization (exposure to financial information in home life), economic pressure (degrees of stress experienced due to financial factors), and the Adverse Childhood Experiences questionnaire [Anda et al., 1999]. Finally the participant completed a self-report on their experience being exposed to the financial information during the experiment.
CHAPTER 6: DATA ANALYSIS

Hypotheses

Given the multiple time point measurements inherent in the study design, the analysis used repeated measures ANOVA to examine changes in autonomic reactivity in response to the tasks. Outcomes of interest included the autonomic scores: HR, RSA, PEP, and GSC with the independent variable being time (measured in eight 30-second epochs within condition or averaged values across conditions). Control variables (e.g., gender, age) and individual difference predictors (e.g., amount of debt, credit score) may be explored in future analyses but are not the primary hypotheses of the thesis and the ongoing project is statistically underpowered to examine individual difference predictors. Thus, these are not discussed further although analyses describing these measures are included. Specific hypothesis includes the four following queries:

Hypothesis 1:

Hypothesis 1a: HR reactivity was predicted to be greater during the stressor conditions (credit score and student loan) compared to baseline, resulting in a sharp increase in HR, indicating a heightened degree of arousal (via either PNS withdrawal or SNS activation). This was tested using an RM ANOVA to examine the eight-epoch responsivity pattern in HR response for each of the three conditions: baseline, credit score, and student loan. Repeated orthogonal contrasts were used to compare the significance of changes between subsequent epochs (e.g. epoch 1 vs. epoch 2, epoch 2 vs. epoch 3, etc.). To give context for baseline, two RM ANOVAs were conducted using averaged HR values for baseline, pre-stressor, and post-stressor for each stress condition.
Hypothesis 1b: HR reactivity was predicted to be stronger (i.e. a greater increase in HR) during the student debt condition compared to its credit score counterpart. This was tested using an RM ANOVA to examine changes between the average HR values of the credit score and student loan conditions.

Hypothesis 2:

Hypothesis 2a: RSA reactivity was predicted to be greater during the stressor conditions (credit score and student loan) compared to baseline, resulting in a sharp decrease in RSA, indicating a withdrawal of the parasympathetic branch. This was tested using an RM ANOVA to examine the eight-epoch responsivity pattern in RSA response for each of the three conditions: baseline, credit score, and student loan. Repeated orthogonal contrasts were used to compare the significance of changes between subsequent epochs (e.g. epoch 1 vs. epoch 2, epoch 2 vs. epoch 3, etc.). To give context for baseline, two RM ANOVAs were conducted using averaged RSA values for baseline, pre-stressor, and post-stressor for each stress condition.

Hypothesis 2b: RSA reactivity was predicted to be stronger (i.e., a larger drop in RSA) in the student debt condition compared to its credit score counterpart. This was tested using an RM ANOVA to examine changes between the average RSA values of the credit score and student loan conditions.

Hypothesis 3:

Hypothesis 3a: PEP reactivity was predicted to be greater during the stressor conditions (credit score and student loan) compared to baseline, resulting in a sharp decrease in PEP, indicating an activation of the sympathetic branch. This was tested using an RM
ANOVA to examine the eight-epoch responsivity pattern in PEP response for each of the three conditions: baseline, credit score, and student loan. Repeated orthogonal contrasts will be used to compare the significance of changes between subsequent epochs (e.g. epoch 1 vs. epoch 2, epoch 2 vs. epoch 3, etc.). To give context for baseline, two RM ANOVAs were conducted using averaged PEP values for baseline, pre-stressor, and post-stressor for each stress condition.

**Hypothesis 3b:** PEP reactivity was predicted to be stronger (i.e. a larger drop in PEP) in the student debt condition compared to its credit score counterpart. This was tested using an RM ANOVA to examine changes between the average PEP values of the credit score and student loan conditions.

**Hypothesis 4:**

**Hypothesis 4a:** GSC reactivity was predicted to be greater during the stressor conditions (credit score and student loan) compared to baseline, resulting in a sharp increase in GSC, indicating an activation of the sympathetic branch. This was tested using an RM ANOVA to examine the eight-epoch responsivity pattern in GSC response for each of the three conditions: baseline, credit score, and student loan. Repeated orthogonal contrasts were used to compare the significance of changes between subsequent epochs (e.g. epoch 1 vs. epoch 2, epoch 2 vs. epoch 3, etc.). To give context for baseline, two RM ANOVAs were conducted using averaged GSC values for baseline, pre-stressor, and post-stressor for each stress condition.
Hypothesis 4b: GSC was predicted to be stronger (i.e. a larger drop in GSC) in the student debt condition than that of its credit score counterpart. This was tested using an RM ANOVA to examine changes between the average GSC values of the credit score and student loan conditions.
CHAPTER 7: RESULTS

Descriptive Statistics

The sample was comprised of 11 participants (72% female) between the ages of 21-30 (Mean =24.45). The average credit score estimate was 596.55 (range: 300-751) versus the actual credit score average of 660.82 (range: 420-762); the estimated student loan debt had a mean of $36,403 (range: $8,130-$110,000) with the actual student loan debt (range: $10,082-$133,739) having a mean of $36,434 (table 1). Correlations were then run between estimated and actual values for both credit scores and student loan debt, finding that the correlation between the estimated and actual credit score values were .755 (p=.007) and .971 (p>.001) for student loans; no correlation was found between actual credit score and actual student loan (table 2). Of this sample, 5 participants (45.45%) planned on deferring their loan payments after graduation, 2 were unsure (18.18%) and 4 (36.36%) did not plan to (table 3). When asked how many times they had viewed their FICO Score in the past 12 months, over half of participants (54.54%) reported not having done so (table 4).

Table 1: Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant Age</td>
<td>24.45</td>
<td>21</td>
<td>30</td>
<td>3.297</td>
</tr>
<tr>
<td>Est. Credit Score</td>
<td>596.55</td>
<td>300</td>
<td>751</td>
<td>164.482</td>
</tr>
<tr>
<td>Actual Credit Score</td>
<td>660.82</td>
<td>420</td>
<td>762</td>
<td>98.869</td>
</tr>
<tr>
<td>Est. Student Loan</td>
<td>36403.45</td>
<td>8130</td>
<td>110000</td>
<td>27926.007</td>
</tr>
<tr>
<td>Actual Student Loan</td>
<td>36434.82</td>
<td>10082</td>
<td>133739</td>
<td>34225.644</td>
</tr>
</tbody>
</table>

Table 2: Correlations between Actual and Estimated Credit Score/Student Loans

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Score (Act. vs. Est.)</td>
<td>0.755</td>
<td>0.007</td>
</tr>
<tr>
<td>Student Loan (Act. vs. Est.)</td>
<td>0.971</td>
<td>0.000</td>
</tr>
<tr>
<td>Student Loan (Act.) vs. Credit Score (Act.)</td>
<td>0.115</td>
<td>0.736</td>
</tr>
</tbody>
</table>
Table 3: Student Plans to Defer Loan Payments after Graduation

<table>
<thead>
<tr>
<th></th>
<th>Defer</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>36.36%</td>
</tr>
<tr>
<td>Unsure</td>
<td>18.18%</td>
</tr>
<tr>
<td>Yes</td>
<td>45.45%</td>
</tr>
</tbody>
</table>

Table 4: Amount of Times FICO Score was Viewed in the Past 12 Months

<table>
<thead>
<tr>
<th>FICO View (12 months)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Time</td>
<td>18.18%</td>
</tr>
<tr>
<td>2 Times</td>
<td>9.09%</td>
</tr>
<tr>
<td>3 Times</td>
<td>9.09%</td>
</tr>
<tr>
<td>4 Times</td>
<td>9.09%</td>
</tr>
<tr>
<td>5+ Times</td>
<td>0%</td>
</tr>
<tr>
<td>None</td>
<td>54.54%</td>
</tr>
</tbody>
</table>

To provide context for the expectations participants had on the realities of paying their loans, they were asked two questions: 1) whether they were confident that their parents would provide support for them to meet their basic needs while they paid off the loan, and 2) whether they were confident that their parents would provide financial support to make paying off the loan relatively stress-free (table 5). It was found that close to half of participants were “somewhat confident” (45.45%) that their parents would provide some form of support to them while they paid the loan, however this number considerably dropped when asked how confident they were that their parents would be the ones to largely pay off the loan, with 45.45% of them reporting being “not confident”.

Table 5: Confidence in Parental Support/Parental Payment

<table>
<thead>
<tr>
<th></th>
<th>Parents Support</th>
<th>Parents Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Confident</td>
<td>27.27%</td>
<td>45.45%</td>
</tr>
<tr>
<td>Slightly Confident</td>
<td>18.18%</td>
<td>27.27%</td>
</tr>
<tr>
<td>Somewhat Confident</td>
<td>45.45%</td>
<td>18.18%</td>
</tr>
<tr>
<td>Very Confident</td>
<td>9.09%</td>
<td>9.09%</td>
</tr>
</tbody>
</table>
**Hypothesis 1: Do participants show reactivity to the stressors?**

To test whether the participants exhibited an autonomic response to the stressor conditions (credit score and student loan), a series of repeated-measures ANOVAs were conducted for each condition (credit score/student debt) separately to see if there was a main effect of time on ANS levels. These analyses were then repeated for each biomarker measured (HR, RSA, PEP, and GSC). To provide the context of the baseline values to that of the stressor conditions, the mean of all eight epochs of the baseline period was taken to generate an average baseline score for each biomarker (HR, RSA, PEP, and GSC). For the two stressor conditions, the first and last four epochs of each condition were averaged to generate a pre-stressor and post-stressor value for both the credit score and student loan conditions. Two RM ANOVAs were then conducted for each biomarker examining the change across three time points: baseline average, pre-stressor average (credit score/student loan), and post-stressor average (credit score/student loan). Repeated orthogonal contrasts were also calculated to determine how the significantly biomarkers changed over time.

