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Pilot Study of the Effects of Heart Rate Variability Biofeedback on Perceived Stress, Perceived Coping Ability, and Resilience in Accelerated Baccalaureate Nursing Students

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PILOT STUDY OF THE EFFECTS OF HEART RATE VARIABILITY BIOFEEDBACK ON PERCEIVED STRESS, PERCEIVED COPING ABILITY, AND RESILIENCE IN ACCELERATED BACCALAUREATE NURSING STUDENTS

BY

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This dissertation is approved as a credible and independent investigation by a candidate for the Doctor of Philosophy degree and is acceptable for meeting the dissertation requirements for this degree. Acceptance of this dissertation does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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"*Whatever you do, work at it with all your heart, as working for the Lord, not for human masters, since you know that you will receive an inheritance from the Lord as a reward. It is the Lord Christ you are serving."* Colossians 3: 23-24

I would like to dedicate this dissertation, and the ability to persevere and finish, to my Lord, Jesus Christ. Without His help, I would not have completed this task. To remember to work for the Lord, not for men, is to remember the greater purpose in all we do.

To my husband, Rodney, who came into my messy office at just the right moments to make me smile and encourage me…thank you. I love you.

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ABBREVIATIONS

1. Accelerated Baccalaureate Nursing (ABN)
2. Bachelor's of Science in Nursing (BSN)
3. Collaborative Institutional Training Initiative (CITI)
4. Coping Effectiveness Training (CET)
5. Coping Self-Efficacy Scale (CSE)
6. Electrocardiogram (ECG)
7. Electroencephalograph (EEG)
8. Electromyography (EMG)
9. Family Educational Rights and Privacy Act (FERPA)
10. Heart Rate Variability (HRV)
11. Heart Rate Variability biofeedback (HRVB)
12. Institutional Review Board (IRB)
13. Lazarus and Folkman's Transactional Theory of Stress and Coping (TTSC)
14. National Council Licensure Examination-Registered Nurse (NCLEX-RN)
15. Perceived Stress Scale (PSS)
16. Primary Investigator (PI)
17. Registered Nurse (RN)
18. Resilience Scale (RS)
19. Serotonin–norepinephrine reuptake inhibitor (SNRI)
20. Selective serotonin reuptake inhibitor (SSRI)
21. United States (US)

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ABSTRACT

EFFECTS OF HEART RATE VARIABILITY BIOFEEDBACK ON PERCEIVED STRESS, PERCEIVED COPING ABILITY, AND RESILIENCE IN ACCELERATED BACCALAUREATE NURSING STUDENTS

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Objective. The purpose of this quasi-experimental randomized controlled two-group pilot study was to test the effectiveness of a Heart Rate Variability Biofeedback (HRVB) intervention on accelerated baccalaureate nursing (ABN) students' perceived stress, perceived coping ability, and resilience over four weeks during an academic term of ABN coursework. This study was guided by Lazarus and Folkman's Transactional Theory of Stress and Coping, with a focus on primary appraisal.

Background. ABN students report higher perceived stress and anxiety compared with nursing students in traditional four-year nursing programs due to the compressed and fast-paced format of the ABN curriculum. Qualitative data points to a growing awareness of the high stress associated with ABN programs and the need for adaptive coping strategies, yet few interventional studies have been reported for this population. HRVB reduces autonomic reactivity and regulates homeostatic physiologic mechanisms, which can lead to decreased stress and anxiety, and increased resilience. Interventions such as HRVB are needed for ABN students in order to promote adaptive coping strategies and increase resilience pre-licensure.

Methods. Thirty-two students from a nationally accredited nursing program in the upper Midwest region of the U.S. in term four of their ABN curriculum were recruited and randomly assigned to one of two groups: HRVB intervention group or wait-list control group. All participants were given pre- and post-intervention surveys, including demographic information, the Perceived Stress Scale (PSS), the Coping Self-Efficacy Scale (CSE), and the Resilience Scale (RS). HRVB intervention group participants received HRVB training and the use of a personal HRVB device from the Primary Investigator.

Results. Findings indicated that HRVB significantly decreased perceived stress (t = 2.8588, p = 0.003832, α = .05), as well as significantly increased perceived coping ability (t = -4.012, p = 0.0001846, α = .05), and resilience (t = -2.7787, p = 0.004663, α = .05), in the ABN participants in the HRVB intervention group as compared to the ABN participants in the wait-list control group.

Conclusion. Despite the stressors and demands of the ABN curriculum, study findings support the use of HRVB as an intervention to assist ABN students in managing stress and increasing resilience.

Chapter 1: Introduction

> *The word accelerated means speed, so expect the workload to be heavy with intense clinical work in a limited time…there is no time to do any other thing, everything in your life stops and school takes over…students are usually in survival mode.* W. Ali, Accelerated Nursing Student (2011, p.13)

The development of Accelerated Baccalaureate Nursing (ABN) programs emerged in 1971 at St. Louis University as a solution to counteract the growing nursing shortage in the United States (US) (Cangelosi, 2007; Domrose, 2001). Nearly 300 ABN programs exist in the US, and additional programs are planned (AACN, 2015a). ABN programs allow nursing students to graduate in less time than a traditional baccalaureate-nursing (BSN) program. Graduates of ABN programs are highly valued by nurse employers who find ABN graduates to be excellent leaders, quick learners, more mature, and to possess strong clinical skills (AACN, 2015a). However, ABN students report higher perceived stress and anxiety compared with nursing students in traditional four-year nursing programs (Cangelosi & Moss, 2010; Hegge & Larson, 2008; Rouse & Rooda, 2010; Youssef & Goodrich, 1996). The compressed and fast-paced format of an ABN curriculum is a stressor, constituting a major life event. The educational demands prohibit ABN students from working or spending time with family and friends, which adds additional stress due to isolation (Hegge & Larson, 2008; Rouse & Rooda, 2010).

Although ABN students enter nursing courses equipped with additional layers of skills, education, and motivation compared to their traditional counterparts (AACN, 2015a), the rate of attrition in ABN programs is six-times the rate of attrition in

traditional BSN nursing programs. This attrition rate is associated with the fast pace and high intensity curriculum of the ABN program (Rouse & Rouda, 2010). ABN students are often non-traditional (older) individuals who bring previous professional experiences, values, and skills more suitable to prior career roles than to the nursing role. Zhao, Lei, He, Gu, and Li (2015) report that when nursing students are placed in environments unfamiliar to previous educational environments, perceived stress is increased. Feelings of helplessness, worry, and insecurity can quickly arise and lead to stress and emotional exhaustion (Utley-Smith, Phllips, & Turner, 2009). Stress is defined as the relationship between a person and his or her environment that is appraised, or assessed, to be overwhelming and exceeding his or her resources, thus leading to potential harm or loss (Lazarus & Folkman, 1984). Perceived stress is the cognitive appraisal of events or circumstances that an individual interprets as stressful or harmful (Folkman, Lazarus, Gruen, & DeLongis, 1986). ABN students experience high levels of stress and/or perceived stress and could benefit from learning adaptive coping strategies while in the ABN program (Penprase & Koczara, 2009).

ABN students in new and intense educational environments often lack the adaptive coping strategies needed to deal with the rigorous, fast-paced curriculum (Cangelosi & Moss, 2010). This inability to cope, or respond to the dynamic requirements of a situation when under stress is an indicator of low resilience (Block & Block, 1980). Resilience is defined as one's ability to adapt and restore equilibrium in one's life, in the midst of stress, and to avoid negative stress-related outcomes (Wagnild & Young, 1993). Innovative coping strategies that build resilience are needed to equip

ABN students with the ability to respond to their dynamic and stressful academic environment, as well as decrease ABN student attrition.

Coping, as defined by Lazarus and Folkman (1984), is the constantly changing cognitive and behavioral efforts one uses to manage specific external and/or internal demands at are appraised as exceeding one's available resources. In times of stress, adaptive coping strategies decrease distressing emotions and improve mental and physical health (Park, Folkman & Bostrom, 2001; Shinde & Hiremath, 2014). Adaptive coping refers to situations in which an individual chooses a coping strategy that "fits" the stressful situation and provides an acceptable outcome, rather than choosing maladaptive coping strategies that fail to manage or regulate the stressful environment (Park et al., 2001).

Qualitative data points to a growing awareness of the high stress in ABN programs and the need for adaptive coping strategies, yet few interventional studies utilizing coping strategies with ABN students have been conducted and/or published (Hegge & Larson, 2008; Rouse & Rooda, 2010). Interventions are needed for ABN students in order to promote adaptive coping strategies and increase resilience before they enter into the nursing profession (Crary, 2013; Hegge & Larson, 2008; Rouse & Rooda, 2010; Weitzel & McCahon, 2008). Ratanasiripong, Sverduk, Prince, and Hayashino (2012) report biofeedback methods in a college setting are more helpful in reducing stress than other traditional methods such as mediation, yoga, or breathing techniques. The development and testing of self-care biofeedback interventions is hypothesized to impact stress and resilience, as well as promote successful assimilation to and retention in the

profession of nursing (Bowie & Carr, 2013, Gibbons, Dempster, & Moutray, 2010; Prato & Yucha, 2013; Ten Cate, Kusrkar, & Willliams, 2011; Weinstein & Ryan, 2011).

A relatively new method of adaptive coping is biofeedback focused on heart rate variability (HRV). HRV biofeedback (HRVB) has emerged in research as a user-friendly and inexpensive method to make biofeedback data more readily available (Lemaire, Wallace, Lewin, De Grood, & Schaefer, 2011; Ratanasiripong, Severduk, Prince, & Hayashino, 2012). HRV measures beat-to-beat heart rate variability, which is an important physiologic index of stress and the body's regulatory capacity and adaptability (Childre, 1998; McCraty & Shaffer, 2015). HRVB is designed to reduce autonomic reactivity and regulate homeostatic physiologic mechanisms. Increased HRV decreases test and performance anxiety (Prato & Yucha, 2013; Shaw, Wilson, & Nihon, 2012), increases resilience (McCraty & Shaffer, 2015), helps with emotional self-management of stress (McCraty, Atkinson, Tomasino, Goelitz, & Mayrovitz, 1999), as well as decreases stress and anxiety in Thai traditional baccalaureate nursing students (Ratanasiripong, Ratanasiripong, & Kathalae, 2012).

Background and Significance

ABN programs continue to develop across the US to increase the number of BSN-prepared nurses and lessen the nursing shortage. These programs, designed for adults with baccalaureate degrees in fields other than nursing, comprise the fastest growing segment of nursing education in the US (Raines, 2011). Most accelerated nursing programs are 12 to 15 months in length, which require the ABN student to complete their BSN degree in an intensely controlled time period.

ABN students may progress through their ABN education without adequate adaptive coping strategies which may then lead to fear and anxiety regarding their future nursing career (Dela Cruz, Farr, Klakovich, & Esslinger, 2013; Hegge & Larson, 2008). Due to the condensed educational timeframe, newly graduated ABN students, although BSN-prepared, often enter the nursing workforce feeling over-whelmed and lack adaptive coping strategies, which may hinder adequate role transition (Dela Cruz et al., 2013; Oermann, Poole-Dawkins, Alvarez, Foster, & O'Sullivan, 2010).Yet, healthcare facilities prefer to hire BSN nurses over non-baccalaureate nurses based on evidence supporting superior patient outcomes related to BSN-prepared nurses' advanced critical-thinking and problem-solving skills (AACN, 2015b). These findings continue to urge the ongoing growth of ABN programs (Kelly, McHugh, & Aiken, 2011; Dimattio, Roe-Prior, & Carpenter, 2010).

According to the Bureau of Labor Statistics' Employment Projections, the total number of job openings for nurses due to growth and replacements will grow to 1.05 million by the year 2022, thus continuing the momentum of US ABN program growth (AACN, 2014; AACN, 2015a). ABN students need to be equipped, while in their ABN educational program, with adaptive coping strategies to increase their ability to acclimate to the ever-changing healthcare landscape upon entry into nursing practice. Little interventional research on adaptive coping strategies has been done with ABN students, and no research can be found on HRVB training in US BSN or ABN programs (Crary, 2013; Hegge & Larson, 2008; Rouse & Rooda, 2010; Weitzel & McCahon, 2008).

Statement of the Problem

Although qualitative research indicates that stressors are greater for ABN students than students in traditional four-year BSN programs, few intervention-based quantitative studies have been reported to investigate how adaptive coping strategies may impact the perceived stress, perceived coping ability, and resilience of nursing students. Research is needed to understand how adaptive coping strategies, such as HRVB, may affect ABN students' perceived stress, perceived coping ability, and/or resilience levels (Crary, 2013; Hegge & Larson, 2008; Ratanasiripong, Ratanasiripong, & Kathalae, 2012; Rouse & Rouda, 2010).

Purpose of the Study

The purpose of this quasi-experimental randomized controlled two-group pilot study was to test the effectiveness of a Heart Rate Variability Biofeedback (HRVB) intervention on ABN students' perceived stress, perceived coping ability, and resilience over four weeks during an academic term of ABN coursework at a Midwestern nationally accredited college of nursing.

The Specific Goal of the Study

Results of this study can be used to address perceived stress, perceived coping ability, and resilience in ABN students. A short-term outcome is providing a potential adaptive coping strategy as the ABN student transfers into their registered nurse role. Ultimately, the long-term impact of HRVB as a resilience-building adaptive coping strategy may yield higher retention rates for nurses within the nursing profession.

Research Question

The research question for this pilot study was: In accelerated baccalaureate nursing (ABN) students, what effect, if any, does the use of a heart rate variability biofeedback (HRVB) intervention have on perceived stress, perceived coping ability, and resilience? The aims, and associated hypotheses are as follows:

Aim #1: Determine what effect, if any, a HRVB intervention has on ABN students' perceived stress over four weeks during an academic term of ABN coursework.

Hypothesis One (H1)

ABN students who complete a four-week HRVB intervention will have decreased perceived stress.

Aim #2: Determine what effect, if any, a HRVB intervention has on ABN students' perceived coping ability over four weeks during an academic term of ABN coursework.

Hypothesis Two (H2)

ABN students who complete a four-week HRVB intervention will have increased perceived coping ability.

Aim #3: Determine what effect, if any, a HRVB intervention has on ABN students' resilience over four weeks during an academic term of ABN coursework.

Hypothesis Three (H3)

ABN students who complete a four-week HRVB intervention will have increased resilience.

Aim #4: Determine the difference, if any, in perceived stress scores between ABN students who participate in the HRVB intervention compared to those in the wait-list control group.

Hypothesis Four (H4)

ABN students who participate in the HRVB intervention will have lower perceived stress posttest scores when compared to the ABN students in the wait-list control group.

Aim #5: Determine the difference, if any, in perceived coping ability scores between ABN students who participate in the HRVB intervention compared to those in the wait-list control group.

Hypothesis Five (H5)

ABN students who participate in the HRVB intervention will have increased perceived coping ability posttest scores when compared to the ABN students in the wait-list control group.

Aim #6: Determine the difference, if any, in resilience scores between ABN students who participate in the HRVB intervention compared to those in the wait-list control group.

Hypothesis Six (H6)

ABN students who participate in the HRVB intervention will have higher resilience posttest scores when compared to the ABN students in the wait-list control group.

Exploratory Aim #7: In ABN students who participate in the HRVB intervention, determine the associations/relationships, if any, between the demographic variables (age, gender, marital status, number of children, and race) and perceived stress.

Exploratory Aim #8: In ABN students who participate in the HRVB intervention, determine the associations/relationships, if any, between the demographic variables (age, gender, marital status, number of children, and race) and perceived coping ability.

Exploratory Aim #9: In ABN students who participate in the HRVB intervention, determine the associations/relationships, if any, between the demographic variables (age, gender, marital status, number of children, and race) and resilience.

Definitions

The following definitions are used for this study (see Appendix S):

Accelerated Baccalaureate Nursing (ABN) Students

Accelerated baccalaureate nursing students are second-degree students who attend a baccalaureate-nursing program in a shorter time period than the typical four-year nursing program, in order to prepare the student to graduate and take the National Council Licensure Examination-Registered Nurse (NCLEX-RN). Most accelerated nursing programs are between 12 to 18 months in length (Penprase & Koczara, 2009).

Traditional Nursing Students

Traditional nursing students are students enrolled in a typical four-year undergraduate baccalaureate-nursing (BSN) program that is preparing them to graduate and take the National Council Licensure Examination-Registered Nurse (NCLEX-RN) (Hegge & Larson, 2008).

Stress

Per Lazarus and Folkman (1984), *stress* is a transaction that occurs between a person and his/her environment that exceeds his/her internal resources, endangers his/her well-being, and burdens his/her coping resources.

Stressor. A *stressor* is an event in one's life that can range from a catastrophic event, such as war, to a health-related event, such as an illness, to a daily life event, such as the aging process. Stress is not caused by the event (the stressor), but is a process caused by a difference in the individual's assessment of the event and his or her capacity to adapt, change, or decrease the stressor to achieve a positive outcome (Lyon, 2012). Stress is a result of how a specific stressor and the potential resources to cope are appraised (Folkman, Lazarus, Gruen, & DeLongis, 1986).