**Heart Rate:** RM ANOVAs conducted examining HR responsivity patterns across eight contiguous 30-second epochs *within* each condition found non-significance for responsivity patterns for all three conditions (table 5): baseline \( F(7,70) = .714, \ p = .660, \ \eta^2 = .067 \), credit score \( F(7,70) = .355, \ p = .925, \ \eta^2 = .034 \), and student loan \( F(7,70) = .724, \ p = .652, \ \eta^2 = .068 \) (figure 5). This indicates that contrary to the initial prediction, no significant HR increases (and thus increased physiological arousal) were found within the conditions themselves.

RM ANOVAs conducted to determine whether HR reactivity occurred *between* experimental conditions found significance for credit score \( F(2,20) = 4.059, \ p = .033, \)
$\eta^2=.289$, as well as trend-level significance coupled with a large effect size for student loan
$[F(2,20)= 2.823, p = .083, \eta^2=.220]$ (table 6). In both conditions HR dropped from baseline
average to the pre and post-stressor conditions. Repeated contrasts for credit score showed a
significant drop in HR between the baseline and the pre-credit score time points $[F(1,0) =$
$7.421, p = .021, \eta^2=.426]$, whereas no significant change was observed between the pre-
stressor and post-stressor credit score time points (figures 6,7). Collectively, while significant
decreases in HR were found between baseline average and the pre-stressor conditions, no
reactivity was found within conditions, indicating that hypothesis 1a. was not supported.

**Table 5:** RM ANOVA results for HR reactivity within conditions

<table>
<thead>
<tr>
<th>HR</th>
<th>F</th>
<th>df</th>
<th>df(Error)</th>
<th>p-value</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0.714</td>
<td>7</td>
<td>70</td>
<td>0.660</td>
<td>0.067</td>
</tr>
<tr>
<td>Credit Score</td>
<td>0.355</td>
<td>7</td>
<td>70</td>
<td>0.925</td>
<td>0.034</td>
</tr>
<tr>
<td>Student Loan</td>
<td>0.724</td>
<td>7</td>
<td>70</td>
<td>0.652</td>
<td>0.068</td>
</tr>
</tbody>
</table>

**Table 6:** RM ANOVA results for averaged HR reactivity across conditions

<table>
<thead>
<tr>
<th>HR</th>
<th>F</th>
<th>df</th>
<th>df(Err)</th>
<th>p-value</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Score Over</td>
<td>4.059</td>
<td>2</td>
<td>20</td>
<td>0.033</td>
<td>0.289</td>
</tr>
<tr>
<td>Credit Pre vs. Base</td>
<td>7.421</td>
<td>1</td>
<td>10</td>
<td>0.021</td>
<td>0.426</td>
</tr>
<tr>
<td>Credit Post vs. Credit Pre</td>
<td>0.124</td>
<td>1</td>
<td>10</td>
<td>0.732</td>
<td>0.012</td>
</tr>
<tr>
<td>Loan Overall</td>
<td>2.823</td>
<td>2</td>
<td>20</td>
<td>0.083</td>
<td>0.220</td>
</tr>
<tr>
<td>Loan Pre vs. Base</td>
<td>3.105</td>
<td>1</td>
<td>10</td>
<td>0.109</td>
<td>0.237</td>
</tr>
<tr>
<td>Loan Post vs. Loan Pre</td>
<td>0.585</td>
<td>1</td>
<td>10</td>
<td>0.462</td>
<td>0.055</td>
</tr>
</tbody>
</table>

**Respiratory Sinus Arrhythmia:** RM ANOVAs conducted examining RSA
responsivity patterns across eight contiguous 30-second within each condition found non-
significance for responsivity patterns for all three conditions (figure 5): baseline $[F(7,70)=$
$.550, p = .794, \eta^2=.052]$, credit score$[F(7,70)= .1.047, p = .407, \eta^2=.095]$, and student loan
$[F(7,70)= .1.549, p = .165, \eta^2=.134]$ (table 7).These results indicate that despite the initial
prediction, no PNS withdrawal(as indexed via reduced RSA) was not observed during the
stressor conditions. RM ANOVAs conducted to determine whether RSA reactivity occurred between experimental conditions (figures 6,7) found no significance for either credit score \[[F(2,20)= 1.061, p = .365, η²=.096]\] or student loan \[[F(2,20)= .870, p = .434, η²=.080]\] (table 8), indicating that even with the baseline values of RSA added for context, no change in RSA were observed across the duration of the experiment. Consequently, hypothesis 2a was not supported.

**Table 7:** RM ANOVA results for RSA reactivity within conditions

<table>
<thead>
<tr>
<th>RSA</th>
<th>F</th>
<th>df</th>
<th>df(Error)</th>
<th>p-value</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0.550</td>
<td>7</td>
<td>70</td>
<td>0.794</td>
<td>0.052</td>
</tr>
<tr>
<td>Credit Score</td>
<td>1.047</td>
<td>7</td>
<td>70</td>
<td>0.407</td>
<td>0.095</td>
</tr>
<tr>
<td>Student Loan</td>
<td>1.549</td>
<td>7</td>
<td>70</td>
<td>0.165</td>
<td>0.134</td>
</tr>
</tbody>
</table>

**Table 8:** RM ANOVA results for averaged RSA reactivity across conditions

<table>
<thead>
<tr>
<th>RSA</th>
<th>F</th>
<th>df</th>
<th>df(Error)</th>
<th>p-value</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Score Overall</td>
<td>1.061</td>
<td>2</td>
<td>20</td>
<td>0.365</td>
<td>0.096</td>
</tr>
<tr>
<td>Loan Overall</td>
<td>0.870</td>
<td>2</td>
<td>20</td>
<td>0.434</td>
<td>0.080</td>
</tr>
</tbody>
</table>

**Figure 5:** HR and RSA reactivity across all epochs
Pre-ejection Period: Due to issues with cardiovascular impedance acquisition, the impedance data of three participants were corrupted and had to be excluded from the analysis (N=8). RM ANOVAs examining PEP responsivity across eight contiguous 30-second epochs found non-significance for responsivity patterns within each condition (figure 6): baseline [F(7,49)= .656, p = .708, η²=.086], credit score [F(7,49)= .602, p = .751, η²=.079], and
student loan \[F(7,49)= .691, p = .679, \eta^2=.090\] (table 9), congruent with the lack of responsivity shown in the biomarkers listed above. With this in mind, it was found that despite the initial prediction, no sympathetic activation (via decline in PEP) was observed during the stressor conditions.

Results of an RM ANOVAs conducted to determine whether PEP reactivity occurred between experimental conditions (figures 6, 7) found no significance for either credit score \[F(2,14)= .775, p = .479, \eta^2=.100\] or student loan \[F(2,14)= .873, p = .439, \eta^2=.111\] (table 10), indicating that even with the baseline values of PEP added for context, no changes in PEP were observed across the duration of the experiment. Consequently, hypothesis 3a. was not supported.

**Table 9:** RM ANOVA results for PEP reactivity within conditions

<table>
<thead>
<tr>
<th>PEP</th>
<th>F</th>
<th>df</th>
<th>df(Error)</th>
<th>p-value</th>
<th>\eta²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0.656</td>
<td>7</td>
<td>49</td>
<td>0.708</td>
<td>0.086</td>
</tr>
<tr>
<td>Credit Score</td>
<td>0.602</td>
<td>7</td>
<td>49</td>
<td>0.751</td>
<td>0.079</td>
</tr>
<tr>
<td>Student Loan</td>
<td>0.691</td>
<td>7</td>
<td>49</td>
<td>0.679</td>
<td>0.090</td>
</tr>
</tbody>
</table>

**Table 10:** RM ANOVA results for averaged PEP reactivity across conditions

<table>
<thead>
<tr>
<th>PEP</th>
<th>F</th>
<th>df</th>
<th>df(Error)</th>
<th>p-value</th>
<th>\eta²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Score Overall</td>
<td>0.775</td>
<td>2</td>
<td>14</td>
<td>0.479</td>
<td>0.100</td>
</tr>
<tr>
<td>Loan Overall</td>
<td>0.873</td>
<td>2</td>
<td>14</td>
<td>0.439</td>
<td>0.111</td>
</tr>
</tbody>
</table>

**Galvanic Skin Conductance:** Data was missing for a single participant and consequently the sample size was N=10 for this analysis. Unlike the results listed above, RM ANOVAs conducted examining GSC responsivity across eight contiguous 30-second epochs for each condition found significance for GSC reactivity during the baseline task \[F(7,63)= 3.124, p = .007, \eta^2=.258\], in which skin conductance increased across all eight epochs indicating SNS reactivity during baseline (table 11). During the credit score condition, there
was trend-level significance (with a large effect size) showing a reduction in skin conductivity (and thus SNS influence) throughout the task \[F(7,63)= 2.121, \ p = .054, \ \eta^2=.191\]. Unlike the previous two conditions, no significant changes in skin conductivity was observed during the student loan task \[F(7,63)= .872, \ p = .534, \ \eta^2=.088\].

Decomposing these results, repeated orthogonal contrasts examining the changes between epochs in the baseline condition showed no significance, indicating that the increase was linear. Interestingly, repeated orthogonal contrasts examining epoch changes during the credit score condition found significance between the first and second epoch \[F(1,9)=7.022, \ p=.026, \ \eta^2=.191\] (table 12). Taken as a whole, not only was the prediction of the stressor conditions eliciting an increase in skin conductivity (hypothesis 3a.) not supported, but that the findings showed a response pattern opposite of what was predicted (i.e. increase in conductivity during the baseline task).

Results of an RM ANOVAs conducted to determine whether GSC reactivity occurred across experimental conditions found significance, in which skin conductivity rose over time for both the credit score \[F(2,18)= 5.407, \ p = .014, \ \eta^2=.375\] and student loan \[F(2,18)= 4.092, \ p = .034, \ \eta^2=.313\] conditions (table 13). Repeated contrasts found that the pre-exposure time point for the credit score condition showed significantly higher levels of skin conductivity compared to the baseline average \[F(1,9)= 7.118, \ p = .026, \ \eta^2=.442\] (figure 10). Similarly, trend-level significance coupled with a large effect size was found for the pre-exposure student loan time point in which higher levels of skin conductivity was found compared to baseline \[F(1,9)= 4.092, \ p = .071, \ \eta^2=.317\] (figure 10). Notably, no significance was found for skin conductance change between the pre-exposure and post-exposure time points for both the credit score and student loan conditions, indicating that the baseline-to-
pre-stressor changes were driven by rise in skin conductance occurring within the baseline period.

**Table 11:** RM ANOVA results for GSC reactivity within conditions

<table>
<thead>
<tr>
<th>GSC</th>
<th>F</th>
<th>df</th>
<th>df(Error)</th>
<th>p-value</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td><strong>3.124</strong></td>
<td>7</td>
<td>63</td>
<td><strong>0.007</strong></td>
<td><strong>0.258</strong></td>
</tr>
<tr>
<td>Credit Score</td>
<td><strong>2.121</strong></td>
<td>7</td>
<td>63</td>
<td><strong>0.054</strong></td>
<td><strong>0.191</strong></td>
</tr>
<tr>
<td>Student Loan</td>
<td>0.872</td>
<td>7</td>
<td>63</td>
<td>0.534</td>
<td>0.088</td>
</tr>
</tbody>
</table>

**Table 12:** Within-Subjects contrasts for GSC during credit score condition

<table>
<thead>
<tr>
<th>Credit</th>
<th>F</th>
<th>df</th>
<th>df(Error)</th>
<th>p-value</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoch 1 vs. Epoch 2</td>
<td><strong>7.022</strong></td>
<td>1</td>
<td>9</td>
<td><strong>0.026</strong></td>
<td><strong>0.438</strong></td>
</tr>
<tr>
<td>Epoch 2 vs. Epoch 3</td>
<td>1.052</td>
<td>1</td>
<td>9</td>
<td>0.332</td>
<td>0.105</td>
</tr>
<tr>
<td>Epoch 3 vs. Epoch 4</td>
<td>2.893</td>
<td>1</td>
<td>9</td>
<td>0.123</td>
<td>0.243</td>
</tr>
<tr>
<td>Epoch 4 vs. Epoch 5</td>
<td>2.585</td>
<td>1</td>
<td>9</td>
<td>0.142</td>
<td>0.223</td>
</tr>
<tr>
<td>Epoch 5 vs. Epoch 6</td>
<td>0.119</td>
<td>1</td>
<td>9</td>
<td>0.739</td>
<td>0.013</td>
</tr>
<tr>
<td>Epoch 6 vs. Epoch 7</td>
<td>0.92</td>
<td>1</td>
<td>9</td>
<td>0.363</td>
<td>0.093</td>
</tr>
<tr>
<td>Epoch 7 vs. Epoch 8</td>
<td>1.081</td>
<td>1</td>
<td>9</td>
<td>0.326</td>
<td>0.107</td>
</tr>
</tbody>
</table>

**Table 13:** RM ANOVA results for averaged GSC reactivity across conditions

<table>
<thead>
<tr>
<th>GSC</th>
<th>F</th>
<th>df</th>
<th>df(Error)</th>
<th>p-value</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Score Overall</td>
<td><strong>5.407</strong></td>
<td>2</td>
<td>18</td>
<td><strong>0.014</strong></td>
<td><strong>0.375</strong></td>
</tr>
<tr>
<td>Credit Pre vs. Base</td>
<td><strong>7.118</strong></td>
<td>1</td>
<td>9</td>
<td><strong>0.026</strong></td>
<td><strong>0.442</strong></td>
</tr>
<tr>
<td>Credit Post vs. Credit Pre</td>
<td>0.215</td>
<td>1</td>
<td>9</td>
<td>0.654</td>
<td>0.023</td>
</tr>
<tr>
<td>Loan Overall</td>
<td><strong>4.092</strong></td>
<td>2</td>
<td>18</td>
<td><strong>0.034</strong></td>
<td><strong>0.313</strong></td>
</tr>
<tr>
<td>Loan Pre vs. Base</td>
<td>4.181</td>
<td>1</td>
<td>9</td>
<td>0.071</td>
<td>0.317</td>
</tr>
<tr>
<td>Loan Post vs. Loan Pre</td>
<td>0.152</td>
<td>1</td>
<td>9</td>
<td>0.705</td>
<td>0.617</td>
</tr>
</tbody>
</table>
**Figure 8:** PEP and GSC reactivity across all epochs

**Figure 9:** Credit score reactivity: PEP and GSC
Hypothesis 2: Do reactivity patterns differ between conditions?

To directly compare the differences in response between the credit score and student loan conditions, all eight epochs of each condition was averaged to create mean scores for credit score and student loan for each biomarker (HR, RSA, PEP, GSC). Using these mean scores, four RM ANOVAs were run comparing the credit score and student loan values for each biomarker (table 14). Results found no significant differences between credit score and student loan means for each of the biomarkers. This indicates that the initial predictions (hypotheses 1b, 2b, 3b, and 4b) that the student loan conditions would show responsivity over and above that of its credit score counterpart were not supported.

Table 14: RM ANOVA comparing average values of credit score and student loan conditions

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>df</th>
<th>df(Error)</th>
<th>p-value</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>0.002</td>
<td>1</td>
<td>10</td>
<td>0.963</td>
<td>0.000</td>
</tr>
<tr>
<td>RSA</td>
<td>0.042</td>
<td>1</td>
<td>10</td>
<td>0.841</td>
<td>0.004</td>
</tr>
<tr>
<td>PEP</td>
<td>0.418</td>
<td>1</td>
<td>7</td>
<td>0.538</td>
<td>0.056</td>
</tr>
<tr>
<td>GSC</td>
<td>1.138</td>
<td>1</td>
<td>9</td>
<td>0.314</td>
<td>0.112</td>
</tr>
</tbody>
</table>

Figure 10: Student loan reactivity: PEP and GSC
CHAPTER 8: DISCUSSION AND CONCLUSION

Discussion

Do participants show autonomic reactivity to the stressor conditions?

*Heart rate:* It was initially predicted that the credit score and student loan conditions would elicit an observable ANS response via increases in HR occurring throughout both conditions, and that the student loan condition would elicit a response over and above that of credit score. However, the study found no significant increase in change in HR occurring during *any* of the conditions (baseline, credit score, or student loan). This indicates that the hypotheses that (1) the stressor conditions would elicit an increase in RSA compared to baseline and (2) that the student loan condition would elicit a stronger reduction in RSA compared to its credit score counterpart were not supported.

In the analysis examining averaged scores (baseline, pre-credit, post-credit, pre-loan, and post-loan) across conditions, significance was found for the credit score condition in which HR was notably elevated in the baseline condition compared to the pre and post-exposure time points. The analysis its student loan counterpart found similar results, albeit with only trend-level significance (*p*=.083), however the statistical relevance of this observation was bolstered by a large effect size (*η²*= .220) indicating that this relationship would become significant given a larger sample size. Taking into account this studies exploratory aims and subsequent sample size limitations, these findings are indicative of a higher degree of physiological arousal during the baseline period that quickly dissipated once the actual stressor started.

In sum, the findings showed that during all conditions (baseline, credit score, and student loan) no reactivity patterns observed *within* each condition, resulting in the initial
hypothesis not being supported. However, in the broader context of the experiment, the findings suggest that while there was no appreciable reactivity pattern during the baseline period, it collectively showed a greater degree of arousal (via increased heart rate) when compared to the other time points.

Respiratory sinus arrhythmia: It was initially predicted that the credit score and student loan conditions would elicit a withdrawal of the PNS, as indexed by a sharp reduction in RSA compared to a non-reactive baseline. However, the findings showed that no significant reactivity patterns in any condition, and that parasympathetic activity was unaffected by both condition and time. The fact that no significant differences were found between the averaged credit score and student loan values, further illustrates that the physiological effects across conditions were physiologically indistinguishable. In sum, these findings indicate that the hypotheses that (1) the stressors would elicit reductions in RSA compared to baseline and (2) that the student loan condition would elicit a stronger reduction in RSA compared to its credit score counterpart were not supported.