Perceived stress. *Perceived stress* is the measure of the degree to which one's life is appraised, or assessed, to be stressful rather than if certain events have happened (Cohen & Williamson, 1988; Crary, 2013). According to Lazarus and Folkman (1984), appraisal of the stressor has two components: 1) primary appraisal, in which the individual determines if there is any potential threat or harm, and 2) secondary appraisal, in which the individual evaluates his or her coping resources that might be available during the stressful event. In this study the definition of *perceived stress* was the apprehension, fear and/or helplessness an ABN student may have in regards to his/her academic success or failure in the condensed high-pace ABN program. For this study, perceived stress was operationalized using the Perceived-Stress Scale (PSS) (Cohen & Williamson, 1988).

Coping

Coping is the "constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person" (Lazarus & Folkman, 1984, p.141). Coping is a dynamic process between the self and the environment, and involves learning strategies to manage the stressful situation one is encountering. According to Lazarus and Folkman (1984), coping can be classified as problem-focused, which involves changing the stressor with problem solving; or emotion-focused, with emphasis on lessening the emotional distress of an event by eliminating or decreasing its associated negative emotions. Adaptive coping refers to situations where an individual chooses the coping strategy that "fits" the stressful situation and provides an acceptable outcome, which is in contrast to maladaptive coping strategies that fail to manage or regulate the stressful environment (Park, Folkman, & Bostrom, 2011).

Perceived coping ability. *Perceived coping ability* is the measure of an individual's confidence in his or her ability to cope effectively. Perceived coping ability is the precursor to changing one's coping behavior (Chesney, Neilands, Chambers, Taylor, & Folkman, 2006). Beliefs about one's ability to perform adaptive coping strategies have the ability to reduce stress and improve well-being (Park, Folkman, & Bostrom, 2001). In this study the definition of *perceived coping ability* was the belief, or confidence, an ABN student may have in regards to his/her ability to cope in a condensed high-pace ABN program. For this study, perceived coping ability was operationalized using the Coping Self-Efficacy scale (CSE) (Chesney et al., 2006).

Resilience

In general terms, *resilience* is the ability to rise above a difficult situation in one's life, adapt better than one expected, and go on to survive and thrive (Wagnild & Young, 1993; Taylor & Reyes, 2012). Resilience is an individual's capacity to recover quickly from stressors and potential stressors (Pipe, et al. 2012). In this study, *resilience* was defined as the ability for the ABN student to positively adapt to the ABN nursing school environment and display effective coping, by turning adversity into opportunity. For this study, resilience was operationalized using the Resilience Scale (RS) (Wagnild and Young, 1993).

Biofeedback

Biofeedback is the process of becoming more aware of the body's physiologic functions, such as heart rate, body temperature, blood pressure, respiration, and brainwave activity. Biofeedback training helps a person to learn to modify one's physiologic activity to improve health, performance, and decision-making abilities (Lehrer & Gevitz, 2014; McCraty & Zayas, 2014). There are multiple biofeedback modalities uses in health care, including: electromyography (EMG), heart rate variability (HRV), electrocardiogram (ECG), electroencephalograph (EEG), and feedback thermometers (Ratanasiripong, Ratanasiripong, & Kathalae, 2012).

Heart Rate Variability Biofeedback (HRVB). HRV measures beat-to-beat heart rate variability, which is an important physiologic index of stress and the body's regulatory capacity and adaptability. HRV biofeedback (HRVB) is designed to reduce autonomic reactivity and regulate homeostatic physiologic mechanisms (McCraty &

Shaffer, 2015). For this study HRVB was operationalized using the HeartMath® emWave technology (Institute of HeartMath, 2013).

HeartMath® emWave HRV biofeedback. There are a variety of instruments available for measuring real-time HRV, however, for this study, the non-invasive devices developed by The Institute of HeartMath® were utilized. These included: the emWave Pro HRVB desktop version and the portable emWave2 and Inner Balance HRVB devices. All of the HeartMath HRVB devices use an ear or fingertip sensor to indicate heart-rhythm patterns and HRV ranges (Institute of HeartMath, 2013).

The following section describes the assumptions and limitations of the research study.

Assumptions and Limitations

This section identifies the assumptions and limitations of the research study, which helps to describe the scope and the boundaries of the research.

Assumptions

This study was based on the following assumptions:

1. All ABN students will answer the survey questionnaires truthfully.
2. All ABN students experience stressors related to academic and life events.
3. The stress that ABN students experience is quantitatively different from the stress experienced by traditional nursing students.
4. The degree and overwhelming nature of the stressors associated with the ABN program affects some or many of the ABN students' abilities to adequately cope.

Limitations

This study was based on the following limitations:

1. The ABN study participants may have entered into the ABN nursing program with differing or atypical levels of stress and resilience, which were unrelated to enrollment in the ABN program.

2. The sample for this study was limited to ABN students enrolled at one state university in the Midwest-region of the U.S. The choice of a convenience sampling methodology for this study limits the generalizability of the findings to all ABN students.

3. The ABN study participants have to self-initiate the use of the HRVB device intervention, and the results will depend on the participants' willingness to use the HRVB device on a daily basis.

Chapter 2: Review of Literature and Conceptual Framework

This chapter provides a thorough literature review covering stress, resilience and coping strategies in nursing students, and biofeedback, with an emphasis on heart rate variability biofeedback (HRVB). The literature review is discussed within the context of ABN students. Additionally, this pilot study's conceptual framework, Lazarus and Folkman's transactional theory of stress and coping (TTSC), is examined through the historical roots of the concept of stress and applied to ABN students utilizing HRVB as an adaptive coping strategy. The purpose of this pilot study was to test the effectiveness of a HRVB intervention on ABN students' perceived stress, perceived coping ability, and resilience, and guides the following literature review.

A comprehensive, scholarly literature review was conducted using the following databases: CINAHL Plus via EBSCO, Cochrane Database of Systematic Reviews, ERIC via EBSCOhost, PubMed, and MEDLINE Web of Knowledge. Broad searches included all possible dates in the selected database, with most articles published in the last 10-15 years. The terms "stress", "perceived stress" "resilience", "coping", and "perceived coping" were searched individually and in relationship to nursing students and ABN students. The search terms "nursing students", "accelerated nursing students", "second degree nursing students", and "second career nursing students" were used to explore and define the study's population of interest. Finally, search terms specific to the intervention included: "biofeedback", "heart rate variability", "HeartMath", "HeartMath® emWave2", and "emWave® biofeedback."

Findings from the literature review were guided by the study's conceptual framework (Figure 3), and synthesized in the following twelve sections: stress; stress and

nursing students; stress and ABN students; resilience; resilience and nursing students; resilience and ABN students; coping; coping strategies of nursing students; coping strategies of ABN students; biofeedback; HRVB; and HeartMath emWave technology HRVB.

Stress

Stress is a universal experience. For decades stress has been associated with causing and exacerbating illnesses such as heart disease and cancer (Lovallo, 2015; McEwen, 1998). However, the concept of stress is subjective and is difficult to measure due to confounding aspects of daily life that may also be place the body at risk for illness. While physiologic systems of the body promote adaptation and homeostasis through their ability to change and respond during challenging experiences, these same systems compromise internal stability when subjected to extreme circumstances (McEwen, 1998).

The history of defining and understanding stress began with Cannon's landmark work describing the neuroendocrine response to stress called the "fight or flight" theory (1932). Some years later, Selye, a young medical student at the University of Prague, identified stress in his "stress-response theory" (1956). For over 50 years, Selye studied the stress-response and its relationship to health. He noted that the "syndrome of being sick" was related to the body's nonspecific reaction to excessive demands or noxious stimuli. He termed this response "stress" and the stimulus that provoked the stress response, the "stressor" (Selye, 1976). In 1974, Selye termed the illness-producing biologic processes the body goes through during stressful times the "general adaptation syndrome" (GAS). Building on Cannon's work (1932), Selye described the body as attempting to attain and maintain homeostasis, or stability of physiologic systems (such

as body temperature), until a stressor elicits the GAS. If the GAS is severe and/or prolonged, disease or even death can result (1976).

In the 1960s, psychologists Holmes and Rahe, became interested in the individual response to life changes, and subsequently, proposed the stimulus-based stress model (1967). This approach differs from Seyle's stress-response theory (1976) by the specific focus on life events as the stressor to which an individual must respond and adapt. Holmes and Rahe define stress as the adjustment or adaptation required by selected life changes or events, and if multiple life events/changes occur in a short period of time, vulnerability to illness is increased (1967).

In the 1980s, Lazarus and Folkman described stress as a transaction between a person and his or her environment (1984). The Transactional Theory of Stress and Coping (TTSC) involves a complex process of cognitive appraisals, emotions, coping responses, and if necessary, reappraisals. The philosophical underpinnings of the TTSC are based on Carl Rogers' humanistic assumptions and cognitive behaviorism that highlights stress as how one perceives and appraises the world around him or her (Hobfoll, 2004). According to Lazarus and Folkman, stress is experienced when harm or loss is appraised and the demands of the situation exceed an individual's resources (1984). The concept of coping, or efforts to manage the stress experience, was a new addition to theories surrounding stress and its effects (Folkman, Chesney, McKusick, Ironson, Johnson, & Coates, 1991). The additional concepts of appraisal and coping establish the TTSC as a suitable framework for this pilot study are described in greater detail later in this chapter.

It is noted individuals may respond to stressful situations in multiple ways.

Responses are based on individual appraisal of the situation (is the situation a threat or benign?) as well as the health status of the individual (in good physical condition versus having a chronic illness) (McEwen, 1998). The primary stress responses are behavioral and biologic. The behavioral responses involve the individual's appraisal and responses, which are associated with external resources such as social support, and internal responses such as learning ability and developmental stage. Biologic responses are based on the body's current health and factors such as genetic makeup and gender (Aschbacher et al., 2013; McEwen, 1998)

Current literature has established the autonomic nervous system (ANS) and the hypothalamic-pituitary-adrenal (HPA) pathway (see Figure 1), part of the neuroendocrine system, as major contributors to the body's interpretation of stressors and the physiologic responses to the stressor. The ANS and HPA pathway play major roles in promoting physiologic adaptation, or allostasis, but problems arise when these pathways are overactive or underactive (McEwen, 1998). The first physiologic mechanism that is activated during the stress response is the ANS. Biomarkers of the ANS stress response include heart rate, blood pressure, and HRV changes (Rice, 2012; McCorry, 2007).

Allostatic load refers to the pathophysiology of an overworked ANS and the HPA pathway. During allostatic load, the ANS and/or the HPA pathway fail to turn off or fail to respond during a stressful experience, which leads to other body systems overreacting and over-secreting hormones and neurotransmitters, such as cortisol (Lovallo, 2015; McEwen, 1998). Cortisol, known as the stress hormone, is released when an event is perceived as stressful or has the potential for harm to one's well-being. Cortisol helps to mobilize the energy for an individual to cope with stressors, which is beneficial.

However, prolonged or excessive cortisol production can lead to reduced immune response, cancers, and premature aging, amongst other negative health outcomes (Aschbacher, O'Donovan, Wolkowitz, Dhabhar, Su, & Epel, 2013).

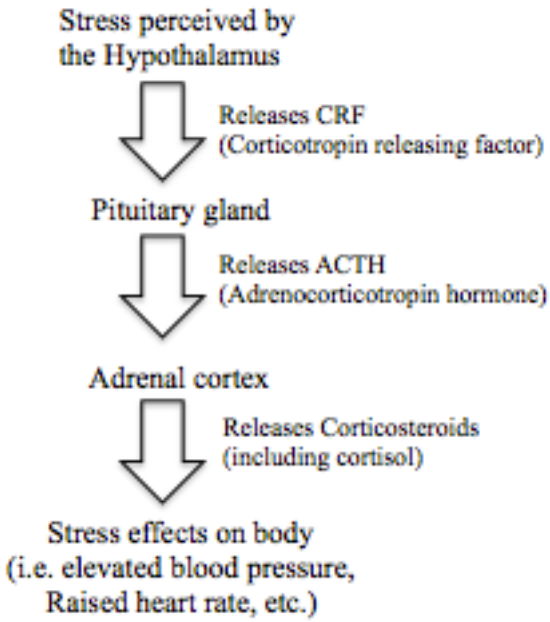


Figure 1. *Diagram of Hypothalamic-Pituitary-Adrenal (HPA) Stress Pathway*

Understanding the negative outcomes of continuous activation of the ANS and/or HPA pathway is foundational to understanding the outcomes of perceived stress on the body. The inability of the body to respond appropriately to a stressful environment is a marker for possible pathologic conditions to occur (Goldberger & Breznitz, 1982).

Stress and Nursing Students

Academic programs, the associated examinations and heavy study demands elicit a stress response for most college students and are an added stressor of work-life imbalance (Howard, 2001; Regehr, Glancy, & Pitts, 2013). Nursing students have added

stressors, such as longer hours of study and clinical practicums and pressure to perform clinical skills accurately while staying attentive to the patient's emotional needs (Chang, Hancock, Johnson, Daly, & Jackson, 2005; Gibbons, Dempster, & Moutray, 2009). Stress in nursing students has global relevance as studies around the world report student nurses describing stressful academic environments, which lead to attrition (Alzayyat & Al-Gamal, 2014; Cohen-Watz, Wiley, Capuano, Baker, & Shapiro, 2005; Pulidoo-Martos, Augusto-Lando, & Lopez-Zafra, 2011; Watson et al, 2008). Stressors unique to nurses in practice are: difficult patients and their families, relationships with physicians, lack of institutional commitment to nurses, increasing patient loads that can lead to poor patient care, as well as the need for ongoing professional development. Nursing students experience these same stressors coupled lack of confidence and exposure to unfamiliar environments (Chernomas & Shaprio, 2013; Watson et al., 2008).

For nursing students, increased stress levels center on academic pressures, practical life-work balance demands, and witnessing the suffering and possible deaths of patients (Alzayat & Al-Gamal, 2014; Lo, 2002). These increased stress levels can contribute to poor academic performance. It is estimated that over 50% of all United States nursing cohorts report significant stress, which is even greater in senior nursing students (Galbraith & Brown, 2011). Among 437 undergraduate Canadian nursing students, 10 percent indicated severe or extremely severe stress as measured by the 42-item Depression Anxiety Stress Scale (DASS) (Chernomas and Shapiro, 2013). The nursing students with the highest stress scores indicated ineffective coping mechanisms, anxiety the night before clinical practice, perceived stress before entering the nursing

program, and continued perceived stress throughout the duration of the nursing program (Chernomas & Shapiro, 2013).

Over the years of 1994 to 1997, 192 nurses and nursing students were studied regarding stress and psychological distress in their professional and personal life experiences (Watson et al., 2008). The results indicate increased stress when life events, such as marriage, and work related stressors such as dealing with difficult patients, intersect. The lack of human resources and support services related to psychological services was highlighted as a needed strategy for decreasing stress in nursing students and newly graduated nurses (Watson et al., 2008). These studies indicate the ongoing need for interventional research to test coping strategies for nursing students.

More recently, 45 baccalaureate-nursing students were studied over the course of their pre-licensure education in regards to their perception of stress and its relation to professional identity and self-care (Hansel and Laux, 2014). The 10-item Perceived Stress Scale (PSS) was used to measured stress levels. The students who engaged in self-care activities, such as physical activity or stress management, experienced decreased stress as they progressed through the nursing program, indicating self-care activities have the potential to reduce stress in nursing students. The stress management techniques that were most successful involved those that promoted homeostasis and growth versus traditional stress management techniques that were heavy on theory teaching, but allowed for little practice (Hansel & Laux, 2014). In 217 undergraduate nursing students in Mainland China, the most common perceived stressors measured by the PSS were class assignments and workload, taking care of patients, stress from peers, and daily life activities (Zhao, Lei, He, Gu, & Li, 2015).

The literature on stress and perceived stress among nursing students has significantly increased over the past 15 years, with most of the studies coming from Europe and the United States (Chernomas & Shapiro, 2013); however, the literature on stress and accelerated baccalaureate nursing (ABN) students continues to lag behind.

Stress and ABN Students

Students in ABN programs have been studied and found to have higher stress levels than their traditional nursing student counterparts. Stressors such as learning the academic material in a compressed time frame, balancing families and children, along with the need to work have led to maladaptive coping strategies for ABN students. Thus, attrition rates of ABN students are six times higher than attrition rates of their nursing peers in a traditional BSN program (Cangelosi & Moss, 2010; Hegge & Larson, 2008; Kohn & Truglio-Londrigan, 2007; Rouse & Rooda, 2010). ABN students describe their stressors in the ABN program to be even greater than previous significant life events, such as death of a family member or a divorce (Hegge & Larson, 2008). A literature review by Neill (2011) on ABN students' experiences in their nursing program reported the following common themes: elevated stress related to the intensity and accelerated nature of the ABN program; highly emotive feelings of anxiety and being overwhelmed regarding the curriculum and the clinical environments; and unstructured curriculum and unsupportive faculty.

An embedded mixed method examined predictors of stress and coping strategies in accelerated versus traditional nursing students at two Midwestern nursing universities (accelerated n =75, traditional n=135) (Wolf, Stidham, & Ross, 2015). The qualitative findings identified three categories of stressors for both the accelerated and traditional

nursing students: 1) fear of failure or incompetence in clinical; 2) problematic relationships; and 3) time management issues. However, as measured by the Perceived Stress Questionnaire (PSQ), the accelerated nursing students reported higher percentages in regards to fear of failure or incompetence and time management. Recommendations from this study include annual stress screenings and stress reduction interventions for both traditional and accelerated nursing students (Wolf et al., 2015).