Pre-ejection period: It was initially predicted that the stressor conditions would elicit activation of the SNS, as indexed by a sharp reduction in PEP compared to a non-reactive baseline. However, the findings showed that no significant reactivity pattern in any condition, indicating that the experimental conditions were insufficient to elicit a cardiovascular sympathetic response to the stressors. In sum, these findings indicate that the hypotheses that (1) the stressors would elicit reductions in PEP compared to baseline and (2) that the student loan condition would elicit a stronger reduction in PEP compared to its credit score counterpart were not supported.
**Galvanic skin conductance:** The initial prediction was that the stressor conditions (credit score and student loan) would exhibit a statistically significant reactivity pattern in which skin conductance would rise as a consequence of sympathetic activation, as an indicator of the SNS activating in the context of a personally-salient stressor. While no statistically significant reactivity was exhibited during the student loan condition, trend-level significance coupled with a large effect size ($p=.054$, $\eta^2=191$) was found for GSC during the credit score condition in which skin conductance was found to drop, a finding contrary to the initial hypothesis of the credit score condition eliciting sympathetic reactivity. Additionally, within-subjects contrasts found the only significant change between time points was a drop in skin conductance between the first and second epochs, a result that was contrary to the initial hypothesis that skin conductivity would increase as a function of the stressor (indicating sympathetic activation). Even more unexpectedly, the baseline condition for GSC showed a steady increase in skin conductivity across all eight epochs, indicating sympathetic activation of the palm’s eccrine sweat glands was occurring during a condition in which the participant was not exposed to financial stressors.

Despite suggesting to the contrary, the finding of there being a significant rise between the averaged baseline condition and the averaged values of the credit score and student loan conditions were actually *consistent* with the findings above. Two important things to consider is that (1) the baseline was an aggregate score and thus did not fully capture the dynamic response across epochs that was observed above and (2) that the baseline average and pre-stressor credit score/pre-stressor student loan time points *were not contiguous* (i.e. that time passed between the end of the baseline and onset of the stressor). The last point is especially important to consider, as the increase in skin conductivity likely
continued while the first stress condition was being prepared; thus, the increase from baseline average to pre-stressor credit score was a consequence of the increase in baseline skin conductivity rather than reactivity occurring during the pre-stressor credit score condition.

In sum, the findings above indicated that the hypotheses that there would be an increase in skin conductance during the stressors and that the student loan condition would demonstrate a skin response over and above that of credit score were not supported. In fact, the findings showed the exact opposite, that there was a significant increase in skin conductivity across the baseline period, followed by a significant decrease from the first epoch of the credit score condition to the second epoch.

**What do all of the findings above suggest?**

Firstly the findings in this study should be contextualized as being primarily exploratory, in which some of the associations that found trend-level significance also showed strong effect sizes ($\eta^2 > .14$) indicating that these relationships would greater significance with an increased sample size. Given that the sample size for these analyses did not exceed N=11 (and in the case of GSC lower), these large effect sizes are impressive. Taken together, the findings described above appear to be counter-intuitive and are contrary to the initial predictions made in this experiment, assuming that the credit score and student loan conditions would elicit observable parasympathetic withdrawal and sympathetic activation. Not only was there no significant reactivity pattern seen within the stress conditions, but also a significant increase in sympathetic activity (as indexed by GSC) occurred during the baseline period, intended to be non-stressful and mundane. This increase culminated in a higher basal level of skin conductance (and by extension sympathetic activity) that the stress conditions hovered around, with no reactivity during or between the
tasks. Coupled with the drop in HR between the baseline and pre-task averages for the tasks (albeit with trend-level significance for the student loan condition), the ANS profile is suggestive of a sympathetically-driven stress response occurred at the onset of the experimental session rather than during the tasks.

**The ’arrival effect’**

The findings of the HR and GSC data are congruent with the idea of there being an ‘arrival effect’, a phenomenon in stress research in which participants exhibit a stress response after arriving for a stress experiment but also before the administration of the stressor. This phenomenon has been observed in existing stress literature and is frequently seen with the hormone cortisol, a major component of the stress response system of which the ANS is a part [Hastings et al., 2011; Shirtcliff, Peres, Dismukes, Lee, & Phan, 2014]. Important to note is that the ‘arrival effect’ isn’t universally observed in stress studies, indicating that its presence isn’t simply a consequence of studying stress in an acute setting. The present study extends the arrival effect literature empirically to support the idea of the sympathetically driven stress response observed across the baseline period of this experiment due to an arrival effect. One other study has also found evidence for the SNS showing an arrival effect using a stress biomarker called Alpha-amylase, a hormone corresponding with elevated SNS activity. Specifically, Balodis, Wynne-Edwards, Olmstead, (2010) has also been observed to be subject to the ‘arrival effect’, in which the participant showed elevation in salivary alpha amylase levels from arrival and immediately before stressor. This adds further support for the notion that the sympathetically-driven autonomic response seen during the baseline was driven by this phenomenon, bringing with it the question of what prompted this baseline response.
One potential cause for this effect is that the participants might have been primed by the nature of the experiment itself, as participants knew ahead of time that the experiment that a) the experiment was designed to be purposefully stressful and that b) the topic of the experiment focused on *their* personal finances. Given that over 50% of participants had not viewed their FICO score within the past 12 months (table 4), this indicates that for over half the sample there was an element of unpredictability going into the experiment with the participant having little (if any) prior knowledge of the state of their credit score. This potential explanation would account for average HR dropping off immediately as the experiment began; that the participants’ expectation of the stress tasks being stressful was wrong, and thus the study was not as ‘scary’ as initially thought. The drastic increase in GSC occurring during the baseline ties into this explanation as well as it illustrates the participants’ SNS ‘ramping up’ across the baseline period before they knew what the task entailed or their true debt and credit score values. However, once the task began, the initial ambiguity of the experiment was dispelled and participants discovered that they were surprisingly accurate in their student debt and credit scores (see below). Thus, the experiment was less intimidating, and the anticipation of financial stress was physiologically worse than real financial stress. The implications of this suggest that merely seeing financially stressful information may not possess the ‘presence’ of its daily realities (such as allocating one’s monthly budget to make payments). Instead, like in a horror movie, the monster is scariest when we don’t see it.

**What does this mean for financial stressors?**

The variables of student loan debt and credit score were deliberately chosen for this study as effective analogs for personally-relevant financial information, differing in saliency
for the participant. Based off of the correlations between actual and estimated values of credit score and student loan debt, the accuracy for credit score values were found to be far lower than for student loan debt, supporting the assumption that credit score was both less salient for the participant as well as something that was more difficult to ‘wrap their head around’. This high degree of accuracy for student loan debt (and to a lesser extent credit scores) indicated that the participant knew approximately how much they owed and thus had a tangible grasp of what they were going to be exposed to, ramping up the giving them something to potentially ‘dread’ while waiting for the experiment to begin.

Mapping this accuracy of financial health onto the ANS responses, this prior knowledge and subsequent rumination on what they will be exposed to suggests that during this waiting period, the participant’s SNS ramped up in anticipation of the stressors. However, once the participant began the task and the anticipation stopped, this sympathetic action ceased. Specifically, this manifested in a higher HR baseline compared to the both the credit score and student loan condition, albeit with trend-level significance. Adding to this, no appreciable reactivity pattern was found during the task itself, meaning that the exposure to the values of student loan debt and credit score played no role in eliciting an ANS response. The presence of a sudden trend-level drop in skin conductance between the initial epoch and subsequent epoch of the credit score, demonstrates the suddenness with which the anticipatory response was dispelled. Collectively, this supports the notion of anticipation eliciting a sympathetically-driven autonomic response whereas the stressful stimuli itself did not.

While credit score and student loan debt were used as metrics for financial health (or lack thereof), their values were completely uncorrelated. This lack of association makes
sense as that while overlap between the two constructs exist, they are largely independent from one another (for instance an individual owing a lot in student loans may in fact have a good credit score provided they make consistent and timely payments). This independence demonstrates that there is no single metric for financial health and that not indicators of poor financial health may be sufficient to elicit an autonomic response. In the context of this study, viewing student loan debt as a number, while being more tangible on a cognitive level, remains as intangible a figure as its less emotionally-salient credit score counterpart.

**Implications**

This study builds on findings from a 2011 study of ISU students which found low levels of general financial literacy as well as significant errors in financial self-reporting for many students [Andruska et al., 2014] and is specifically known for those between the ages 18 of 34 in the US [Lin et al., 2016]. The imminent transition out of school increases the likelihood for stress related to finances, with the consequences of student debt and the importance of good credit arising as preeminent financial concerns [Lusardi, Mitchell, &Curto,2010]. Financial stress is likely to arise from fears of the unknown, along with uncertainty of one’s current financial standing. For the participants in this study it was shown that the anticipation of the stressor elicited significant sympathetic nervous system reactivity whereas the stressors themselves (credit score and total student loan debt) did not.

**Limitations**

This study as it stands carries with it several notable limitations that may hinder its ability to be generalizable to a larger population; firstly, with a sample size of only 11, the study lacks the power to extrapolate the findings to a larger population. When designing this study, the presumption going into it was that exposing participants to personally-relevant
financial information would be effective at eliciting a stress response in an acute setting. The findings however, demonstrated this to not be the case, with the baseline period of filling out questionnaires actually exceeding the non-responsive pattern of autonomic activation shown during the stressor conditions. Important to the sample is the fact that ¾ of participants reported some degree of confidence that their parents’ would offer them support to help them meet basic needs while they paid off the loan (table 5), potentially reducing the potency of the stressor as the majority of participants felt they had some support to fall back on if paying the loan proved difficult. Additionally, 45% of participants reported that they planned to defer their loan payments (table 6), potentially reducing the sense of immediacy that the threat of paying student loans would otherwise have.

Additionally, the fact that there was a high correlation between predicted and actual student loan debt \( r = 0.971 \) and credit score \( r = 0.755 \) suggests that the participants were extremely knowledgeable of their finances, which is in contrast to prior studies on a similar population [Klepfer, 2015, 2016]. Thus, it is possible that our participants may not be representative of the overall population they were sampled from, possibly due to our recruitment strategy that informed potential participants that the study was on financial stress. This knowledge may have potentially blunted a stress response that may be present in less knowledgeable students. However, the fact that significance was found with only an 11-person sample size and in the opposite direction of what was predicted, suggests that this is not merely a consequence of signal artifact. Additionally, a common source of artifact for skin conductance (the metric that showed the most compelling results in this study) is that of elevated room temperature. While the room itself was kept relatively cold, this room effect could still pose a factor in the findings.
Conclusion

The purpose of this study was to assess whether personally-relevant financial information could elicit an autonomic stress response in an acute setting, and whether the emotional saliency of that information would moderate the response. It was found in this study that neither credit score nor student loan debt could serve as an effective stressor, but that the predicted stress response in fact occurred during the baseline period in which the participant anticipated the start of the putative stressor. The presence of an apparent arrival effect was found for two of the ANS biomarkers, HR and GSC in unique ways, both measures that are influenced by the sympathetic branch of the ANS. Observing an arrival effect in this context, coupled with a lack of response during either stressor conditions, including the hypothesized emotionally salient student loan debt value, suggests that both of these forms of financial information remain separated from the everyday realities of coping with student loan debt (such as having to consciously allocate sizable portions of one’s monthly budget to pay off the loan) or navigating the complexities of an intangible credit score. In a world where one’s financial circumstance is an omnipresent threat, the experience of ruminating on these threats is far scarier than confronting its mundane reality.
REFERENCES


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Cannon, W. B. (1932). The wisdom of the body.


APPENDIX A: SLIDES SHOWN DURING STRESSOR CONDITIONS

Student Loan Task:

Pre-Stressor: Slide 1

In this task you will be shown information on student loans.
You will not need to press any buttons to proceed unless prompted to do so.
During the task, try to stay still and remain seated.

Thank you for participation.
Press ENTER to continue.

Pre-Stressor: Slide 2 [Emotion Rating Follows]

What are student loans?
- Student loans are a type of loan designed to help students pay for college (such as tuition, fees, and living expenses).
- There are two common types of student loans: Direct federal loans and Stafford loans.
Pre Stressor: Slide 3

What is the difference between direct federal loans and Stafford loans?

- Direct federal loans are loans in which the government acts as the lender.
- Stafford loans come from private lenders with the government acting as a middle man.
- These loans can be either subsidized or unsubsidized.

Pre Stressor: Slide 4

What is the difference between subsidized and unsubsidized loans?

- Subsidized loans are loans in which the government pays the interest gained while you are in school.
- Unsubsidized loans gain interest while you are in school.
- After graduation, there is a 6 month grace period before you begin paying off these loans.
Pre-Stressor: Slide 5

Post-Stressor: Slide 1 [Emotion Rating Follows]

Here is how much you estimated you owed in student loan debt:

$\text{studLoan}$

You actually owe:

$\text{actstudLoan}$

In the United States, 44.2 million Americans owe $1.48 trillion dollars in student loan debt. 71% of students graduating from a four-year college have taken out student loans.

The average monthly payment for a student borrower between the ages of 20-30 is $351, with the average debtor taking an average of 21 years to fully pay off the loan.
What are your options to make paying off student loans easier?

- Consolidate your loans: Most federal student loans are eligible for consolidation (combining multiple loans into one). This can make keeping track of your repayment easier by reducing it into one monthly bill.

- While on the job market, pay attention to the benefits offered by potential employers, as some offer student loan assistance as part of their benefits.

- Paying more than your monthly statement will help pay down the principle on your loans, reducing the interest you’ll have to pay.

- Ask for help, financial counselors specialize in helping people find the best option of how to make paying back your loans more manageable!

Please wait for further instructions.
Credit Score Task

Pre-Stressor: Slide 1

In this task you will be shown information on credit scores.
You will not need to press any buttons to proceed unless prompted to do so.
During the task, try to stay still and remain seated.

Thank you for participation.
Press ENTER to continue

Pre-Stressor: Slide 2 [Emotion Rating Follows]

What is a credit score?
A credit score is a number between 300 and 850 that measures "credit worthiness", or the risk you pose for not making regular payments, this is called a FICO score.
These scores are generated by three national credit bureaus (Equifax, Experian, and TransUnion), and are used in decision making that impacts your personal finance.
Pre Stressor: Slide 3

Where do credit scores come from?

Credit scores are calculated by taking into account:
- Amount of money owed: 30%
- Length of credit history (when you were first extended credit): 15%
- Credit mix (amount of credit cards and loans you have): 10%
- New credit (recent credit cards and loans): 10%
- Payment history (how often you paid your bills on time): 35%

Pre Stressor: Slide 4

What are credit scores used for?

Credit scores are used in all kinds of financial decisions, such as:
- Credit card companies setting your credit limit and interest rates
- Lenders deciding whether to offer you a loan (as well as its terms)
  - Employers in determining whether to extend you a job offer
  - Landlords in determining whether they will lease you an apartment
Pre-Stressor: Slide 5

Please wait for further instructions.

Post-Stressor: Slide 1 [Emotion Rating Follows]

This is what you estimated your credit score was:

[CredScore]

Your credit score is currently:

[actCredScore]

The average credit score in the United States is 673.

Credit scores are classified based on where your score lies within the 300-850 range:

- Very Poor (< 580)
- Poor (580-649)
- Fair (650-699)
- Good (700-749)
- Excellent (750-850)
Post-Stressor: Slide 2

What can you do to improve your credit score?

- Delinquent payments (i.e. late payments) can negatively impact your score, but paying bills on time can help improve your credit score.
- Keeping a low balance on your credit cards
- Applying for new credit accounts only as needed
- Paying off your debt rather than moving it around
- Ask for help, financial counselors can help you understand your options of what you can do NOW to improve your credit score!

Post-Stressor: Slide 3

Please wait for further instructions.
APPENDIX B: QUESTIONNAIRES

Questionnaires Administered Before the Task

Basic Demographic Questionnaire

How old are you? ___

What is your sex?

- Male
- Female
- Other

Ethnic origin: Please specify your ethnicity.

- White
- Hispanic or Latino
- Black or African American
- Native American or American Indian
- Asian / Pacific Islander
- Other

College Major:

What college does your major reside in?

- Agriculture and Life Sciences
- Business
- Design
- Engineering
- Human Sciences
- Liberal Arts and Sciences
- Veterinary Medicine
- I don’t know

What is your specific major?

- Engineering
- Kinesiology and Exercise Science
- Marketing/Marketing Management
- Dietetics/Dietitian
- Accounting
- Finance
- Education
- Mathematics
- Business
- Biology/Biological Sciences
- Physics
- English/Literature
If other, what is your major? _____________________________________________

Education Background Questionnaire

Please answer the following questions about your educational and work experience.

(1) Are you employed?
   (1) Yes, full time.
   (2) Yes, part time.
   (3) No

(2) What kind of job do you hold, or did you hold most recently? ______________________

(3) Yearly Income:
   ☐ Less than $15,000 ☐ $15,000-$30,000 ☐ $30,000-$50,000 ☐ $50,000-$80,000 ☐ $80,000-$120,000 ☐ Over $120,000

(4) Check off the highest grade in school completed by your mother (if applicable):
   ☐ Grade School ☐ High School or GED ☐ 2 Year college, trade or technical school ☐ 4 year college ☐ Graduate School

(5) Check off the highest grade in school completed by your father (if applicable):
   ☐ Grade School ☐ High School or GED ☐ 2 Year college, trade or technical school ☐ 4 year college ☐ Graduate School

(6) Is your mother employed? ☐ Yes, full time. ☐ Yes, part time. ☐ No
(7) What kind of job did your mother hold, or did she hold most recently?

(8) Is your father employed? ☐ Yes, full time. ☐ Yes, part time. ☐ No
(9) What kind of job did your father (or secondary parental figure hold, or did s/he hold most recently?

________________________________________
HBQ: Your Physical Health

For each question, please place a check (☑) next to your answer or write your answer in the space provided.