As supported by Wolf, Stidham, and Ross (2015), research in the area of ABN students has shifted from examining the ineffective coping strategies of students to potential interventional strategies. ABN students enter with a positive perspective—the honeymoon—and within hours to months, enter into the next phase—conflict. This is the phase in which ABN students feel inadequate dealing with personal and academic demands, and begin to display emotions such as depression, anger, helplessness and lack of energy (Utley-Smith, Phillips, & Turner, 2007). ABN students need to develop a plan of action to meet these stressors, which may include mentors, seeking help, and using positive, adaptive, coping strategies (Hegge & Larson, 2008). The ABN program educational environment also needs to be reevaluated to allow for opportunities to teach adaptive coping strategies with the potential to decrease stress and increase resiliency for students in the rigorous ABN program (Boellaard, Brandt, & Zorn, 2015; Earvolino-Ramirez, 2007).). Relaxation techniques, as one stress management intervention, have been recommended to help reduce ABN students' stress levels and teach lifelong adaptive coping strategies that could also decrease attrition in the nursing workforce (Penprase & Koczara, 2009).

Resilience

Resilience has been defined in literature many different ways and by a variety of disciplines, from ecology and engineering to nursing and medicine (Earvolino-Ramirez, 2007). Landmark studies define resilience as being "invincible" or "invulnerable" (Anthony, 1974), implying risk evasion, and therefore absolute and unchanging (Luthar, Cicchetti, & Becker, 2000). As research in the area of resilience matured, it became clear that individuals respond to different life experiences with varying degrees of resilience, (Waller, 2001) and was instead a dynamic process of change (Luthar et al., 2000). Individuals with higher levels of resilience had common protective factors, such as flexibility, having a sense of control over fate, being future-oriented, and a belief in self-efficacy. These "protective factors" have been found to be contextual, situational, and individual, and can lead to a variety of outcomes (Johnson & Wiechelt, 2004).

More recently, resilience has been defined as the ability to rise above difficult situations, adapt better than expected in adversity, and recover, or "bounce back," from the adversity (Martin & Marsh, 2006; Tusaie, Pushkar, & Sereika, 2007). Resilience is a necessary quality for success in the nursing profession (Jackson, Firtko, & Edenborough, 2007), and the development of resilience-based interventions is needed to promote positive adaptation to the nursing role (Earvolino-Ramirez, 2007).

Resilience and Nursing Students

Limited research has been published regarding nursing students and resilience. In 2005, Parse's Human Becoming Theory was used as a framework for helping undergraduate nursing students develop professional resilience as a resource when the nursing profession seems overwhelming. Parse's theory, when applied to educational

practice for nursing students, allows the students to explore meanings and philosophies of caring in order to enhance their professional roles (Hodges, Keeley, & Grier, 2005). More recently, Taylor and Reyes (2012) explored self-efficacy and resilience related to test grades among nursing students. Self-efficacy improved over the student's semester, as well as the resiliency subscales of perseverance and existential aloneness (Taylor & Reyes, 2012). A pilot study (N=60) using the 18-item Stress Resiliency Profile (SRP) measured stress perceptions of undergraduate nursing students pre/post resiliency training. Results indicated no significant increase in overall resiliency post intervention, however one subscale of resiliency "necessitating" or focusing on commitment rather than choice had a significant increase ($p < 0.01$) (Pines et al., 2014). These studies highlight the need for further studies with additional resiliency interventions, larger samples, and replication (Pines et al., 2014; Taylor & Reyes, 2012).

In a sample of 124 undergraduate and graduate nursing students, correlations among academic success, spiritual well-being, empowerment, and resilience were explored using the 14-item Resilience Scale (RS) (Wagnild & Young, 1993) to measure resilience. While academic success was not significantly correlated with resilience among undergraduate nursing students, a positive correlation between academic success and resilience was reported in graduate nursing students (r=.467) (Beauvais, Stewart, DeNisco, & Beauvais, 2013).

Finally, an interventional pilot study explored the impact of a stress management and mindfulness intervention on stress and resilience among undergraduate nursing and midwifery students (n=14), reporting potential benefits of increased resilience, overall well-being, and decreased stress. Recommendations for further research included

quantitative studies to determine the effects of stress management techniques and coping strategies on stress, resilience, and the ability for enhanced self-care (van der Riet, Rossiter, Kirby, Dluzewksa, & Harmon, 2015).

Resilience and ABN Students

No published literature could be found in the stated databases on ABN students and resilience. One dissertation (Wolf, 2015) describes this gap in knowledge and focuses on resilience levels using the Connor-Davidson Resiliency Scale (CD-RISC). The ABN students' (n=156) resilience levels were measured over a nine-month period during the ABN program. Resilience levels did increase, although not statistically significant, illuminating that resilience can develop and grow. Studies in the ABN academic setting that incorporate ways to foster resiliency are needed (Wolf, 2015).

Coping

The study of coping focuses on the ways that individuals deal with and react to stressors in their lives. The definitions of coping include: "constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of a person" (Lazarus & Folkman, 1984, p. 141); regulation under stress (Compas, Connor, Osowiecki, & Welch, 1997); and "how people mobilize, guide, manage, energize, and direct behavior, emotion, and orientation or how they fail to do so" (Skinner & Wellborn, 1994, p. 113). Collectively, these definitions support a link between coping and regulatory efforts on behalf of the individual and his or her environment (Skinner & Zimmer-Goldbeck, 1997).

There are two primary ways of coping are adaptive and maladaptive. Adaptive (or constructive) coping includes responses such as problem solving, seeking help,

distraction, or accommodation. Responses associated with maladaptive coping include escapism, opposition, or social isolation (Skinner & Zimmer-Gembeck, 2011). Coping is also viewed as multi-level process that includes adaptive, episodic, and interactional processes. The adaptive process focuses on developmental time, relating to how individuals learn to deal with stressors throughout their lifespan. The episodic process focuses on coping over time and is shaped by the individual's appraisals and resources, while the interactive process is coping in real-time (Skinner & Zimmer-Gembeck, 2007).

It is noted that the concept of control is closely tied in with the coping process (Dweck, 1999; Folkman, 1984; Skinner, 1995). Three types of control: objective, subjective, and experiences of control, shape coping (Folkman, 1984). For example, when an individual has high confidence and/or self-efficacy, or the situation seems objectively controllable, the individual is more likely to be effective when dealing with the stressor. In this instance, the stressor would be perceived as a challenge, not a threat (Lazarus & Folkman, 1984).

As individuals continue to encounter stressors in their lives, and adaptively deal with the stressor(s), they learn patterns of coping. Over time, these patterns of coping increase the individual's perceived coping ability and competence. In the opposite fashion, if an individual doubts his or her ability to control and cope with a stressor, he or she becomes less confident in his or her perceived coping ability which leads to ongoing helplessness. These dynamics of coping provide an interpretation of an individual's differences in perceived control, perceived coping ability, and patterns of coping with stressors (Schmitz & Skinner, 1993; Seligman, 1975). The ability to change confidence in one's coping ability is integral to intervention studies. If an individual believes that he or

she has the capacity to perform a specific coping strategy or behavior, coping can be improved and new coping strategies can be introduced (Chesney, Neilands, Chambers, Taylor, & Folkman, 2006).

Coping Strategies used by Nursing Students

In a highly referenced longitudinal study (Lo, 2002), a cohort of nursing students (*n* year one=120, *n* year two=112, *n* year three=101) was followed for three years to investigate their perception of stress, sources of stress, and the coping mechanisms used. The modified Ways of Coping questionnaire (WCQ) was used to measure the actions and thoughts used to deal with stressful situations. The nursing students reported the following coping mechanisms: problem solving, recreation and sports, social support, which consisted primarily of family and friends, tension reduction strategies, and avoidance. A future study recommendation included introducing stress management training as part of the nursing curriculum to help equip nursing students with methods to positively reduce stress levels (Lo, 2002).

An exploratory study studied the coping styles of nursing students (N= 171) as one of the variables. Feeling support, whether from faculty and/or family and friends, emerged as one of the adaptive coping mechanisms, while avoidance coping, such as drug and alcohol use, was the prominent maladaptive coping mechanism (Gibbons, Dempster, & Moutray, 2010). In a study of 180 nursing students in New Delhi, the Adolescent Coping Orientation Program Experience (ACOPE) scale was used to determine coping strategies used by the students to overcome stress (Kumar, 2011). The most commonly used coping mechanisms for nursing students in this study included: ventilating feelings, such as crying or swearing; seeking diversions, such as going to a

movie or drinking alcohol; relaxing; self-reliance, such as working harder; and developing social support. Recommendations for future studies included a focus on the development and testing of positive, adaptive coping mechanisms (Gibbons, Dempster, & Moutray, 2010; Kumar, 2011). Additionally, nursing students with maladaptive coping strategies are more likely to have higher levels of stress, anxiety, and depression (Chernomas & Shapiro, 2013), indicating the need for interventional studies that address adaptive coping strategies for nursing students.

Examples of interventional studies on positive coping mechanisms among traditional BSN students include: a hardiness educational intervention (Jameson, 2014); mindfulness meditation programs (Kang, Choi, & Ryu, 2009; van der Riet, Rossiter, Kirby, Dluzewksa, & Harmon, 2015); and biofeedback (Ratanasiripong, Park, Ratanasiripong, and Kathalae, 2015). The majority of studies indicated reduced stress and/or anxiety levels in the nursing students as a result of the intervention. The primary indications for further research in these areas include: longevity studies, larger samples, and nursing schools of varying demographics (Kang et al, 2009; Ratanasiripong et al., 2015; van der Riet et al., 2015). Lastly, Hensel and Laux (2014) reported that helping nursing students develop coping strategies that incorporate self-help were more helpful in reducing stress than focusing on relaxation activities alone. The lack of interventional studies utilizing adaptive coping strategies with nursing students is evident in the literature.

Coping Strategies used by ABN Students

Research with traditional nursing students and their coping strategies continues to flourish, yet there is still little research on coping strategies in the rapidly growing ABN

student population. The 53-item COPE scale was used to gather data to measure the coping strategies of 137 ABN students. The most helpful coping strategies identified included: seeking social support, religious support, positive reinterpretation and growth, planning, and acceptance. The top negative coping mechanisms were: denial, behavioral disengagement, substance abuse escape, and restraint coping (Hegge & Larson, 2008). In a similar study, the self-identified coping strategies of 75 ABN students included positive thinking and social support (Wolf, Stidham, & Ross, 2015). Both studies recommend interventional research focusing on promoting coping strategies to reduce stress in ABN students (Hegge & Larson, 2008; Wolf et al., 2015).

The vast majority of the literature focuses on the difference between traditional and accelerated nursing students, not only in the curriculum design, but also in the personal attributes that each bring (Boellaard, Brandt, & Zorn, 2015; Bowie & Carr, 2013; Neill, 2011; Oermann, Alvarez, O'Sullivan, & Foster, 2010; Utley-Smith, Phillips, & Turner, 2007). This research helps define and distinguish the unique differences of ABN students, yet fails to address the need for appropriate and time-sensitive coping strategies for this growing population.

Biofeedback

In research, biofeedback has been defined as a process of becoming aware of the body's physiologic functions, such as heart rate and breathing patterns, and learning to control these physiologic body functions (Childre, 1998; McCraty & Shaffer, 2015; Ratanasiripong, Ratanasiripong, & Kathalea, 2012). This has been studied through different methods and instruments, such as temperature probes, electroencephalography (EEG), electromyography (EMG), and heart rate and respiration monitors (McCraty &

Shaffer, 2015; Ratansasirirpong, Sverduk, Hayashino, & Prince, 2010; Varogli & Darviri, 2011). Research has shown significant improvements in health when biofeedback is used for health problems such as anxiety, stress, depression, chronic pain, insomnia, and hypertension (Hui-Chin, Kuan-Chia, Chun-Jen, Tze-Chun, Ling-Ling, & Chien-Yu, 2014; Prinsloo, Derman, Lambert, & Rauch, 2013; Reiner, 2008).

The use of EMG biofeedback training with nursing students was first used in the 1970s in Ireland to help nursing students deal with anxiety (Leboeuf, 1977). In this study, 16 extroverts and 16 introverts, as measured by the Eysenek Personality Inventory, were chosen due to scoring high on the State-Trait Anxiety inventory. After the five-day EMG biofeedback training sessions were complete, the study results showed a significant decrease in anxiety in the introvert nursing students, but no significant decrease in anxiety was noted in the extroverts (Lefoeuf, 1977). Since this time, few studies have been done with biofeedback in nursing students.

In 2008, 155 American nursing students were trained on biofeedback relaxation to reduce anxiety (Prato and Yucha). The 20-item Spielberger's Test Anxiety Inventory (TAI) measured anxiety levels before and after the relaxation biofeedback intervention. The intervention included: diaphragmatic breathing instruction, progressive muscle relaxation, and autogenic training, followed up by 15-minute personal practice sessions at the participant's homes. After the biofeedback intervention, the students verbally reported a decrease in test anxiety, but no significant decrease was noted on the TAI. Significant differences were seen post-intervention on the students' respiratory rate and temperature, indicating the need for more studies to focus on biofeedback in these areas (Prato & Yucha, 2008).

HRVB. A relatively new method of biofeedback focusing on heart rate variability (HRV) has emerged in research as a user-friendly and inexpensive way to make biofeedback more readily available (McCraty & Shaffer, 2015; Ratanasiripong, Severduk, Prince, & Hayashino, 2012). HRV measures the beat-to-beat heart rate variability, which is an important physiologic index of stress. HRV biofeedback (HRVB) is designed to reduce autonomic nervous system reactivity and regulate homeostatic physiologic mechanisms. This involves deep rhythmic breathing that allows the participant to inhale until they see their heart rate rise, and exhale as their heart rate begins to fall again (Reiner, 2008).

HRV is measured by the variations in the RR intervals (the R-wave peaks) between heartbeats. The RR interval can be influenced by both physical and psychological variables, including certain medications. Beta-blockers, a medication class used for hypertension, has been shown to cause increased HRV in some individuals, while other common anti-hypertension medications, such as diuretics and angiotensin-converting enzyme (ACE) inhibitors, may decrease overall HRV (Schroeder et al., 2003). Additionally, certain anti-depression medications, such as serotonin–norepinephrine reuptake inhibitor (SNRIs) and selective serotonin reuptake inhibitor **(**SSRIs), have been shown to decrease HRV in some individuals (Kemp et al., 2010).

Respiratory sinus arrhythmia (RSA) refers to the element of change that is synchronized to an individual's breath cycle (Kim et al., 2015). When an individual is breathing at an optimal frequency, as is learned in HRVB training, RSA is reported to be a dominant component of the RR interval change (Lehrer, Vaschillo, & Vaschillo, 2000). Studies support that HRVB, which influences RSA and enhances the variation of the RR

intervals, can directly enhance an individual's ability to self-regulate, or cope, both physically and emotionally (Hassett et al., 2007; Karavidas et al., 2007; Kim et al., 2015; Lehrer & Gevirtz, 2014; Lehrer et al., 2000). Thus, HRV is often seen as a measure of an individual's emotional and physical resilience, and HRVB can repair suppressed autonomic function and increase resilience (Lehrer et al., 2010). Study participants report HRVB to be more effective than yoga, meditation, or deep breathing alone (Prinsloo, Derman, Lambert, & Rauch, 2013; Ratanasiripong, Ratanasiripong, & Kathalea, 2012). HRVB has been shown to decrease test anxiety in students (Ratanasiripong et al., 2012), help with emotional self-management of stress (McCraty, Atkinson, Tomasino, Goelitz, & Mayrovitz, 1999), as well as decrease stress and anxiety in a short-term study on Thai nursing students (Ratanasiripong et al., 2012).

HeartMath emWave® HRVB. HeartMath emWave biofeedback technology has been used to help thousands of individuals, in classroom settings to computer labs to home-based use. The emWave2 and Inner balance are small, non-invasive handheld versions based on the emWave desktop version that uses an ear or fingertip sensor and LED lights to indicate heart-rhythm patterns and HRV ranges (Institute of HeartMath, 2014). College students who have used the emWave handheld self-regulation technology devices report key benefits including improved academic focus, increased emotional resilience, reduced test anxiety, and higher performance levels (Ratanasiripong, Ratanasiripong, & Kathalea, 2012; Ratansasirirpong, Sverduk, Hayashino, & Prince, 2010; Ratanasiripong, Severduk, Prince, & Hayashino, 2012).

The HeartMath portable emWave2 has been used for patients with brain injury to improve recognition and regulation of emotional states (O'Neill & Findlay, 2014). In an

interventional study using HeartMath emWave technology in women with breast cancer, significant increases in coping skills and decreased stress, as well as improved immune function were reported (Groff, et al., 2010). In 40 Canadian physicians, stress, as measured by the Perceived Stress Scale (PSS), was significantly decreased (p=0.013) after a 28-day HRVB intervention with a portable HeartMath emWave HRVB device (Lemaire, Wallace, Lewin, DeGrood, & Schaefer, 2011). Stress was decreased by 40 percent and resilience, or emotional vitality, was increased by 25 percent in a study conducted with 14 police officers using HeartMath emWave2 handheld technology (Weltman, Lamon, Freedy, & Chartrand, 2014). The intervention dose of the HeartMath emWave handheld training sessions varies in literature from a single-episode session (Prinsloo, Derman, Lambert, & Rauch, 2013) to three to eight week session trainings (Groff et al., 2010; Weltman et al., 2014; Ratanasiripong, et al., 2012); yet, all report significant findings of decreased stress.