Global Physical Health

1. **In general**, would you say your physical health is excellent, good, fair, or poor?
   0 ______ Excellent
   1 ______ Good
   2 ______ Fair
   3 ______ Poor

2. **In general**, how much do you worry about your health?
   0 ______ None at all
   1 ______ A little
   2 ______ Somewhat
   3 ______ A great deal

3. **In general**, how much difficulty, pain or distress does your health cause you?
   0 ______ None at all
   1 ______ A little
   2 ______ Some
   3 ______ A great deal

4. To what extent does health limit you in any way, keeping you from activities you want to do?
   0 ______ None at all
   1 ______ A little
   2 ______ Some
   3 ______ A great deal

5. How often **in an average month** do you stay home or come home from school/work because of illness?
   0 ______ Rarely or never (less than 1 day/month)
   1 ______ A little of the time (1-2 days/month)
   2 ______ Sometimes (3-5 days/month)
   3 ______ Often (6 or more days/month)

Injuries and Accidents

6. Have you ever had an **injury** or **accident** requiring medical attention?
   0 ______ No (If No, please go to Question 7)
   1 ______ Yes

6a. How many times have you ever had an injury/accident requiring medical attention? #:____

6b. How many times did a serious injury ever keep you from participating in normal daily activities, either at home or at school? ........... #:____

6c. How many times have you had an injury or accident requiring medical attention **within the past year**? ........... #:____
Neurological Risk

7. At birth did you have any health problems that were serious enough that you were in the neonatal intensive care unit (ICU for at least 24 hours)?
   0 ______ No (If No, please go to Question 8
   1 ______ Yes ↓

7a. How many days were you in the intensive care unit? ..................................... #: ___

8. Have you ever been unconscious due to any injury or illness?
   0 ______ No
   1 ______ Yes

9. Have you ever had a serious head injury (whether unconscious or not?)
   0 ______ No
   1 ______ Yes

10. Have you ever had a seizure or fit?
    0 ______ No (If No, please go to Question 11
    1 ______ Yes ↓

10a. How many seizures or fits have you ever had?..................................................... #: ___

10b. How many of these occurred before 5 years of age and during an illness with fever? #: ___

10c. Has your doctor ever said you have epilepsy or a seizure disorder?

   0 ______ No
   1 ______ Yes

11. Other than seizures, have you ever had a neurological (brain condition?

    0 ______ No (If No, please go to Question 12
    1 ______ Yes ↓

11a. Please Describe:_________________________________________________________________

Chronic Medical Conditions

12. Below is a list of chronic medical conditions. For each one, please make a check (☒ to mark whether or not you have ever had the condition. Please mark an answer for each item even if you have never had the condition.

Have you ever had . . .

<table>
<thead>
<tr>
<th></th>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Arthritis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Asthma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Other chronic or recurrent lung disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Birth defects, such as spina bifida or cleft lip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Blood diseases, such as sickle cell anemia or hemophilia</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
f. Bowel diseases, such as inflammatory bowel disease or chronic constipation  ____0  ____1

g. Congenital heart disease  ____0  ____1

h. Cystic fibrosis  ____0  ____1

i. Diabetes  ____0  ____1

j. HIV infection or AIDS  ____0  ____1

k. Kidney disease  ____0  ____1

l. Leukemia or cancer  ____0  ____1

m. Nerve or muscle problems such as muscular dystrophy  ____0  ____1

n. Repeated, persistent ear infections  ____0  ____1

o. Repeated, persistent urinary infections  ____0  ____1

p. Repeated, persistent respiratory infections such as colds, bronchitis, or croup  ____0  ____1

q. Bad allergies requiring doctor visits and frequent medications  ____0  ____1

r. Hearing problems  ____0  ____1

s. Vision problems  ____0  ____1

t. Learning disorder  ____0  ____1

u. Speech disorder  ____0  ____1

13. Have you ever had any other chronic health problems than those listed above?
   0 ______ No (If No, please go to Question 14
   1 ______ Yes ↓

13a. Please describe the other chronic health problem(s):

   1st problem:__________________________________________________________

   2nd problem:__________________________________________________________

   Additional problems:___________________________________________________

_High Care Utilization_

These questions ask about your use of a variety of health care services

14. Have you ever been admitted to a hospital overnight?
   0 ______ No (If No, please go to Question 15)
   1 ______ Yes ↓

14a. How many times have you ever been admitted to a hospital overnight?........... #: ______
14b. How many days was the longest hospitalization? #: _____

14c. Why were you hospitalized each time:

1st time: ________________________________________________________________

2nd time: ________________________________________________________________

3rd time: ________________________________________________________________

Additional times: __________________________________________________________

14d. How many times have you been admitted to a hospital overnight within the past year? #: _____

15. How many times have you been seen by your primary care provider for a sick visit within the past year, not including any visits for routine check-ups? #: _____

15a. For what illnesses/injuries? ______________________________________________

16. Have you been to the Emergency Room within the past year?

0 ______ No (If No, please go to Question 17

1 ______ Yes ↓

16a. How many times have you been to the Emergency Room within the past year? #: _____

16b. Why were you seen in the Emergency Room each time:

1st time: ________________________________________________________________

2nd time: ________________________________________________________________

Additional times: __________________________________________________________

17. Please circle whether or not you receive each of the following services currently or within the past year.

<table>
<thead>
<tr>
<th>Service</th>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Resource room at school</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>b. Speech/language therapy</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>c. Physical/occupational therapy</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>d. Emotional/behavioral therapy or counseling</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>e. Another service (Please specify)</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Medications

18. Do you currently take any prescription or non-prescription medications on a regular basis (daily basis for at least a month)?
   0 _____ No
   1 _____ Yes ↓

   Name of Medication → Taken for what?
   a. ________________________ → ______________________
   b. ________________________ → ______________________
   c. ________________________ → ______________________
   d. ________________________ → ______________________

Financial Literacy Questionnaire

FICO Score

Q1: How many times have you viewed your FICO Score within the past 12 months?
   (1) I did not review my FICO® Score within the past 12 months
   (2) 1 time
   (3) 2 times
   (4) 3 times
   (5) 4 times
   (6) 5 or more times
   (7) Not sure

Q2: What do you think the range of possible credit score values are?
   (1) 1-100
   (2) 150-700
   (3) 350-800
   (2) 300-850
   (3) 500-1000

Q3: How familiar are you with the concept of a FICO Score or another credit score?
   (1) Very familiar, I'm confident that I can explain what a credit score is to a friend
(2) Somewhat familiar, I could explain what a credit score is in very general terms
(3) Somewhat unfamiliar, I have heard about credit scores but I don't exactly know what a credit score is
(4) Not at all familiar, I have never heard of credit scores

Knowledge of Creditworthy Actions

Q4: Which of the following do you think are considered positive credit behaviors - that is actions that may improve your credit? (Select all that apply)

(1) Paying your bills on time
(2) Having no credit cards
(3) Having a lot of credit cards
(4) Keeping a high balance on your credit card
(5) Keeping a low balance on your credit card
(6) Using as much of your credit limit as possible
(7) None of the above

Financial Literacy

Q5: If a student takes out a $5,000 student loan at 7% interest, will he have to pay back. . . ?

(1) Less than $5,000
(2) Exactly $5,000
(3) More than $5,000
(4) I'm not sure

Q6: Imagine that there are two options when it comes to paying back your student loan and both come with the same interest rate. Provided you have the needed funds, which option would you select to minimize your out-of-pocket costs over the life of the loan?

(1) Option 1 allows you to take 10 years to pay back the loan
(2) Option 2 allows you to take 20 years to pay back the loan
(3) Both options have the same out-of-pocket cost over the life of the loan
(4) I'm not sure
Q7: When a private student loan, such as the Smart Option Student Loan from Sallie Mae, is deferred, that is, no payment is required while the student is enrolled in college, what happens to the interest on this loan?

(1) Interest doesn't start accruing until the student has graduated and starts repaying the loan

(2) Interest is capitalized, that is, the interest that accrues during the deferment period is added to the principal amount of the loan

(3) Interest accrues, but nobody has to pay for it

(4) Other, please specify

(5) I don't know

Student Loan Knowledge:

How confident are you in your family will ensure your basic needs are met while you pay off this loan?

- Not confident at all
- Slightly confident
- Somewhat confident
- Very confident

How confident are you that your family will provide financial support to ensure that paying off your loans is relatively stress-free?

- Not confident at all
- Slightly confident
- Somewhat confident
- Very confident

When do you believe that you will first begin paying your student loans post-graduation?

- A few days
- A few weeks
- A few months
- A few years

Do you plan on deferring your initial payments for your student loans post-graduation (such as for graduate school)?

- Yes
- No

If yes, for what reason will you be deferring your initial payments? ______________
Once you begin your payments, how long do you think it will take you to pay off these loans?

- Under a year
- 2-4 years
- 5 to 10 years
- 10+ years

How would you describe your understanding of student loans?

- Very Good
- Good
- Fair
- Poor
- Very Poor

How would you describe your understanding of credit scores?

- Very Good
- Good
- Fair
- Poor
- Very Poor
Questions Administered During the Task (via ePrime)

**Emotional State**

*Administered twice during each condition, before and immediately after exposure to stressor*

On a scale of 1 to 5 (Not at All, A Little, Somewhat, Mostly, Very Much So), how would you rate experiencing these emotions right now?