Summary

Hegge and Larson (2008) described the additional stressors that ABN students face in nursing school when compared to traditional nursing students, as well as highlighted the great need for coping strategies to help reduce ABN student's stress levels. Wolf and associates (2015) reinforced the need for interventional research focusing on promoting coping strategies to reduce stress in ABN students. Studies on different coping mechanisms, such as relaxation techniques and offering mentors, (Penprase and Koczara; 2009) have been trialed with traditional nursing students, but little research has been done with ABN students. Research has shown that HRVB significantly decreases stress, and increases resilience and performance in college

students (Ratanasiripong, Severduk, Prince, & Hayashino, 2012) and Thai nursing students (Ratanasiripong, Ratanasiripong, & Kathalea, 2012). These indicate a possible significant coping strategy using HRVB with ABN students. No published studies have been found on the use of HRVB as an intervention to decrease stress, increase perceived coping ability, or increase resilience in ABN students. Based on the concepts of Lazarus and Folkman's Transactional Theory of Stress and Coping (TTSC) (1984), an interventional pilot study utilizing HRVB as an adaptive coping strategy is hypothesized to decrease stress, increase perceived coping ability, and/or increase resilience in ABN students.

Theoretical framework

The theoretical framework for this pilot study is Lazarus and Folkman's Transactional Theory of Stress and Coping (TTSC) (1984). The concepts and relational statements in the TTSC framework are congruent with the event (stressor) and variables in the pilot study. In the following paragraphs, a historical perspective on the TTSC is provided, followed by a description of the theory's concepts, and finally, a diagram of the conceptual framework for this study, based on the TTSC, is displayed and described (Figure 2).

Historical perspectives. In the 1960s, Dr. Richard Lazarus, a social-personality psychologist, became interested in explaining the dynamics of troublesome, or stressful, experiences. He believed that stress was a concept with empirical value, but was not measurable by a single factor (Lazarus, 1966; Lyon, 2012). Instead, Lazarus stated that stress did not exist in the *event*, but rather as the result of a transaction between a person and his or her environment "in a dynamic, mutually reciprocal, bi-directional

relationship" (Lazarus & Folkman, 1984, p. 293). In 1984, Lazarus, along with colleague Dr. Susan Folkman, a psychologist, published their TTSC in the book *Stress, Appraisal and Coping*. The idea of stress being a *transaction* was in opposition to previous views on stress that included: stress as *response* to noxious stimuli (Selye, 1956); and stress as a *stimulus* in which life events were the stressor that required a response or adaptation (Holmes & Rahe, 1967).

Building on the Carl Roger's humanistic philosophy and the tradition of cognitive behaviorism (Hobfoll, 2004), the fundamental components of Lazarus and Folkman's theory are primary appraisal, stress, secondary appraisal and coping (see Figure 2). The TTSC outlines a model in which an event, termed the stressor, results in an appraisal of that event as harm, a threat, or a challenge. The appraisal of the stressor is influenced by personal and situational resources, and determines coping behaviors (Lazarus & Folkman, 1984). Stress theories prior to Lazarus and Folkman's TTSC (1984) did not define or conceptualize coping, thus coping is an important and unique concept to the TTSC (Lyon, 2012). Coping behaviors, according to the TTSC, are classified as either problem-focused or emotion-focused, and will either provide the individual with a favorable outcome and positive emotions, or an unfavorable outcome with distress. Unfavorable outcomes result in a return to appraisal of the stress, known as reappraisal (Lyon, 2012).

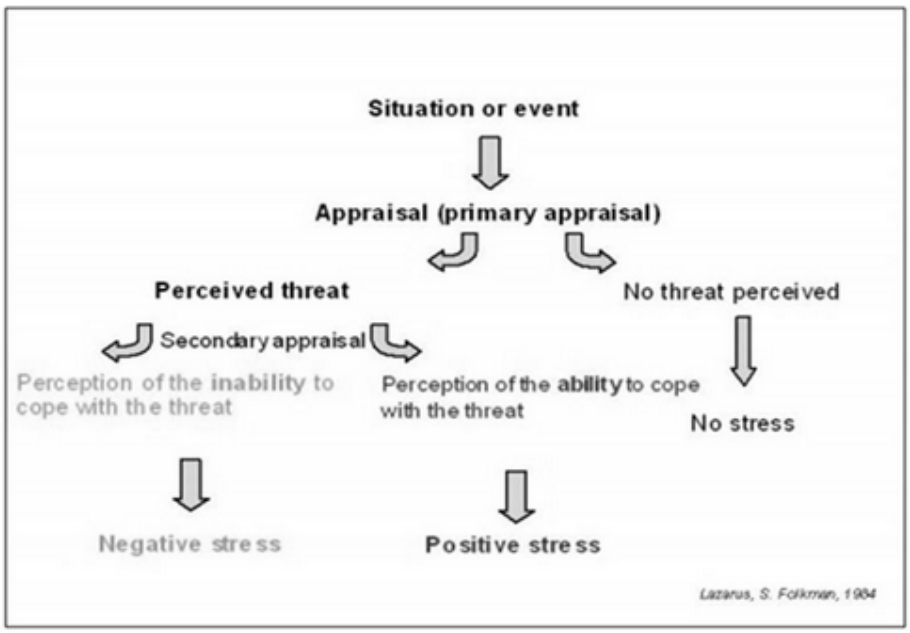


Figure 2. *Lazarus and Folkman's Transactional Theory of Stress and Coping (1984)*

Concepts. The TTSC framework begins with an event or stressor and moves through two core processes: appraisal and coping. The TTSC seeks to provide a foundation to help understand the interaction between stressors, the environment, and the effects of appraisal and coping strategies on event outcomes (Lazarus & Folkman, 1984).

Stressor. A stressor is an event in one's life that can range from a catastrophic event, such as war, to a health-related event, such as an illness, to a daily life event, such as the aging process. Stress is not caused by the event (the stressor), but is a process caused by a difference in the individual's assessment of the event and his or her capacity to adapt, change, or decrease the stressor to achieve a positive outcome (Lazarus & Folkman, 1984; Lyon, 2012). Stress is a result of how a specific stressor and the potential resources to cope are appraised (Folkman, Lazarus, Gruen, & DeLongis, 1986).

Appraisal. Appraisal is a mental process in which an individual assesses his or her person-environment relationship in regards to two factors: 1) whether the demands of the

event, or stressor, threaten his or her well-being, and 2) whether the individual feels he or she has the resources to meet the demands of the stressor. There are two types of appraisal: primary and secondary. Both primary and secondary appraisal lead to an effort to cope with the stressor and influence coping strategies, which ultimately affects the outcome. Often both types of appraisal occur simultaneously, so measurement of each separately can be difficult (Folkman, Lazarus, Gruen, & DeLongis, 1986; Lazarus & Folkman, 1984; Lyon, 2012).

Primary appraisal. Primary appraisal is a judgment about how an individual appraises a challenging event in relation to his or her own "values, goals, commitments, beliefs about self, and situational intentions" (Lazarus & Folkman, 1984, p.75). During primary appraisal, the individual assesses the possible effects of demands and resources on his or her well-being. If the individual appraises the person-environment relationship as exceeding his or her resources and endangering his or her well-being, the event is perceived as stressful. The event may be perceived as: a threat, a potential for loss or harm; harm, where actual harm has already occurred; or as a challenge, where the event may bring some type of benefit or gain. Threat and harm appraisals are typically characterized by negative emotions such as anxiety, fear or anger; while challenge appraisals are often associated with positive emotions such as excitement and hope (Lazarus & Folkman, 1984; Lyon, 2012).

Secondary appraisal. If an individual perceives a life event as stressful, or threatening, he or she will determine how to cope with the stress. The individual will assess the coping strategies and options that are available to them and how effective they

might be. The perception of threat is the trigger for secondary appraisal (Lazarus & Folkman, 1984; Lyon, 2012).

Reappraisal. As the event or situation evolves, the individual is in the process of continuously evaluating, changing, and/or relabeling prior primary and secondary appraisals. This process is called reappraisal. For example, something that originally was viewed as threatening may be reappraised as a challenge due to changes in the environment or modified emotional responses (Folkman et al., 1991; Lazarus & Folkman, 1984).

Coping strategies. When an event, or stressor, is appraised as stressful, coping strategies are the thoughts and behaviors an individual uses to handle the demands of the stressor. According to the TTSC, stress is viewed as controllable by helping individuals change their perceptions of a stressor, providing them with strategies to cope, and improving their confidence and ability to do so (Lazarus & Folkman, 1984). Coping efforts begin with assessment of the stressor and are situation specific. Coping is also process-oriented, which refers to what the individual thinks or does, and how he or she changes these thoughts and actions as the situation unfolds, without regard to the final outcome. The focus is on management of the stressor, not the success of those efforts (Folkman et al., 1991).

Lazarus and Folkman identify two forms of coping strategies: problem-focused and emotion-focused (1984). Problem-focused coping necessitates "managing or altering the problem", while emotion-focused coping is "directed at regulating the emotional response to a problem" (Lazarus & Folkman, 1984, p.150). Problem-focused coping strategies include cognitive problem solving and decision making, goal setting and/or

time management with the goal to alter or manage the event causing stress. Emotion-focused coping includes cognitive efforts that change the meaning of a situation, without actually changing the environment, through cognitive reframing, minimization, escapism, and/or self-help, like exercise or meditation. Problem-focused and emotion-focused coping strategies can work together or work against one another, depending on the circumstance (Folkman et al., 1991).

The choice of coping strategy used to handle a stressor is influenced by the individual's available resources, which can include skills, abilities, social resources, physical resources, psychological resources and/or institutional, cultural or political resources. There are times when an individual has adequate resources, yet may not be able or know how to use them to their fullest extent due to lack of training, lack of support, or certain personal vulnerabilities (Folkman et al., 1991).

Outcomes. Lazarus and Folkman describe event/stressor outcome possibilities as either favorable, with positive emotions, or unfavorable, with distressing emotions. The process begins with appraisal of the stressor as the individual attempts to work toward a favorable outcome (Lazarus & Folkman, 1984). However, it must be noted that coping, according to Folkman et al. (1991), is without reference to its outcome, meaning that there may be life events/stressors that cannot be mastered and an individual may realize that effective coping involves coming to terms with the undesired outcome.

Research utilizing the TTSC. Lazarus and Folkman's TTSC has produced a proliferation of research during the last 30 years including research on health-related events and their physiologic effects (Balneaves & Long, 1999; Mok, Lai, & Zhang, 2004; Outlaw, 1993), work stress (Lim, Bogossian, & Ahern, 2010; Thornton, 1992),

depression (Kennedy, Duff, Evans, & Beedie, 2003), and immune response (Dowling, Hockenbery, & Gregory, 2003; Payne, 2014). The TTSC (1984) has been applied to a wide variety of populations including nurses (Bianchi, 2004; LeSergent & Haney, 2005), physicians (Lindfors, Boman, & Alexanderson, 2012), social workers (Ying, 2008), students (Sheu, Lin, & Hwang, 2002), children (Walker, Smith, Garber, & Claar, 2007), and caregivers (Kelso, French, & Fernandez, 2005; Hong & Tae, 2013).

Many of the studies incorporating Lazarus and Folkman's TTSC (1984) are interventional studies including studies testing coping strategies for airline pilots post simulated hijacking attempts (Strentz & Auerbach, 1983) to helping women cope after intimate partner abuse (Beecham, 2014). The use of the TTSC as a framework for interventional studies is supported by additional empirical evidence offered by Folkman, Chesney, McKusick, Ironson, Johnson, and Coates (1991) in the publication "Translating Coping Theory into an Intervention." Interventions based on the TTSC take into account characteristics of both the individual and the situation as they define the stressor and highlight the processes, appraisal and coping, that can help restructure the stressful transaction. Lazarus and Folkman's TTSC focuses on the concepts of effective appraisal and coping, which have important implications when developing adaptive coping strategies through interventional research (Folkman et al., 1991).

Conceptual Framework

Lazarus and Folkman's Transactional Theory of Stress and Coping (1984) has been adapted for use in guiding this pilot study that measures perceived stress, perceived coping ability, and resilience in students in an ABN program, while testing HRVB as a coping strategy. See Figure 3.

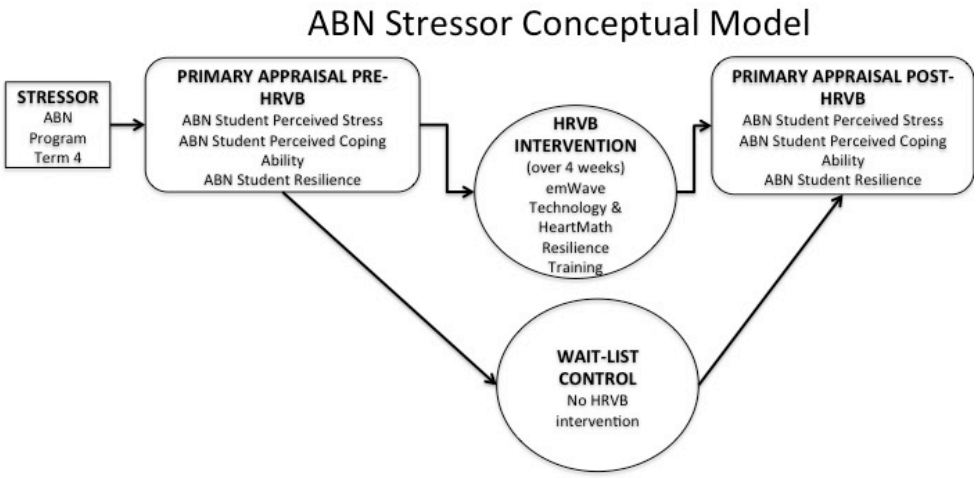


Figure 3. *ABN Stressor Conceptual Model: Adapted from Lazarus and Folkman's TTSC (1984)*

Through the lens of the TTSC, coping processes are seen as changeable, meaning they can be modified by interventions such as education, counseling and/or therapies or treatments. This is an important distinction from previous coping theories that define coping as a relatively stable and enduring property of a person, not easily changed (Folkman et al., 1991). The introduction of a new coping strategy, HRVB, for ABN students within their high-intensity learning environment, has the possibility of providing an innovative resource to mediate appraised threats as the student attempts to successfully cope with the stressor of an ABN program.

This conceptual framework guides this pilot study in the following ways: 1) the stressor, or event, is the ABN program Term 4; 2) the primary appraisal involves each ABN participant's perception of his or her perceived stress, perceived coping ability, and

level of resilience; and 3) HRVB, using the HeartMath resiliency training and emWave HRVB technology (Institute of HeartMath, 2014, 2016), is the coping strategy taught to the intervention group. Primary appraisal, or the evaluation of an event being a threat to one's well being (Lazarus & Folkman, 1984), is a central focus in this study. The primary appraisal process is measured twice in this study, before and after a four-week HRVB intervention. The participants in the wait-list control group, who are experiencing the ABN program Term 4 as usual, without HRVB intervention, also use primary appraisal during week one and after week four of the study. The primary appraisal of the wait-list control group is measured to the differences between the two groups.

HRVB, as an adaptive coping strategy, is congruent with Lazarus and Folkman's definition of coping (1984). HRVB is process-oriented, contextual and without reference to its outcome (Lazarus & Folkman, 1984). HRVB utilizes a variety of learned techniques that an individual can chose from and alter as a specific situation unfolds. These techniques include heart-rhythm patterns that are associated with lower stress and higher resilience. HRVB is coping strategy that is used to manage a stressor, such as the ABN program in this study, instead attempting to control the outcome.

As an example, a study conducted with police officers (n=14), used HRVB training as a coping strategy to reduce stress and build resilience when work-related stressful encounters occurred, such as witnessing scenes of death or injury (Weltman, Lamon, Freedy, & Chartrand, 2014). After the police officers received four-weeks of HRVB training, the outcomes of the HRVB coping strategy indicated the police officers had a stress reduction of 40% and increased resilience (emotional vitality) of 25%. Additionally, the police officers praised the ability to easily apply the HRVB techniques

in real-life stressful situations (Weltman et al., 2013). This study demonstrates HRVB as an adaptable, contextual intervention that can decrease stress and increase resilience, even if the outcome of the event cannot be changed.

The use of HRVB, as a malleable, situation-specific adaptive coping strategy, with ABN students has the potential for important implications to reduce perceived stress, increase perceived coping ability, and increase resilience, even when the stressor, the ABN program, cannot be altered. These concepts are congruent with Lazarus and Folkman's TTSC (1984), and the ABN Stressor Conceptual model for this pilot study. Thus, the purpose of this quasi-experimental randomized controlled two-group pilot study was to test the effectiveness of a HRVB intervention on ABN students' perceived stress, perceived coping ability, and resilience over four weeks during an academic term of ABN coursework at a Midwestern nationally accredited college of nursing.