- Relaxed
- Happy
- Surprised
- Angry
- Anxious
- Scared
- Stressed

**Student Loan Information**

*Administered pre-stressor during student loan condition*

On a scale of 1-5: (1) Owe far less than average, (2) Owe slightly less than average, (3) Owe the average amount of debt, (4) Owe slightly more than the average amount of debt, (5) Owe far more than average; where do you think your total student loan debt would qualify as?

1. Owe far less than average
2. Owe slightly less than average
3. Owe the average amount of debt
4. Owe slightly more than average
5. Owe far more than average

If you were to guess, what would you estimate your student loan debt is? ______

If you were to guess, what would you estimate the average student loan debt is for a college student finishing their undergraduate degree? ______
Credit Score Information

[Administered pre-stressor during credit score condition]

On a scale of 1 to 5: (1) Very Bad, (2) Bad, (3) Fair, (4) Good, (5) Excellent; what would you estimate your credit score is?

1. Very Bad
2. Bad
3. Fair
4. Good
5. Excellent

If you were to guess, what would you estimate your credit score is? ______

If you were to guess, what do you think an average person’s credit score is? ______
Questionnaires Administered Between Tasks (via Qualtrics)

Locus of Control

Each number below has two statements- A and B. Please read each statement carefully, and choose which you agree with more. Please choose only A or B for each number. Write your answer in the blank next to the number.

1. A. Children get into trouble because their parents punish them too much.
   B. The trouble with most children nowadays is that their parents are too easy with them.

2. A. Many of the unhappy things in people’s lives are partly due to bad luck.
   B. People’s misfortunes result from the mistakes they make.

3. A. One of the major reasons why we have wars is because people don’t take enough interest in politics.
   B. There will always be wars, no matter how hard people try to prevent them.

4. A. In the long run, people get the respect they deserve in this world.
   B. Unfortunately, an individual’s worth often passes unrecognized no matter how hard he/she tries.

5. A. The idea that teachers are unfair to students is nonsense.
   B. Most students don’t realize the extent to which their grades are influenced by accidental happenings.

6. A. Without the right breaks, one cannot be an effective leader.
   B. Capable people who fail to become leaders have not taken advantage of their opportunities.

7. A. No matter how hard you try, some people just don’t like you.
   B. People who can’t get others to like them don’t understand how to get along with others.

8. A. Heredity plays a major role in determining one’s personality.
   B. It’s someone’s experiences in life which determine what they’re like.

9. A. I have often found that what is going to happen will happen.
   B. Trusting fate has never turned out as well for me as making a decision to take a definite course of action.

10. A. In the case of the well prepared student, there is rarely, if ever, such a thing as an unfair test.
    B. Many times exam questions tend to be so unrelated to course of work that studying is really useless.
11. A. Becoming a success is a matter of hard work; luck has little or nothing to do with it.
   B. Getting a good job depends mainly on being in the right place at the right time.

12. A. The average citizen can have an influence on government decisions.
   B. This world is run by the few people in power, and there is not much the little guy can do about it.

13. A. When I make plans, I am almost certain that I can make them work.
   B. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.

14. A. There are certain people who are just no good.
   B. There is some good in everybody.

15. A. In my case, getting what I want has little or nothing to do with luck.
   B. Many times we might just as well decide what to do by flipping a coin.

16. A. Who gets to be the boss often depends on who was lucky enough to be in the right place.
   B. Getting people to do the right thing depends upon ability; luck has little or nothing to do with it.

17. A. As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.
   B. By taking an active part in political and social affairs, the people can control world events.

18. A. Most people don’t realize the extent to which their lives are controlled by accidental happenings.
   B. There really is no such thing as “luck.”

19. A. One should always be willing to admit mistakes.
   B. It is usually best to cover up one’s mistakes.

20. A. It is hard to know whether or not a person really likes you.
   B. How many friends you have depends upon how nice a person you are.

21. A. In the long run, the bad things that happen to us are balanced by the good ones.
   B. Most misfortunes are the result of lack of ability, ignorance, laziness or all three.

22. A. With enough effort, we can wipe out political corruption.
   B. It is difficult for people to have much control over the things politicians do in office.
23. A. Sometimes I can’t understand how teachers arrive at the grades they give.
   B. There is a direct connection between how hard I study and the grades I get.

24. A. A good leader expects people to decide for themselves what they should do.
   B. A good leader makes it clear to everybody what their jobs are.

25. A. Many times I feel that I have little influence over the things that happen to me.
   B. It is impossible for me to believe that chance or luck plays an important role in my life.

26. A. People are lonely because they don’t try to be friendly.
   B. There’s not much use in trying too hard to please people; if they like you, they like you.

27. A. There is too much emphasis on athletics in high school.
   B. Team sports are an excellent way to build character.

28. A. What happens to me is my own doing.
   B. Sometimes I feel that I don’t have enough control over the direction my life is taking.

29. A. Most of the time I can’t understand why politicians behave the way they do.
   B. In the long run, the people are responsible for bad government on a national as well as local level.

**STAI**

A number of statements which people have used to describe themselves are written below. Read each statement and then choose the appropriate answer to indicate how you feel right now, that is, in this moment. There are no right or wrong answers. Do not spend too much time on any one statement, but give the answer that seems to describe your present feelings best.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Not at All</th>
<th>Somewhat</th>
<th>Moderately So</th>
<th>Very Much So</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel calm.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. I feel secure.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. I am tense.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I feel strained.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. I feel at ease.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>6.</td>
<td>I feel upset.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>I am presently worrying over possible misfortunes.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>8.</td>
<td>I feel satisfied.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>I feel frightened.</td>
<td>1</td>
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<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>I feel comfortable.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>I feel self confident.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>I feel nervous.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>I am jittery.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>I feel indecisive.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>I am relaxed.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>I feel content.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>I feel worried.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>18.</td>
<td>I feel confused.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>19.</td>
<td>I feel steady.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>20.</td>
<td>I feel pleasant.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>21.</td>
<td>I feel nervous and restless.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>22.</td>
<td>I feel satisfied with myself.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>23.</td>
<td>I wish I could be as happy as others seem to be.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>24.</td>
<td>I feel like a failure.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>25.</td>
<td>I feel rested.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>26.</td>
<td>I am cool, calm, and collected.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>27.</td>
<td>I feel that difficulties are piling up so that I cannot overcome them.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>28.</td>
<td>I worry too much over something that doesn’t really matter.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>29.</td>
<td>I am happy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>30.</td>
<td>I have disturbing thoughts.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>31.</td>
<td>I lack self confidence.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
The following are ways people react to various difficult, stressful, or upsetting situations. Please circle a number, from 1-5 for each item. Indicate how much you engage in these types of activities when you encounter a difficult, stressful or upsetting situation.

<table>
<thead>
<tr>
<th>32. I feel secure.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>33. I make decisions easily.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>34. I feel inadequate.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>35. I am content.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>36. Some unimportant thoughts run through my mind and bother me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>37. I take disappointments so keenly that I can’t put them out of my mind.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>38. I am a steady person.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>39. I get in a state of tension or turmoil as I think over my recent concerns and interests.</td>
<td>1</td>
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<tr>
<td>10. Outline my priorities.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. Try to go to sleep.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. Treat myself to my favorite food or snack.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. Feel anxious about not being able to cope.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. Become very tense.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. Think about how I have solved similar problems.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>16. Tell myself that it is really not happening to me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17. Blame myself for being too emotional about the situation.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>18. Go out for a snack or meal.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>19. Become very upset.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>20. Buy myself something.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>21. Determine a course of action and follow it.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>22. Blame myself for not knowing what to do.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>23. Go to a party.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>24. Work to understand the situation.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>25. “Freeze” and don’t know what to do.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>26. Take corrective action immediately.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Not At All</th>
<th></th>
<th>Very Much</th>
</tr>
</thead>
<tbody>
<tr>
<td>27. Think about the event and learn from my mistakes.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>28. Wish that I could change what had happened or how I felt.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>29. Visit a friend.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>30. Worry about what I am going to do.</td>
<td>1</td>
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<tr>
<td>31. Spend time with a special person.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>32. Go for a walk.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>33. Tell myself that it will never happen again.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>34. Focus on my general inadequacies.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>35. Talk to someone whose advice I value.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>36. Analyze the problem before reacting.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>37. Phone a friend.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>38. Get angry.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>39. Adjust my priorities.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>40. See a movie.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>41. Get control of the situation.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>42. Make an extra effort to get things done.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>43. Come up with several different solutions to the problem.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>44. Take time off and get away from the situation.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>45. Take it out on other people.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>46. Use the situation to prove that I can do it.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>47. Try to be organized so I can be on top of the situation.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>48. Watch TV.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Financial Self Report

Financial Socialization:

Stem: While growing up at home, did your family do any of the following?

<table>
<thead>
<tr>
<th>Question</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Discussed family financial matters with me.</td>
<td>1 (Yes), 2 (No)</td>
</tr>
<tr>
<td>2. Spoke to me about the importance of saving.</td>
<td>1 (Yes), 2 (No)</td>
</tr>
<tr>
<td>3. Discussed how to establish a good credit rating.</td>
<td>1 (Yes), 2 (No)</td>
</tr>
<tr>
<td>4. Taught me how to be a smart shopper.</td>
<td>1 (Yes), 2 (No)</td>
</tr>
<tr>
<td>5. Taught me that my actions determine my success in life.</td>
<td>1 (Yes), 2 (No)</td>
</tr>
<tr>
<td>6. Provided me with a regular allowance.</td>
<td>1 (Yes), 2 (No)</td>
</tr>
<tr>
<td>7. Provided me with a savings account.</td>
<td>1 (Yes), 2 (No)</td>
</tr>
</tbody>
</table>

Recoded as:
- Greater than the median number of financial socialization activities when growing up
- Median number or fewer

In recoding, we:

1. Created a sum scale score equal to the sum of all seven items for respondents who responded to all seven
2. Calculated the weighted median (midpoint of the sum scale score for the sample as a whole.
3. Categorized respondents as having sum scale scores either above the weighted median value or at/below the weighted median.
Economic Pressure

Stem: How much do you agree or disagree with each of the following statements about your financial situation?

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Variable Labels: Adult</th>
<th>Response Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>p1finstress_1</td>
<td>I have trouble sleeping because of my financial problems.</td>
<td>1 (Strongly Disagree to 5 (Strongly Agree)</td>
</tr>
<tr>
<td>p1finstress_2</td>
<td>I am concerned because I cannot afford adequate health insurance.</td>
<td>1 (Strongly Disagree to 5 (Strongly Agree)</td>
</tr>
<tr>
<td>p1finstress_3</td>
<td>I often worry about my financial situation.</td>
<td>1 (Strongly Disagree to 5 (Strongly Agree)</td>
</tr>
<tr>
<td>p1finstress_4</td>
<td>My financial situation is much worse this year than it was a year ago.</td>
<td>1 (Strongly Disagree to 5 (Strongly Agree)</td>
</tr>
<tr>
<td>p1finstress_5</td>
<td>I do not know how I will be able to support myself in the next year.</td>
<td>1 (Strongly Disagree) to 5 (Strongly Agree)</td>
</tr>
<tr>
<td>p1finstress_6</td>
<td>I have enough money to afford the kind of place to live in that I should have</td>
<td>1 (Strongly Disagree) to 5 (Strongly Agree)</td>
</tr>
<tr>
<td>p1finstress_7</td>
<td>I have enough money to afford the kind of clothing that I should have.</td>
<td>1 (Strongly Disagree) to 5 (Strongly Agree)</td>
</tr>
<tr>
<td>p1finstress_8</td>
<td>I have enough money to afford the kind of furniture or household appliances that I should have.</td>
<td>1 (Strongly Disagree) to 5 (Strongly Agree)</td>
</tr>
<tr>
<td>p1finstress_9</td>
<td>I have enough money to afford the kind of car that I need.</td>
<td>1 (Strongly Disagree) to 5 (Strongly Agree)</td>
</tr>
<tr>
<td>p1finstress_10</td>
<td>I have enough money to afford the kind of food that I need.</td>
<td>1 (Strongly Disagree) to 5 (Strongly Agree)</td>
</tr>
<tr>
<td>p1finstress_11</td>
<td>I have enough money to afford the kind of medical care that I need.</td>
<td>1 (Strongly Disagree) to 5 (Strongly Agree)</td>
</tr>
<tr>
<td>p1finstress_12</td>
<td>During the past 12 months, how much difficulty have you had in paying your bills?</td>
<td>1 (No Difficulty at All) to 5 (A Great Bit of Difficulty)</td>
</tr>
<tr>
<td>p1finstress_13</td>
<td>Over the past 12 months, at the end of each month, do you generally end up with...</td>
<td>1 (Not Enough Money to Make Ends Meet) to 5 (More than Enough Money Left Over)</td>
</tr>
</tbody>
</table>
Adverse Childhood Experience (ACE) Questionnaire
Finding your ACE Score

While you were growing up, during your first 18 years of life:

1. Did a parent or other adult in the household often …
   Swear at you, insult you, put you down, or humiliate you?
   or
   Act in a way that made you afraid that you might be physically hurt?
   Yes  No  If yes enter 1

2. Did a parent or other adult in the household often …
   Push, grab, slap, or throw something at you?
   or
   Ever hit you so hard that you had marks or were injured?
   Yes  No  If yes enter 1

3. Did an adult or person at least 5 years older than you ever …
   Touch or fondle you or have you touch their body in a sexual way?
   or
   Try to or actually have oral, anal, or vaginal sex with you?
   Yes  No  If yes enter 1

4. Did you often feel that …
   No one in your family loved you or thought you were important or special?
   or
   Your family didn’t look out for each other, feel close to each other, or support each other?
   Yes  No  If yes enter 1

5. Did you often feel that …
   You didn’t have enough to eat, had to wear dirty clothes, and had no one to protect you?
   or
   Your parents were too drunk or high to take care of you or take you to the doctor if you needed it?
   Yes  No  If yes enter 1

6. Were your parents ever separated or divorced?
   Yes  No  If yes enter 1

7. Was your mother or stepmother:
   Often pushed, grabbed, slapped, or had something thrown at her?
   or
   Sometimes or often kicked, bitten, hit with a fist, or hit with something hard?
   or
   Ever repeatedly hit over at least a few minutes or threatened with a gun or knife?
   Yes  No  If yes enter 1

8. Did you live with anyone who was a problem drinker or alcoholic or who used street drugs?
   Yes  No  If yes enter 1

9. Was a household member depressed or mentally ill or did a household member attempt suicide?
   Yes  No  If yes enter 1

10. Did a household member go to prison?
    Yes  No  If yes enter 1

Now add up your “Yes” answers: __________ This is your ACE Score
Financial Literacy and Counseling (Post Task)

[Global assessment of student loan debt and credit scores before and after study]

How would you now describe your understanding of student loans?

- Very Good
- Good
- Fair
- Poor
- Very Poor

How would you now describe your understanding of credit scores?

- Very Good
- Good
- Fair
- Poor
- Very Poor

[Assessment of prior knowledge of information specifically shown during the study]

How would you describe your prior knowledge of the student loan information shown to you today?

- I knew about all of the things shown to me
- I generally knew the information shown to me
- I only vaguely understood the information shown to me
- I knew almost nothing about the information shown to me

How would you describe your prior knowledge of the credit score information shown to you today?

- The information shown to me in this study were things I already knew
- The information shown to me in this study were things I largely knew about but didn’t fully know the details of
- The information shown to me in this study were things I only vaguely knew about
- The information shown to me in this study were things I knew nothing about

[How stressful the participant felt learning about their financial information was]

How stressful was the experience of learning about your student loans?
• Very Stressful
• Somewhat Stressful
• A Little Stressful
• Not Stressful at all

How stressful was the experience of learning about your credit score?

• Very Stressful
• Somewhat Stressful
• A Little Stressful
• Not Stressful at all

How stressful was your overall experience learning about personal finance?

• Very Stressful
• Somewhat Stressful
• A Little Stressful
• Not Stressful at all

[How much the participant learned about student loans and credit scores]

Compared to what you knew, how much did you learn about student loans today?

• A lot
• Some
• A little
• Not at all

Compared to what you knew, how much did you learn about credit scores today?

• A lot
• Some
• A little
• Not at all

[Information regarding pursuit of financial counseling]

After learning your credit score and student loan debt, would you be interested in someone from the ISU Financial Counseling Clinic contacting you to schedule a financial counseling appointment?
• Yes
• Maybe
• No

Has the experience of this study made you more or less likely to pursue financial counseling?

• Very likely
• Somewhat likely
• Not at all likely
APPENDIX C: IRB MATERIALS

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
2420 Lincoln Way, Suite 202
Ames, Iowa 50014
515 294-4556

Date: 12/21/2018
To: Elizabeth B Shirtcliff
From: Office for Responsible Research
Title: Physiology of Financial Stress
IRB ID: 19-358

Submission Type: Initial Submission
Review Type: Full Committee
Approval Date: 12/21/2018
Date for Continuing Review: 12/20/2020

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- Use only the approved study materials in your research, including the recruitment materials and informed consent documents that have the IRB approval stamp.

- Retain signed informed consent documents for 3 years after the close of the study, when documented consent is required.

- Obtain IRB approval prior to implementing any changes to the study.

- Inform the IRB if the Principal Investigator and/or Supervising Investigator and their role or involvement with the project with sufficient time to allow an alternate PI/Supervising Investigator to assume oversight responsibility. Projects must have an eligible PI to remain open.

- Immediately inform the IRB of (1) all serious and/or unexpected adverse experiences involving risks to subjects or others; and (2) any other unanticipated problems involving risks to subjects or others.

- Stop all human subjects research activity if IRB approval lapses, unless continuation is necessary to prevent harm to research participants. Human subjects research activity can resume once IRB approval is re-established.

- Submit an application for Continuing Review at least three to four weeks prior to the date for continuing review as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.
Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g., student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **IRB approval in no way implies or guarantees that permission from these other entities will be granted.**

Please be advised that your research study may be subject to **post-approval monitoring** by Iowa State University’s Office for Responsible Research. In some cases, it may also be subject to formal audit or inspection by federal agencies and study sponsors.

Upon completion of the project, transfer of IRB oversight to another IRB, or departure of the PI and/or Supervising Investigator, please initiate a Project Closure to officially close the project. For information on instances when a study may be closed, please refer to the **IRB Study Closure Policy.**

Please don’t hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.