Chapter 3: Method and Procedures

Introduction

The increased stress associated with obtaining a BSN degree via an ABN program versus a traditional BSN program has been well documented in the literature (Cangelosi & Moss, 2010; Hegge & Larson, 2008; Rouse & Rooda, 2010; Youssef & Goodrich, 1996). The compressed and fast-paced format of an accelerated nursing program is a stressor, and the demands of the ABN educational program also prohibit ABN students from working or spending time with family and friends, which adds additional stress due to isolation (Hegge & Larson, 2008; Rouse & Rooda, 2010).

Ratanasiripong, Sverduk, Prince, and Hayashino (2012) report biofeedback methods tested among college students are more effective in reducing stress than other traditional methods such as mediation, yoga, or breathing techniques. The development and testing of self-care biofeedback interventions is hypothesized to impact stress and resilience, as well as promote successful assimilation to and retention in the profession of nursing (Bowie & Carr, 2013, Gibbons, Dempster, & Moutray, 2010; Prato & Yucha, 2013; Ten Cate, Kusrkar, & Willliams, 2011; Weinstein & Ryan, 2011). The use of HRVB as a coping mechanism with student populations is relatively new. HRVB outcomes, in populations other than ABN students, show significant reductions in stress and anxiety (Ratanasiripong, Park, Ratansiripong, & Kathalae, 2015; Weltman, Lamon, Freedy, & Chartrand, 2014). Little research on coping interventions has been reported with ABN students, and no research can be found on HRVB training in US BSN or ABN programs (Crary, 2013; Hegge & Larson, 2008; Rouse & Rooda, 2010; Weitzel & McCahon, 2008). The purpose of this pilot study was to test the effectiveness of a Heart

Rate Variability biofeedback (HRVB) intervention on ABN students' perceived stress, perceived coping ability, and resilience over four weeks during the fourth term of ABN coursework at a Midwestern nationally accredited college of nursing.

This chapter describes the research design, sample selection, study setting, and the study's intervention procedure for this pilot study. Information regarding the instruments and operationalization of constructs is described, including information on reliability and validity. Institutional Review Board (IRB) procedures are identified, and data analysis plans are delineated.

Research Design

Randomized controlled trials must include randomization, an intervention and a control; quasi-experimental studies exclude one of these required variables (Polit & Beck, 2012). Quasi-experimental studies are also common in natural settings, such as education, where true randomization is difficult (Cook, 2001; Polit & Beck, 2012). This study could not fully incorporate a randomized sample due to only one ABN school selected for the study and the need for a convenience sample. Therefore, a quasi-experimental randomized controlled two-group design was chosen for the design of this interventional pilot study.

The two groups of ABN students included: a) an HRVB interventional group and b) a wait-list control group. The dependent variables in this pilot study were perceived stress, perceived coping ability, and resilience. The independent variable was participation in a four-week HRV biofeedback intervention. Covariates entered into data analyses came from demographic variables: age, gender, marital status, number of children, race, and original baccalaureate degree. Resource and time constraints were

limited due to the compressed nature of the ABN program coursework and the expense of the HRVB emWave portable technology devices, thus this study was considered a pilot study.

The use of a wait-list control group design allowed participants from the same population to serve as controls while still using an experimental design (Polit & Beck, 2012). Participants were randomly assigned to either the HRVB intervention group or a wait-list control group during the active study period. This approach allowed the participants in the wait-list control to receive the HRVB intervention after the active study if they desired. The use of a wait-list control group added rigor to the experimental design of this pilot study thus advancing the limited number of experimental intervention studies of coping effectiveness of ABN students. Kinser and Robins (2013) recommended a wait-list control group in mind-body interventional studies, such as HRVB, to enhance recruitment and retention, help control threats to internal validity, and provide the most ethical approach to the intervention process.

Study Population

The chosen study population was the accelerated baccalaureate nursing (ABN) students admitted to the 2015-2016 accelerated nursing cohort at a public accredited nursing program in the upper Midwestern region of the U.S.

Study Sample

To reduce Type II errors, or false negatives, a power analysis was conducted to determine the sample size for this pilot study (Polit & Beck, 2012). According to Polit and Beck (2012), conducting a power analysis to determine sample size and power is an important step in the research planning process. The value for effect size for a two-group

t-test of means is estimated at ".20 for small effects, .50 for medium effects, and .80 for large effects" (Polit & Beck, 2012, p.424).

Upon review of the literature examining a HRVB intervention with ABN students, no prior research studies were found on this topic, thus an estimated large effect size of .80 was used for this pilot study. The G*Power 3 Statistical Power Analysis Program (Faul, Erdfelder, Lang, & Buchner, 2013) was used to conduct a power analysis to determine the sample size. To achieve a power of .80 and an estimated effect size of .80, with a significance level, or alpha (α), of .05, the total sample size needed for this pilot study was 52 students, or 26 for each group (Faul et al., 2013). However, due to limited ABN students per cohort in the Midwestern region, it was estimated that approximately 40 students, or 20 for each group, would be recruited. Data from one ABN cohort was collected over four weeks during one term of ABN coursework.

Inclusion/Exclusion criteria. Eligible participants were: full-time students currently enrolled in the 2015-2016 accelerated nursing cohort at the chosen public accredited nursing program in the upper Midwestern region of the U.S.; male or female; at least 18 years of age; and able to read, write, and understand English. Participants previously trained in HRVB were excluded from this pilot study.

Sampling procedures. After the ABN volunteer participants signed the informed consent forms, they were randomly assigned to the HRVB intervention group or the wait-list control group. Simple random sampling technique was used to divide the participants into the HRVB intervention and wait-list control group. This type of sampling strategy provided the probability that all eligible students had a chance to participate in the HRVB intervention. The initials of each participant were assigned a number. These numbers

were plotted on a random numbers table via the computer program Random.org (2016), and the participants whose numbers corresponded to the first column of numbers were assigned to the HRVB intervention group (Polit & Beck, 2012).

Study Setting

The study was conducted through an accredited nursing program in the upper Midwestern region of the U.S. The chosen nursing program has an accredited one-year accelerated baccalaureate program of nursing, a traditional choice for students seeking their first nursing degree, an online option for nurses with an associate degree who wish to obtain a Bachelor of Science in Nursing (BSN) degree, as well as graduate and doctoral programs of nursing. The HRVB training sessions were held in an onsite nursing classroom with technology that supported the use of a PowerPoint presentation.

Confidentiality, Informed Consent, and Protection of Human Subjects

According to de Vaus (2001), protection of human rights is a crucial aspect of any study. This involves receiving informed consent, voluntary participation, protecting the participants from harm, and maintaining confidentiality. The university's Institutional Review Board (IRB) and Nursing Research Committee reviewed and approved the protocol for this study, as well as the informed consent and proposed instruments (see Appendices D and R). Protection of Human Subject's followed the guidelines of the Declaration of Helsinki (World Health Organization, 2007) (See Human Subjects form Appendix C). The PI is certified in the Collaborative Institutional Training Initiative (CITI) on Human Subjects Research (See Certification Appendix Q).

According to Polit and Beck (2012), the elements in the informed consent process included: a brief description of the study, the potential risks and benefits, disclosure of

any and all alternatives to participating in the study, as well as insuring confidentiality. The ABN participants in this study had the opportunity to read the informed consent, ask questions about the study, consider if they want to participate, sign and date the consent form, and they all received a copy of the form for their own record-keeping (See Participant Consent Form Appendix B).

The ABN students were notified that there may be no benefit to participation in this pilot study, although the participants in the HRVB intervention group were informed that they may have potential benefits of decreased perceived stress, increased perceived coping ability, and increased resilience. All participants who completed the study received one week of free yoga/exercise class passes to a local fitness studio (Form Fitness), and were entered in drawings for the following: $75 VISA gift card and $75 Form Fitness gift card (the same participant could not win both gift cards). This was not meant to be coercive for study participation, but to provide all ABN students encouragement to participate (Polit & Beck, 2012). The primary investigator (PI) for this pilot study was not associated with the faculty at the chosen nursing program, so pressure to participate for academic reasons was eliminated.

Risks to participating in this study included possible loss of up to 10 hours of time due to the commitments of participating in the HeartMath HRVB training sessions and calendar journaling requirements; psychological or emotional distress due to self-disclosure on the pretest and posttest questionnaires, as well as the potential loss of confidentiality, which can occur anytime information is exchanged. In order to reduce the risk of loss of confidentiality, the following procedures took place: 1) after the study's completion, personal information was de-identified on the data collected, 2) during the

active study timeframe, the participant's data was stored on a laptop in a locked room in the PI's office, and 3) only the PI and her study team had access to the data collected from this pilot study (Polit & Beck, 2012).

Study Procedure (see timeline: Appendix A)

To increase the fidelity of this pilot study, the study procedure was informed by two HRVB interventional studies: 1) Ratanasiripong, Ratanasiripong, and Kathalea's 2012 study on 60 baccalaureate nursing students attending one nursing program in Thailand; and 2) Lemaire, Wallace, Lewin, De Grood, and Schaefer's 2011 study on 40 staff physicians in Canada. Both studies utilized HeartMath HRVB technology as a coping strategy to decrease stress. In addition, prior to this study, the PI conducted a feasibility pilot study using HeartMath HRVB with ABN students (n=3) to test the study instruments and HeartMath resiliency program (Harmelink, 2015).

Recruitment. Following institutional approval, potential participants for this study were invited to participate in this study at one of their pre-scheduled course dates during their fourth term in their ABN program. The fourth term is 12 weeks before graduation from the ABN program. Since the PI did not have access to the students' contact information as part of the Family Educational Rights and Privacy Act (FERPA) (U.S. Department of Education, 2015), recruitment emails were sent to all students in the 2015-2016 ABN cohort via a faculty member teaching in the chosen ABN nursing program, (see example email in Appendix L). The recruitment emails briefly described the study, the inclusion/exclusion criteria, as well as the compensation (incentive) if they chose to participate and complete the study requirements. The exclusion criteria were listed to inform potential participants the reasons they would not qualify for this study so

that they would not attend the PI's recruitment visit, thus further protecting their privacy. Two emails were sent four days and one day prior to the PI's official recruitment visit to the 2015-2016 ABN cohort. The recruitment visit occurred during one of the ABN student's planned days of onsite ABN instruction.

Informed consent. At the official recruitment visit by the PI to the ABN program location, the ABN students who chose to participate completed the informed consent process before any research intervention began. To fully complete this process, each participant read the informed consent form, were allowed to ask any additional questions regarding the study, signed and dated the informed consent, and finally, received a personal copy of his or her informed consent form. At the recruitment visit all interested participants filled out the demographic form for review by the PI to determine any participant exclusions.

Planned intervention. Pre-study and post-study surveys were administered to all eligible participants at the recruitment visit and at the conclusion of week four of the study (See Figure 4). After the pre-study forms were completed, the participants were randomly assigned to either the HRVB intervention group or the wait-list control group by the described simple random sampling technique. The PI informed each participant via email within two business days following recruitment regarding their random group assignment.

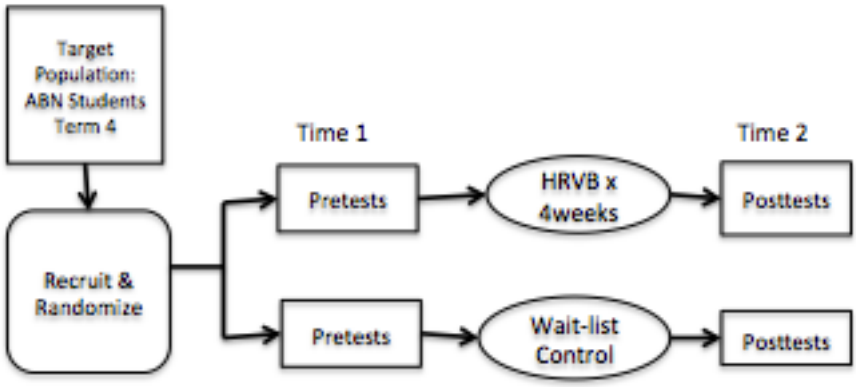


Figure 4. *Intervention map.*

Group HRVB training session. The participants randomly assigned to the HRVB intervention group received a 2.5-hour group training session one week after the recruitment visit. The training session occurred on the campus where the ABN students attend classes. The PI led the HRVB training and provided snacks for the participants. During the training, the HRVB intervention group was instructed on how to use the HeartMath HRVB techniques, as well as the emWave2 and Inner Balance portable HRVB devices (see Appendix I). Participants with an acceptable iPhone device were given the Inner Balance for the remainder of the study, while those without iPhone devices were given emWave2 devices. The emWave2 and Inner Balance measured the participant's HRV and provided visual and auditory feedback to the participant in order to help him or her learn to control his or her HRV. The emWave2 has lighted bars and sounds that help the participant control his or her breathing and learn to sustain heart-rhythm patterns associated with lower stress and higher resilience. In the same way, the Inner Balance attaches to an iPhone© (Apple Products, 2016), and provides visual and auditory feedback to help the participant learn to sustain heart-rhythm patterns associated

with lower stress and higher resilience. The PI is a certified educator in the HeartMath HRVB techniques and the use of the emWave2 and Inner Balance products (Institute of HeartMath, 2016) (see Appendix O).

The HRVB intervention participants were specifically taught how to control his/her HRV through slower breathing and positive emotions. In order for one to be able to utilize HRVB, participants must first be aware of the necessary three steps of this intervention: (1) become aware of involuntary HRV, (2) learn to control HRV through slower breathing and positive emotions, and (3) achieve a heart-rhythm associated with lower stress (Ratanasiripong, Ratanasiripong, & Kathalae, 2012). Each HRVB intervention group participant was taught these techniques by the PI and received a handbook with detailed information on how to most fully utilize HeartMath HRVB techniques. An example of one of the techniques, Heart Focused Breathing, can be found in Appendix N.

Daily HRVB practice. Each participant was encouraged to practice the learned HeartMath HRVB training methods with the portable HRVB device (either the emWave2 or Inner Balance) for five minutes at least three times daily for the remainder of the four-week study. The participants were instructed how to record their practice time into a printed calendar provided to each participate at the initial training session (see Appendix P). During week two of the study, the PI returned to the ABN campus and met individually with each HRVB participant and practiced the learned heart-rhythm patterns associated with lower stress and higher resilience on the PI's emWavePro. The HRVB intervention participants received an email reminder from the PI two days before the PI was on campus regarding the emWavePro practice session. Each individual session lasted

approximately five minutes. The PI asked the following open-ended question at each individual HRVB meetings: “Do you have any questions or concerns regarding the HRVB technology device you are using?” The participants in the HeartMath HRVB intervention group were able to contact the PI at any time during the four-week study to meet for additional individual sessions to view their heart-rhythms on the emWavePro. The participants in the wait-list control group did not receive any training on HeartMath techniques or the portable HRVB devices during this time.

Posttests. At the conclusion of the four-week study, all participants met to fill out the post-study surveys (See Figure 3). At this point in the study, participants who completed all the required sessions received the indicated compensation. The HRVB intervention group returned the emWave2 or Inner Balance portable device to the PI. The wait-list control group was offered information on future HRVB training available to them free of charge.

Materials. Materials needed for this intervention included the HeartMath training booklets, and the portable emWave2 and Inner Balance HRVB devices. These were purchased at a discount through the Institute of HeartMath (2016) since the PI is a certified educator of the HeartMath HRVB methodology being used for the intervention. The PI already owned the emWavePro desktop version.

Threats to Reliability and Validity

The sample was limited to ABN students from one university in the Midwest. Study participants were selected from one group: students in their fourth term of nursing courses in an accredited ABN nursing program in the upper Midwestern region of the U.S. Since the sample did not include other regions of the country, generalizability of the

findings is limited. Furthermore, the sample size was determined by only two previous similar studies and calculations of effect size; statistically significant results may require a larger sample.

Potential threats to internal validity included: maturation of the ABN students as they progressed through the term; repeated testing leading to familiarity of the questionnaires from pretest to posttest; and potential expectancy of the primary investigator having bias towards the expected results of the intervention (Polit & Beck, 2012). Potential threats to external validity included: pretest sensitization for the results of the posttest; interaction of the ABN participants in the control group with those in the intervention group; and lack of true randomized selection of participants (Polit & Beck, 2012).

Instruments

Three scales were used to collect data on the dependent variables perceived stress (PSS), perceived coping ability (CSE), and resilience (RS). These scales represent operationalization of the dependent variables in the conceptual framework, and all have sound psychometric properties. See Appendices F-H for sample instruments and scoring descriptions.

ABN participants, including those in the HRVB intervention and wait-list control groups completed the three scales, a basic demographic form, which included the following information: name, date, current contact information, age, gender, marital status, number of children, original baccalaureate degree, and a list of their current medications (see Appendix E for demographic form). It was important for the PI to know what medications an ABN student participant was taking, as some medications, such as

blood pressure controlling medications, can potentially increase or decrease HRV, which may subsequently influence HRV readings (Kamath, Watanabe, & Upton, 2013). The PI informed participants in the HRVB intervention group regarding those medications that had the potential to affect HRV. Additionally, the HRVB intervention participants were trained on the emWave2 and Inner Balance portable HRVB devices, the instrument used to measure HRV.

Perceived Stress Scale. The instrument that was used to measure *perceived stress* was the Perceived Stress Scale (PSS) by Cohen and Williamson (1988); therefore the operational definition of *perceived stress* is the score on the PSS. The PSS is a 10-item questionnaire that measures situations in the nursing student's life that are deemed stressful. This Likert-type instrument has each item scored 0 (never), 1 (almost never), 2 (sometimes), 3 (fairly often), to 4 (very often). An example question on the PSS is: *In the past month, how often have you felt nervous and "stressed"?* The total score possibility of the PSS is 56, with the higher the number, the greater the perceived stress. Scores near 13 are considered average, with scores greater than 20 indicating high stress. The Cronbach's alpha internal reliability of the PSS ranges from 0.84-0.86 (Cohen & Williamson, 1988).

The original PSS was a 14-item survey, with subsequent development of 4-item and 10-item versions. The Cronbach's alpha coefficient for the internal reliability of the original PSS-14 was .75. In an exploratory factor analysis (EFA) of the PSS-14, Cohen and Williamson (1988) eliminated four poorly performing items and the alpha coefficient increased to 0.84-.86 on the newly developed PSS-10. Scores on the PSS-10 and PSS-4 demonstrated moderate convergent variability, but the PSS-4 scores performed with

relatively low reliability (.60), thus the PSS-10 is the recommended perceived stress tool for future research (Cohen & Williamson, 1988; Taylor, 2015). The PSS-4 is only recommended for situations where perceived stress measurements must be taken quickly (Taylor, 2015).

Based on the premises of Lazarus and Folkman's transactional theory of stress and coping (TTSC) (1984), the PSS measures the degree in which one appraises a life situation as stressful (Cohen, Kamarck, & Mermelstein, 1983). The PSS was designed for use in community samples with at least a junior high school education, and was used with a wide-range of populations, including those with depression (Kuiper, Olinger, & Lyons, 1986), and those wanting to quit smoking (Glasgow, Klesges, Mizes, & Pechacek, 1985). The PSS has been translated into more than 25 different languages, and has been validated on diverse samples (Cohen, 2013), including a sample of pregnant women taking antidepressants, with a reported Cronbach's alpha of .90 (Karam et al., 2012). More recently, the PSS-10 effectively showed a significant reduction in perceived stress following a mindfulness stress reduction intervention (Ergol, Singer, McIntyre, & Stefanov, 2014). Roberti, Harrington, and Storch (2006) recommend the PSS-10 as a means to tracking a participant's response to an intervention.

Coping Self-Efficacy Scale. The instrument used to measure perceived coping ability was the Coping Self-Efficacy Scale (CSE) by Chesney, Neilands, Chambers, Taylor, and Folkman (2006). The operational definition of *perceived coping ability* is the score on the CSE. The CSE is a 26-item questionnaire that measures perceived self-efficacy for coping with life challenges or threats. Coping self-efficacy is the individual's confidence in his or her ability to cope effectively, and is an important precursor to

changing coping behaviors (Chesney et al., 2006). The CSE assesses change over time within intervention research and has underpinnings from Lazarus and Folkman's coping theory (1984) and Bandura's Self-Efficacy theory (1997). This Likert-style instrument scores items on an 11-point scale from 0 (Cannot do at all) through 5 (Moderately certain can do) to 10 (Certain can do), and is based on three subscales: problem-focused coping, emotion-based coping, and support from family and friends. An example statement on the CSE is: *When things aren't going well for you, how confident are you that you can sort out what can be changed, and what cannot be changed.* The total CSE score is determined by the sum of each item rating; a higher score indicates higher perceived coping ability. The highest score possible on the CSE is 260. An average score on the CSE is between 137-138 (Chesney et al., 2006).

The development of the CES began with two randomized controlled clinical trials investigating the efficacy of a Coping Effectiveness Training (CET) intervention with 348 HIV-seropositive depressed men living in the San Francisco Bay area. Using study data collected from 1992 to 1994 and from 1997 to 2000, Chesney et al. (2006), conducted exploratory (EFA) and confirmatory factor analyses (CFA) and reported a 13-item reduced form of the CSE with three factors: use problem-focused coping (6 items, $\alpha = 0.91$); stop unpleasant emotions and thoughts (4 items, $\alpha = 0.91$); and get support from friends and family (3 items, $\alpha = 0.80$). The internal consistency and test-retest reliability was reported strong for all three factors. Concurrent validity analyses supported that the three factors assessed for self-efficacy for different types of coping. Predictive validity analyses showed change scores in coping ability indicating reduced psychological distress and increased psychological well-being, over time. The CSE scale is a

psychometrically sound instrument suitable for measuring an individual's perceived ability to cope and changes in coping ability over time in intervention research (Chesney et al., 2006).

In addition to the research using the CSE with HIV-seropositive men (Chesney, Neilands, Chambers, Taylor, & Folkman, 2006; Park, Folkman, & Bostrom, 2001), the CSE has been used with burn patients and their perceptions on posttraumatic stress symptoms (PTSD) during the first 12 months after their burn injury (N=178, $\alpha = 0.88$) (Bosmans, Hofland, De Jong, & Van Loey, 2015); as well as coping with psychological distress in two samples of rheumatoid arthritis patients (N=146 and N=102, $\alpha = 0.96$ and 0.97, respectively) (Benka et al., 2014). Building on the study by Chesney et al. (2006), Denton, Rostosky, and Danner (2015) conducted a web-based survey study of 576 lesbian, gay, and bisexual individuals regarding their coping self-efficacy related to social stigmas and their associated stressors. The Cronbach's alpha for the total CSE was 0.95, with the three CSE subscales (problem-focused coping, emotion-based coping, and support from family and friends) yielding 0.94, 0.96, and 0.86, respectively (Denton et al., 2015). The CSE continues to provide evidence of validity in measures of perceived coping ability and is supported by research.

Resilience Scale. The instrument that was used to measure *resilience* was the Resilience Scale (RS) by Wagnild and Young (1993); therefore the operational definition of *resilience* is the summative score on the RS. The RS is a 25-item questionnaire that measures individual resilience, which is considered a positive personality characteristic that enhances adaptation. This Likert-type instrument scores items on a 7-point scale ranging from 1 (disagree) to 7 (agree). An example statement on the RS is: *I feel that I*

can handle many things at a time. The score range for the RS is 25-175, with scores greater than 147 reflective of higher resilience. The RS has demonstrated high reliability with alpha coefficients ranging from 0.85-0.94 (Wagnild & Young, 1993).

The development of the Wagnild and Young Resilience Scale began in 1988 with a qualitative pilot study of women (n = 24) who had successfully adapted after a major life event (Wagnild & Young, 1993). Five components of resilience were identified from the study participants' narratives: 1) equanimity, which is the balanced perspective of one's life and experiences; 2) perseverance, which is the act of persistence despite adversity; 3) self-reliance, which is a belief in oneself and one's capabilities; 4) meaningfulness, which is the realization that life has a bigger purpose; and 5) existential aloneness, which is the realization that each person's life journey is unique (Wagnild & Young, 1993). These five components were the foundation for the development of the original 25-item RS (1993); 14 item and 10 item revised resilience scales are available.

The RS is appropriate for use with adolescents (age 16 and older), young and older adults. The RS has been pilot tested with undergraduate nursing students and was found to be at sixth grade reading level (Wagnild & Young, 1993). Since the development of the original RS in 1993, the RS has been used in a wide variety of populations including: older women, caregivers of spouses with Alzheimer's, first-time mothers returning to the workplace, nursing and medical students, and residents of community living facilities, as well as translated into more than 40 different languages (Beauvais, Stewart, DeNisco, & Beauvais, 2014; Celik, 2013; Ergol, Singer, McIntyre, & Stefanov, 2014; Wagnild & Young, 1993). The RS is best used to measure resilience at

one point in time and may easily be adapted for use in pre-test/post-test research methods.

The RS possesses priori content validity in that during construction of the items, the selected items on the RS reflect the generally accepted definitions of resilience and are drawn from the characteristics of persons who characterize resiliency (Wagnild & Young, 1993). Prior to further testing, the RS was reviewed by two psychometricians and two nurse researchers for wording of the items as they relate to resilience. Minor word changes were made, and the RS was pilot tested with 39 undergraduate nursing students for readability, specificity of directions, and reliability. The internal consistency reliability coefficient of the RS was 0.89 in this tested sample (Wagnild & Young, 1993). Additional studies have shown the reliability coefficient to be between 0.85-0.94 (Beauvais et al., 2014; Celik, 2013, Ergol, Singer, McIntyre, & Stefanov, 2014). According to Polit and Beck (2012), reliability coefficients greater than 0.80 are good and stable. Construct validity of the RS was also established as positive and significantly correlated to the theoretical definition of resilience defined in the original pilot study (Ahern, Kiehl, Sole, & Byers, 2006; Wagnild & Young, 1993).

In order to fully examine the psychometric properties of the RS, a study was conducted on a large randomly selected sample of 810 community dwelling older adults in the northwest region of the US. The data was analyzed with the Statistical Package for the Social Sciences (SPSS), version 3.0. Bivariate relationships were explored by correlational analyses and factor analyses were conducted to examine the internal consistency and validity of the RS (Wagnild & Young, 1993). Findings included a high reliability coefficient of 0.91 ($p < 0.0001$) and positive item-to-total correlations ranging

from .37-.75, with the majority of the items between .50-.70 using the standard to eliminate any items scoring less than .30 (Polit & Beck, 2012). The 25-item RS was analyzed using the Principal Component Analysis (PCA) factor analysis, followed by oblimin rotation and Kaiser normalization. The factor loadings of the 25 items in the RS ranged from .30-.76, with the majority of the items between .45-.70; and correlation between the factor scores and the total RS score was .99 ($p \leq .001$). Factor loadings are measures of the correlation between the individual variables and the overall factor, with loadings greater than .30-.40 showing some degree of relationship (Portney & Watkins, 2009).

emWave Pro®. The emWave Pro, designed and patented by the Institute of HeartMath (2015), is computer software program that collects pulse data through a pulse sensor that plugs into a computer (see Appendix I). The pulse sensor can be placed on the participant's earlobe or fingertip. The software then translates the information from the participant's heart rhythms into user-friendly graphics displayed on the computer monitor, which allows the researcher to watch in real time how thoughts and emotions are affecting the participant's heart rhythms (see Appendix I for example of computer monitor HRV reading). The emWave Pro is based on decades of research, incorporates patented HRV measurement, and is used by ten's of thousands of people in over 85 countries (Institute of HeartMath, 2015). The emWavePro has been validated as an effective tool in stress reduction in populations ranging from severe head injury patients (Kim et al., 2015) to graduate students (Climov, 2008).

emWave2® and Inner Balance®. The emWave2 and Inner Balance are the portable versions of the original desktop version of emWave, which is promoted through

the Institute of HeartMath (2016) (see Appendix J). The emWave2 and Inner Balance measure the participant's HRV through a noninvasive ear or fingertip probe and provide visual and audio feedback. The analysis of HRV is a noninvasive way of measuring the heart-brain interaction and autonomic nervous system subtleties, which are sensitive to changes in the participant's emotional state (Institute of HeartMath, 2016). The emWave2 is a stand-alone portable device, while the Inner Balance portable device is compatible with iPhones and requires the download of the Inner Balance app from the Apple App Store located on the iPhone (Apple Products, 2016). The Inner Balance app is supplied free with use of the Inner Balance product. The portable emWave2 and/or the Inner Balance have been validated as an effective tool to measure HRV and its relationship to stress in studies with physicians (Lemaire, Wallace, Lewin, De Grood, & Schaefer, 2011), Thai nursing students (Ratanasiripong, Ratanasiripong, & Kathalea, 2012), and college students (Ratanasiripong, Sverduk, Prince, & Hayashino, 2012). In this pilot study, the participants in the HRVB intervention group were trained on how to use the emWave2 and Inner Balance portable HRVB devices.

Data Analysis

Data analysis was performed using *The R Project for Statistical Computing* (R) version 3.2.3 (2015), with assistance from Mr. Chad Birger, Business Intelligence Analyst at Sanford Health Enterprise Data and Analytics. The significance or alpha level for all analyses was 0.05. After data cleaning, descriptive statistics including means, standard deviations and statistical distributions, were computed for the PSS, CSE, RS and the following demographic data: age, gender, marital status, number of children, race, and original baccalaureate degree. The Shapiro-Wilk test for normality was conducted on

the dependent variables to determine if inferential statistical methods could be used for data analysis.

Paired *t*-tests were used to measure the differences on the PSS within the HRVB intervention group, pre-test and post-test (H1). Independent two-sample paired *t*-tests were used to measure differences on the PSS post-tests scores between the HRVB intervention group and wait-list control group. Ad hoc repeated measures analysis of variance (ANOVA) were used to compare differences on the PSS between and within the HRVB intervention and control groups, pre-test and post-test, to test whether there was a significant difference (H4). Paired *t*-tests were used to measure the differences on the CSE within the HRVB intervention group, pre-test and post-test (H2). Independent two-sample paired *t*-tests were used to measure differences on the CSE post-tests scores between the HRVB intervention group and wait-list control group. Ad hoc repeated measures analysis of variance (ANOVA) were used to compare differences on the CSE between and within the HRVB intervention and control groups, pre-test and post-test, to test whether there was a significant difference (H5). Paired *t*-tests were used to measure the differences on the RS within the HRVB intervention group, pre-test and post-test (H3). Independent two-sample paired *t*-tests were used to measure differences on the RS post-tests scores between the HRVB intervention group and wait-list control group. Ad hoc repeated measures analysis of variance (ANOVA) were used to compare differences on the RS between and within the HRVB intervention and control groups, pre-test and post-test, to test whether there was a significant difference (H6). For exploratory Aims 7-9, multiple regression was used to determine possible relationships between the

demographic variables: age, gender, marital status, number of children, and race; and the results of the PSS, CSE and RS.

Missing data. Listwise deletion was used for any participant that failed to fill out the entirety of any of the pre-study or post-study surveys, thus deleting that participant's data from the data analysis. Two participants failed to fill out the post-test surveys, therefore their data was deleted from the data analysis for this pilot study. If individual data values were found to be missing from an instrument, maximum likelihood (MI) estimation would have been utilized to compute the value of that parameter that is most likely to have resulted in the data. This allows for an unbiased estimate without reducing the statistical power (Szalacha, 2012). However, no missing data points were found in the included pre- and post-tests used for data analysis. One participant incorrectly filled out the pre-test data surveys, and thus, this participant was excluded from the data analysis.

Chapter 4: Results

The purpose of this pilot study was to test the effectiveness of a Heart Rate Variability biofeedback (HRVB) intervention on ABN students' perceived stress (PSS), perceived coping ability (CSE), and resilience (RS) over four weeks during the fourth term of ABN coursework at a Midwestern nationally accredited college of nursing. This chapter describes the data collection, cleaning, analysis methods, and results for each research question.

This chapter is divided into two sections. Section one includes descriptive statistics to characterize the ABN participants and summarizes the instrument research data. Section two reports the results of the inferential statistical analyses used to test and analyze the research hypotheses. Data analyses reported in this chapter includes data obtained from the study participants at two points in time (before and after the HRVB intervention), which are four weeks apart (see Appendix A).

Survey data was manually entered into a Google Form database for each participant. After manual entry, data was double-checked by an independent statistician. The data was verified, de-identified, and loaded into data sets. All data was password protected, and data cleaning and analysis was completed in *The R Project for Statistical Computing* (R) version 3.2.3 (2015).

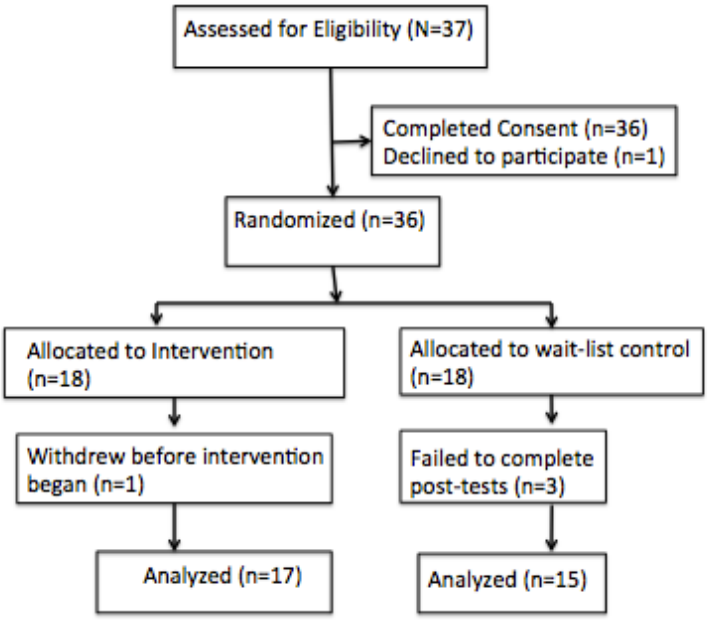
Sample Demographics

Demographic data of the study sample and the individual HRVB intervention and wait-list control groups are described in the following paragraphs.

Description of the sample. Accelerated baccalaureate nursing (ABN) students recruited for this pilot study were admitted to the 2015-2016 accelerated nursing cohort at

a nationally accredited nursing program located in the upper Midwestern region of the US in Term 4 of their ABN curriculum were recruited for this pilot study. They were in Term 4 of their ABN curriculum; cohort size was 37. This number is consistent with prior cohort sizes at this university (mean = 37 for past three cohorts) (J. Ledwell, personal communication, June 8, 2016). Thirty-six (97%) of the ABN students completed the required informed consent and demographic information sheet at the initial recruitment visit; all met the inclusion/exclusion criteria. Of these, one participant withdrew from the study before data collection began; one participant incorrectly filled out the pre-test forms and was excluded from the study; and two participants failed to complete the post-test forms. The latter were excluded from the data analysis due to listwise deletion. Thus, the sample size for this pilot study was 32, or 86% of the recruited ABN cohort. Of the 32 participants, 17 participants were in the HRVB intervention group and 15 participants were in the wait-list control group (see Figure 5).

Figure 5. *Recruitment Flow chart*



The mode age category of the study participants was 23-27 (range 19-41). Seventy-eight percent of the total sample of ABN students were female and 22% were male. The majority of the participant sample was single (69%), had no children (94%), and identified their race as White (97%). Additionally, 75% of the ABN students had previous Bachelors of Science degrees, compared to 25% of ABN students with Bachelor's of Arts degrees (see Table 1). Of the HRVB intervention group, three participants (18%) were on a prescribed medication that has been shown to possibly affect HRV (See table 2). None of the participants had been previously trained in HRVB.

Table 1. *Demographic Distribution of Total Sample and Tested Groups*

Total Sample Demographic distribution (N = 32)				HRVB Intervention Group (N =17)		Wait-List Control Group (N= 15)	
		n =	**%**	*n* =	%	*n* =	%
Gender	Male	7	22%	3	18%	4	27%
	Female	25	78%	14	82%	11	73%
Race	White	31	97%	17	100%	14	93%
	Other	1	3%	0	0%	1	7%
Age	18-22	2	6%	1	6%	1	7%
	23-27	24	75%	11	65%	13	86%
	28-32	4	13%	0	0%	0	0%
	33-36	1	3%	4	23%	1	7%
	37-41	1	3%	1	6%	0	0%
Marital Status	Single	22	69%	10	59%	12	80%
	Married	9	28%	6	35%	3	20%
	Partnered	0	0%	0	0%	0	0%
	Separated	1	3%	1	6%	0	0%
	Divorced	0	0%	0	0%	0	0%
	Widowed	0	0%	0	0%	0	0%
Number of Children	0	30	94%	15	88%	0	0%
	1-2	1	3%	1	6%	0	0%
	3+	1	3%	1	6%	0	0%
Original Baccalaureate Degree	BS	23	72%	10	59%	13	87%
	BA	8	25%	6	35%	2	13%
	Other	1	3%	1	6%	0	0%
TOTAL		**32**		**17**		**15**	

Table 2. *Medications Used by HRVB Intervention Group*

Class of Medication	***n*=**	**Possible effect on HRV**
Beta-Blocker	1	None or increased
SSRI	1	None or decreased
Anti-depressant (other than SSRI, SNRI, or Tricyclic)	1	None or decreased

Demographics by group. Table 1 also provides a demographic description of the participants by HRVB intervention group versus wait-list control group. The HRVB intervention group and wait-list control group were demographically similar in gender (female) and race (Caucasian). The HRVB intervention group was slightly older in age (29% >33 years old) than the wait-list control group (7% > 33 years old). The HRVB intervention group had a slightly higher percentage of married participants (35%) when compared to the wait-list control group (20%), and two of the HRVB intervention participants had children, while none of the wait-list group participants had children. Finally, a higher percentage of the wait-list control group had Bachelor's of Science degrees (87%) when compared to the HRVB intervention group's previous Bachelor's of Science degrees (59%) (see table 1).

Descriptive statistics on dependent variables. The dependent variables in this study included: perceived stress, as measured by the PSS; perceived coping ability, as measured by the CSE; and resilience, as measured by the RS. Means and standard deviations were calculated for each dependent variable pre- (T1) and post-intervention (T2) (see tables 3-5).

Table 3.
Descriptive Statistics: PSS (Total Possible Score: 56)

PSS	Group	*n*	Mean	Range	SD
	Intervention (T1)	17	21.882	18-27	2.891
	Intervention (T2)	17	20.000	17-22	1.802
	Control (T1)	15	22.866	17-27	2.531
	Control (T2)	15	22.533	17-28	3.113

Table 4.
Descriptive Statistics: CSE (Total Possible Score: 260)

CSE	Group	*n*	Mean	Range	SD
	Intervention (T1)	17	159.352	64-211	37.277
	Intervention (T2)	17	210.294	155-245	25.440
	Control (T1)	15	165.533	113-227	32.930
	Control (T2)	15	171.133	139-210	29.782

Table 5.
Descriptive Statistics: RS (Total Possible Score: 175)

RS	Group	*n*	Mean	Range	SD
	Intervention (T1)	17	138.765	120-158	12.813
	Intervention (T2)	17	153.235	123-173	13.155
	Control (T1)	15	134.067	94-171	18.371
	Control (T2)	15	140.867	127-169	11.855

Analysis

Prior to running statistical analyses, the Shapiro-Wilk test of normality was run on each dependent variable, pre- and post-test, to determine if sample data were normally distributed. The Shapiro-Wilk test of normality performs well with studies with smaller samples utilizing the 5% significance level (Ahmad & Sherwani, 2015). All but one dependent variable, the post-test PSS, were normally distributed. The post-test PSS was slightly skewed to the right, which can be expected with smaller samples sizes (Polit & Beck, 2012). According to the Shapiro-Wilk test of normality, all *p*-values must be greater than the chosen alpha level. In this pilot study the chosen alpha level is 0.05. Due to the majority of the data being normally distributed, parametric statistical analysis was feasible (see table 6).

Table 6.

Shapiro-Wilk Test of Normality on Survey Data

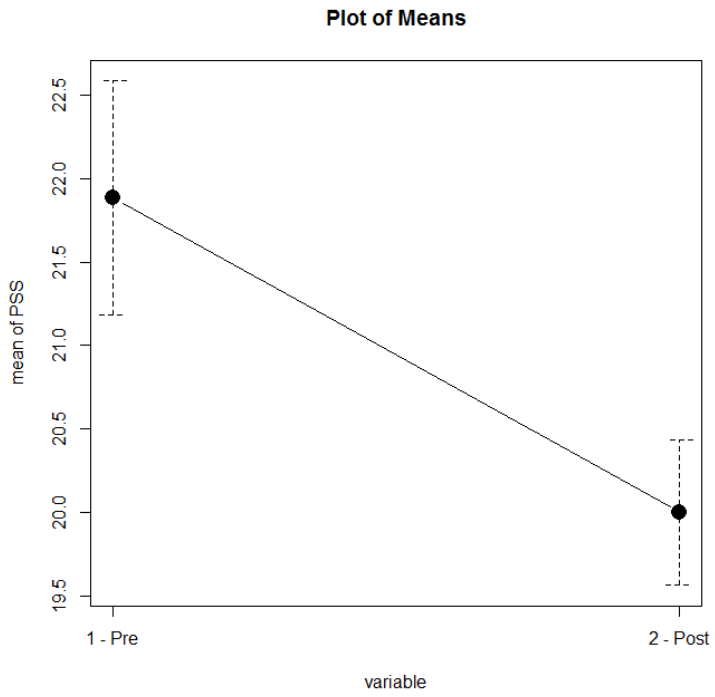
Test	W	*p*-value	Normally distributed?
Pre-test PSS	0.9724	0.5687	Yes
Post-test PSS	0.9163	0.0165	No/Right skewed
Pre-test CSE	0.9762	0.6867	Yes
Post-test CSE	0.9448	0.1026	Yes
Pre-test RS	0.9773	0.7196	Yes
Post-test RS	0.9705	0.5149	Yes

The guiding research question for this pilot study was: In accelerated baccalaureate nursing (ABN) students, what effect does the use of a heart rate variability biofeedback (HRVB) intervention have on perceived stress, perceived coping ability, and resilience? Each hypotheses and the statistical analysis of the data is presented below.

Hypothesis One (H1): ABN students who complete a four-week HRVB intervention will have decreased perceived stress.

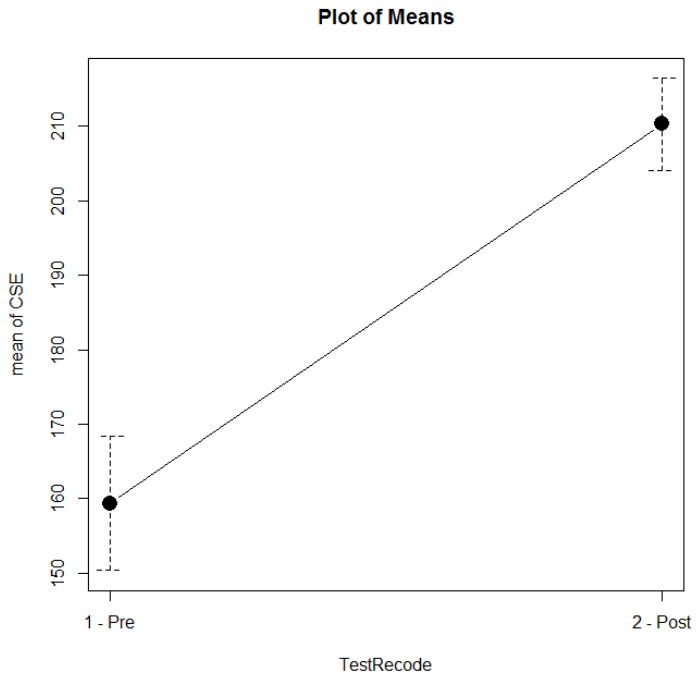
A one-tailed paired *t*-test was computed to determine if the dependent variable perceived stress, as measured by the PSS, was significantly decreased after a four-week HRVB intervention (Figure 6). Data analysis indicated a statistically significant decrease ($t = -2.3416$, df = 16, $p = 0.01623$) in perceived stress, thus the hypothesis (H1) was supported. As predicted, ABN students who participated in the four-week HRVB intervention in this pilot study had decreased perceived stress.

Figure 6: *One-Tailed Paired t-test PSS*



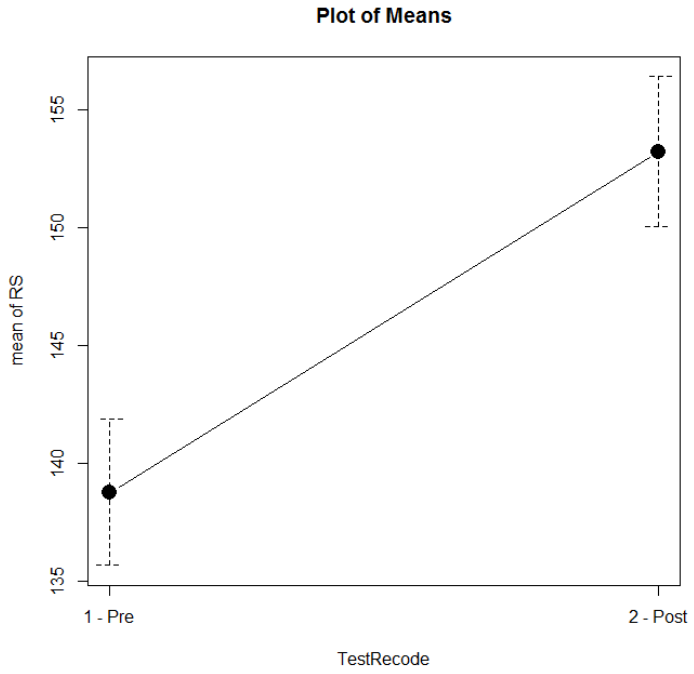
Hypothesis Two (H2): ABN students who complete a four-week HRVB intervention will have increased perceived coping ability. A one-tailed paired *t*-test was computed to determine if the perceived coping ability, as measured by the CSE, was significantly increased after a four-week HRVB intervention (Figure 7). Data analysis indicated a statistically significant increase ($t = 4.5762$, df = 16, $p = 0.00002$) in perceived coping ability, thus the hypothesis (H2) was supported. As predicted, ABN students who participated in the four-week HRVB intervention in this pilot study had increased perceived coping ability.

Figure 7: *One-Tailed Paired t-test CSE*



Hypothesis Three (H3): ABN students who complete a four-week HRVB intervention will have increased resilience. A one-tailed paired *t*-test was computed to determine if the dependent variable resilience as measured by the RS, was significantly increased after a four-week HRVB intervention (Figure 8). Data analysis indicated a statistically significant increase ($t = 3.9138$, df = 16, $p = 0.0006$) in resilience, thus the hypothesis (H3) was supported. As predicted, ABN students who participated in the four-week HRVB intervention in this pilot study demonstrated increased resilience.

Figure 8: *One-Tailed Paired t-test RS*

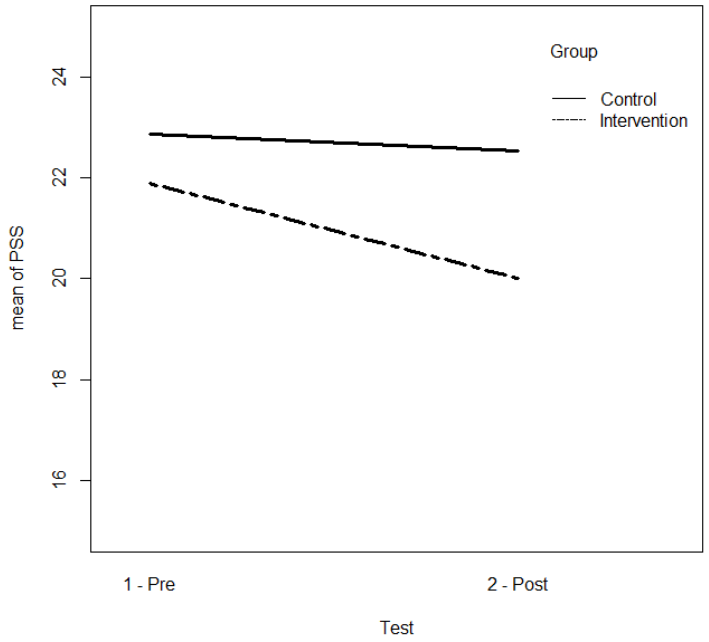


Hypothesis Four (H4): ABN students who participate in the HRVB intervention will have lower perceived stress posttest scores when compared to the ABN students in the wait-list control group. After performing Levene's Test for Homogeneity of Variance the population variances were found to be unequal ($p = 0.02635$) (Bryk & Raudenbush, 1988). An independent two sample t-test, using unequal variances, on the PSS post-test scores between the intervention and wait-list control group indicated statistical significance ($t = 2.8588$, df= 30, $p = 0.003832$). Thus, the hypothesis (H4) was supported. As predicted, ABN students who participated in the HRVB intervention had lower perceived stress posttest scores when compared to the ABN students in the wait-list control group.

Post hoc analysis. Post hoc analysis of repeated measures analysis of variance (ANOVA) was performed between and within groups to test for interaction. The overall

mean score of the PSS between the intervention and wait-list control group showed a significant decrease (F =6.583, p = 0.0155) from pre-test to post-post test. Within group analysis was also included as a part of repeated measures ANOVA indicated there was not a significant effect of the PSS pre- versus post-test (F =1.537, p = 0.2246) (see Figure 9).

Figure 9: *PSS Repeated Measures ANOVA*

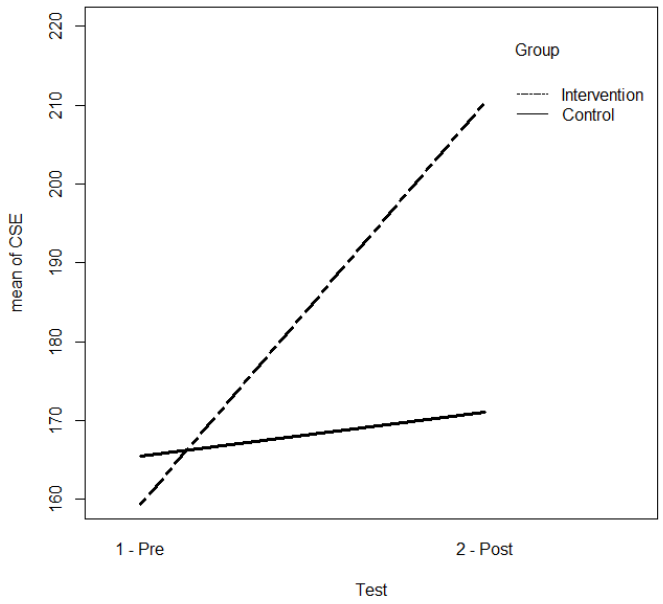


Hypothesis Five (H5): ABN students who participate in the HRVB intervention will have increased perceived coping ability posttest scores when compared to the ABN students in the wait-list control group. After performing Levene's Test for Homogeneity of Variance, the population variances were found to be equal (p = 0.6375) (Bryk & Raudenbush, 1988). An independent two-sample t-test, assuming equal population variances, on the CSE post-test scores between the intervention and wait-list control group indicated statistical significance (t = -4.012, df = 30, p = 0.0001846). Thus, the

hypothesis (H5) was supported. As predicted, ABN students who participated in the HRVB intervention had increased coping ability when compared to those in the wait-list control group.

Post hoc analysis. Post hoc analysis repeated measures analysis of variance (ANOVA) was performed between and within groups to test for interaction. The overall mean score of the CSE between the intervention and wait-list control group did not show a significant increase ($F = 3.174$, $p = 0.085$) from pre-test to post-test. Within group analysis was also included as part of repeated measures ANOVA indicated the interaction between test (CSE) and group was significant ($F = 12.78$, $p = 0.0121$) (see Figure 10). The significant interaction indicates that the groups are changing over time and are changing in different ways; meaning, in the graph the lines of the groups will not be parallel (IDRE, n.d.).

Figure 10: *CSE Repeated Measures ANOVA*

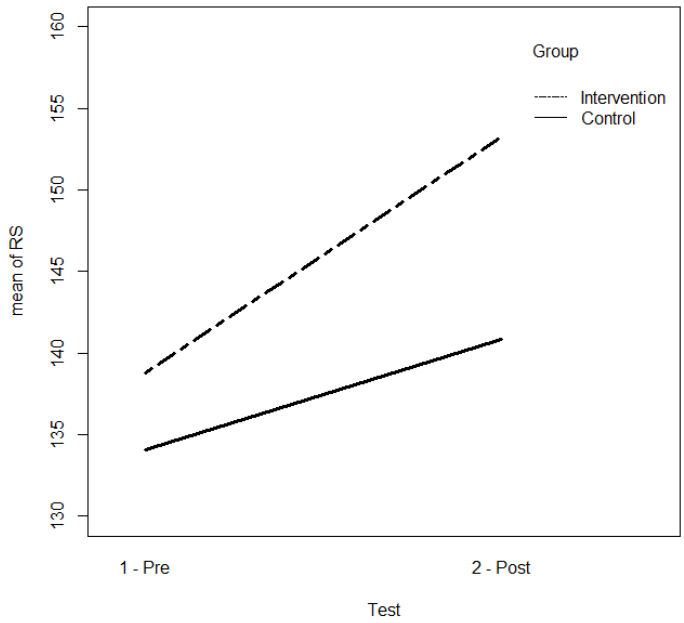


Hypothesis Six (H6): ABN students who participate in the HRVB intervention will have higher resilience posttest scores when compared to the ABN students in the wait-list control group. After performing Levene's Test for Homogeneity of Variance, the population variances were found to be equal ($p = 0.534$) (Bryk & Raudenbush, 1988). An independent two-sample t-test, assuming equal population variances, on the RS post-test scores between the intervention and wait-list control group indicated statistical significance ($t = -2.7787$, df = 30, $p = 0.004663$). Thus, the hypothesis (H6) was supported. As predicted, ABN students who participated in the HRVB intervention had higher resilience posttest scores when compared to the ABN students in the wait-list control group.

Post hoc analysis. Post hoc analysis repeated measures analysis of variance (ANOVA) was performed between and within groups to test for interaction. The overall mean score of the RS between the intervention and wait-list control group did not show a

significant decrease ($F = 4.061$, $p = 0.0529$) from pre-test to post-post test. Within group analysis was also included as part of repeated measures indicating there was not a significant effect of the RS pre- versus post-test ($F = 2.001$, $p = 0.1675$) (see Figure 11).

Figure 11: RS *Repeated Measures ANOVA*



Exploratory Aims

In order to determine a relationship and/or association between categorical, such as race or gender, and numerical data, such as the PSS score, a multiple regression model was utilized. A multiple regression model is used to look at a relationship and/or association between a dependent variable and demographic variables in order to develop a prediction based on the data analysis (Heavey, 2015). After coding each independent variable as a dummy variable (Munro, 2005), multiple regression was used for exploratory aims #7-#9.

Exploratory Aim #7: In ABN students who participate in the HRVB intervention, determine the associations/relationships, if any, between the demographic variables (age, gender, marital status, number of children, and race) and perceived stress. Due to all HRVB study participants identifying their race as White, no relationship/association could be calculated. After multiple regression was calculated for the other demographic variables as predictors, none of the demographic variables were shown to be significant predictors for change in perceived stress.

Overall, only approximately 7% of the variance is accounted for by the model (multiple R-squared = 0.07221), and the negative adjusted R-squared indicates the model is not helpful in predicting a response (Adjusted R-squared = -0.237). The *p*-value (0.9142) of the model indicates that overall these demographic variables, when combined, are not significant predictors of change in perceived stress (see table 7) (Pagano, 1994).

Table 7. *Multiple Regression Coefficients on Change in PSS in HRVB Intervention Group*

Demographic variable	Estimate	Standard Error	*t*-value	*p*-value
Gender	1.3586	2.7286	0.498	0.628
Marital Status	0.5782	1.6423	0.352	0.731
Age	0.1611	0.2541	0.634	0.538
Number of Children	-1.5242	1.6667	-0.915	0.378
Multiple R-squared: 0.07221		Adjusted R-squared: -0.237		*p*-value: 0.9142

Exploratory Aim #8: In ABN students who participate in the HRVB intervention, determine the associations/relationships, if any, between the demographic variables (age, gender, marital status, number of children, and race) and perceived coping ability. Due to all HRVB study participants identifying their race as White, no relationship/association could be calculated. After multiple regression was calculated for the other demographic

variables as predictors, only marital status was shown to be a significant predictor for change in perceived coping ability (see tables 8 and 9).

Overall, the model accounts for 21% of the variance (multiple R-squared = 0.4132), and adjusted R-squared indicates the model is not helpful in predicting a response (Adjusted R-squared = 0.2176). The *p*-value (0.1421) of the model indicates that overall these demographic variables, when combined, are not significant predictors of change in perceived coping ability. Marital status, on its own, however, may be a significant predictor in change in perceived coping ability (see table 8) (Pagano, 1994).

Table 8. *Multiple Regression Coefficients on Change in CSE in HRVB Intervention Group*

Demographic variable	Estimate	Standard Error	*t*-value	*p*-value
Gender	14.388	30.050	0.479	0.6407
Marital Status	51.025	18.087	2.821	0.0154*
Age	-1.296	2.798	-.463	0.6515
Number of Children	-18.675	18.355	-1.017	0.3290

Multiple R-squared: 0.4132 Adjusted R-squared: 0.2176 *p*-value: 0.1421

Table 9. *Mean change in CSE in HRVB Intervention Group*

Marital Status	*n*=	Mean Change in CSE
Married	6	50
Separated	1	177
Single	10	38.9

Exploratory Aim #9: In ABN students who participate in the HRVB intervention, determine the associations/relationships, if any, between the demographic variables (age, gender, marital status, number of children, and race) and resilience. Due to all HRVB study participants identifying their race as White, no relationship/association could be calculated. After multiple regression was calculated for the other demographic variables

as predictors, only marital status was shown to be a significant predictor for change in resilience (see tables 10 and 11).

Overall, the model accounts for 40% of the variance (multiple R-squared = 0.4132), and adjusted R-squared indicates the model is not helpful in predicting a response (Adjusted R-squared = 0.2017). The *p*-value (0.157) of the model indicates that overall these demographic variables, when combined, are not significant predictors of change in resilience. Marital status, on its own, however, may be a significant predictor in change in resilience (see table 10) (Pagano, 1994).

Table 10. *Multiple Regression Coefficients on Change in RS in HRVB Intervention Group*

Demographic variable	Estimate	Standard Error	*t*-value	*p*-value
Gender	-10.4716	10.815	-1.039	0.3194
Marital Status	13.6771	6.0680	2.254	0.0437*
Age	-0.9134	6.1581	-.973	0.3497
Number of Children	2.7840	6.1581	0.452	0.6593
Multiple R-squared: 0.4013		Adjusted R-squared: 0.2017		*p*-value: 0.157

Table 11. *Mean change in RS in HRVB Intervention Group*

Marital Status	*n*=	Mean Change in CSE
Married	6	19.16667
Separated	1	41
Single	10	9

Additional Analysis

Apart from the research questions, a secondary analysis was conducted on responses to “Do you have any questions or concerns regarding the HRVB technology device you are using?” Participants who replied to the question provided the following answers:

> *"It's going well. No problems with the technology. I'm still not quite sure what this all means, but it's very interesting and gives me a good time to relax," "I like it! I forget once in awhile," "I like this. It's very interesting. I had sick kids this past weekend, so I forgot a couple of times, but otherwise I'm enjoying it. I'm going to increase the difficulty of the skills this week and see how it goes"; "I like it! It works well"; "I'm anxious when I look at [the emWave2], so I try not to look at it as often. I do better when I just leave it in my pocket."; "HRVB is working really well! I'll admit, I did forget to do it a few days while running around to all the different clinicals but I definitely find myself practicing in the car or before exams!" and, "Everything is going well regarding my practice and the technology."*

Overall, the ABN participants expressed affirming statements regarding HRVB and the technology. Several participants conveyed the difficulty in remembering to use the HRVB devices, even with the provided reminder calendar. One participant described anxiety while using the HRVB device and preferred to practice without the technology.

Chapter 5: Conclusions

> *I will tell you about a time I noticed that having the [HRVB] skill made a difference. During [lab] check offs, I usually get really tense and can feel my heart rate go up. After using the [HRVB] equipment for about a week, I had a check off. When I first started I could feel myself tensing up, but I was able to focus, relax, and could feel myself be more centered. My heart wasn't racing and I honestly felt more confident. It was awesome!* (HRVB study participant, 2016)

The purpose of this quasi-experimental randomized controlled two-group pilot study was to test the effectiveness of a Heart Rate Variability Biofeedback (HRVB) intervention on ABN students' perceived stress, perceived coping ability, and resilience over four weeks during an academic term of ABN coursework at a nationally accredited Midwestern college of nursing.

Chapter 1 provided the necessary background and significance to support this study's research hypotheses focusing on HRVB, as an adaptive coping strategy, for ABN students. Chapter 2 provided a description of the theoretical framework guiding this study, as well as a detailed review of the relevant literature. The research methodology of this pilot study was discussed in Chapter 3, and the study results were presented in Chapter 4. The purpose of this chapter is to summarize and discuss the results of this pilot study in relation to the research hypotheses. Limitations are discussed, as well as implications and recommendations for further research in the area of HRVB as an effective adaptive coping strategy for ABN students.

Summary of the Results

Thirty-two students from a nationally accredited nursing program in the upper Midwest region of the U.S. in term four of their ABN curriculum were recruited and randomly assigned to one of two groups: the HRVB intervention group or the wait-list control group. All participants were given pre- and post-intervention surveys, including demographic information, the Perceived Stress Scale (PSS), the Coping Self-Efficacy Scale (CSE), and the Resilience Scale (RS). HRVB intervention group participants received HRVB training and the use of a personal HRVB device from the Primary Investigator. The HRVB intervention group had 17 participants, while the wait-list control group had 15 participants (N=32).

There were no significant demographic differences between the HRVB intervention group and the wait-list control group. The majority of the sample was female, single, had no children, and identified their race as White. The HRVB intervention group was slightly older in age and had more married participants than the wait-list control group. The nursing cohort represented in this pilot study is reflective of the general demographics of nursing students in the upper Midwestern region of the U.S. (SD BON, 2014).

The Shapiro-Wilk test of Normality indicated the majority of the pre- and post-survey data were normally distributed, which allowed for parametric statistical analysis. The significance (alpha) level for all data analysis was set at 0.05. The means of the pre-tests of all three instruments (PSS, CSE, and RS) were similar for both groups. When comparing pretest to post test scores, the overall mean of the PSS decreased by approximately 3% in the HRVB group, compared to 2% in the wait-list control group; the

overall mean of the CSE increased by approximately 19% in the HRVB intervention group compared to an approximate 3% increase in the wait-list control group; and the overall mean of the RS in the HRVB intervention group increased by approximately 8% compared to 3% in the wait-list control group.

In the HRVB intervention group, one-tailed paired *t*-tests were conducted on all three instruments pre- and post- the HRVB intervention to determine statistical significance of the intervention. After the four-week HRVB intervention, perceived stress significantly decreased, and perceived coping and resilience significantly increased.

Independent two-sample *t*-tests on post-test scores indicated participants in the HRVB intervention group, when compared to those in the wait-list control group, had: statistically significant lower perceived stress; statistically significant increased coping ability; and statistically significant increased resilience. Ad hoc analysis utilizing repeated measures ANOVA comparing the overall mean scores pretest to post test between the HRVB intervention group and wait list control group indicated: significant decrease in PSS; non-significant increase in CSE; and non-significant increase in RS. Repeated measures ANOVA within groups indicated: non-significant effect of the PSS pre- versus post-test; the interaction between the CSE and the group was significant; and non-significant effect of the RS pre- versus post-test.

In the exploratory aims, multiple regression was used to determine if a relationship existed between demographic variables and scores on the instruments in the HRVB intervention group. None of the demographic variables were shown to be significant predictors of perceived stress; however, marital status was shown to be a significant predictor of perceived coping ability and resilience.

Secondary analysis, based on participant's verbal answers to an open-ended question regarding the HRVB intervention, indicated that overall participants had positive experiences related to the HRVB intervention technology and the implementation of HRVB techniques. Several participants described some ambiguity in the reasoning behind using HRVB, as well as forgetting to use the technology on a daily basis.

Discussion of the Results

The results of this quasi-experimental pilot study provided important data regarding the effects of a four-week HRVB intervention on perceived stress, perceived coping ability, and resilience in ABN students, and helps fill the gap in the literature surrounding ABN students and adaptive coping strategies. The data analysis indicated significant decrease in perceived stress, and significant increases in coping ability and resilience in those participants utilizing HRVB. The results are consistent with the two studies guiding this pilot study in the areas of decreased stress when utilizing HRVB (Lemaire, Wallace, Lewin, De Grood, & Schaefer, 2011; Ratanasiripong, Ratanasiripong, & Kathalea, 2012), yet this study added to the literature by including measurements of coping ability and resilience.

HRVB and its effects on resilience have been measured in one reported pilot study with oncology nurses and nurse leaders (Pipe et al., 2012), although the instrument, the POQA-R (Personal and Organizational Quality Assessment-Revised) was an indirect measure of resilience. However, results indicated an increase in resilience-building factors after the HRVB intervention (Pipe et al., 2012). Utilizing the RS in this

dissertation pilot study allowed for direct measurement of resilience, thus adding to the limited published literature on resilience in nursing students.

Implications and Recommendations for Further Research

The results from this pilot study using HRVB with ABN students in the U.S. is the first study that can be found in the published literature. The implications of the findings of this study include replication with a larger, more diverse sample of ABN students to improve generalization of the study's findings. The use of multi-site samples would help decrease cross-contamination of the study's findings and more clearly demonstrate the effects of HRVB on perceived stress, perceived coping ability, and resilience of ABN students. The use of an attention-control group, an intervention that mimics the theoretically inactive elements (Popp & Schneider, 2015), versus a wait-list control group, could increase the reliability of the results (Melnyk & Morrison-Beedy, 2012), in order to rule out time and attention effects as possible confounders of changes in perceived stress, perceived coping ability, and/or resilience.

Longitudinal designs should be implemented to determine the impact of HRVB training on perceived stress, coping ability, and resilience of ABN students one to two years post graduation in order to better understand the long-term efficacy of the HRVB intervention. Longevity studies on HRVB training as an adaptive coping strategy in nursing programs could help bridge the gap between education and practice as one tool to increase retention of BSN-prepared nurses in the healthcare setting (Wolf, Stidham, & Ross, 2015).

Regarding the HRVB intervention, future studies incorporating longer, more intensive education on HRV, HRVB, as well as technology devices outside of those used

by HeartMath, would lend greater credibility to HRVB as a stress-reducing, resilience-building adaptive coping strategy. Due to the compressed time frame of the ABN curriculum, a two-hour training session was chosen for this pilot study. However, several of the ABN participants expressed confusion and/or the desire to have more knowledge regarding the HRVB techniques (see Additional Analysis in Chapter 4). It is highly recommended to have at least a four-hour HRVB training to allow adequate time for teaching and participant questions (Institute of HeartMath, 2014).

The PI for this pilot study was trained in HeartMath HRVB methods only, yet there are other HRVB training methodologies available, such as the HRVB certification by the BCAI (Biofeedback Certification International Alliance, 2016). Incorporating multiple HRVB methodologies and technology could increase the authority of HRVB as a stress-reducing, resilience-building intervention, as HRVB and its associated affordable user-friendly technology is still a relatively new method of biofeedback research (Ratanasiripong, Sverduk, Prince, & Hayashino, 2012).

As the current literature continues to report traditional BSN-prepared students are experiencing stress levels similar to that of ABN students (Wolf, Stidham, & Ross, 2015), future studies could expand to educate all BSN-prepared students on HRVB intervention. The implementation of the HRVB intervention across nursing program types has increased implications to reduce attrition rates in nursing schools, as well as increased nurse retention as the BSN-graduates begin their nursing careers. The implementation of HRVB in other career fields has been reported to decrease employee stress and increase retention (Rosch, 2008).

Finally, due to the results of exploratory aims 8 and 9 indicating marital status as a possible predictor of increased coping ability and resilience, future studies in this area could help delineate the effects of marital status on these variables, among others. Does simply being married in ABN school increase one's resilience and ability to cope? Or are there other variables influencing coping and resilience in married ABN participants? What about non-married ABN students? What other interventions may be available for single/separated/divorced ABN students to increase baseline coping and resilience? These are potential future study questions that should be explored.

Lazurus and Folkman's TTSC (1984) provides the foundation for the concepts in this pilot study. ABN students are experiencing stress, as described by Lazurus and Folkman (1984), as a transaction between themselves and their ABN educational environment. The ABN students are going through a complex process of appraisals, coping responses, and possibly, reappraisals, within their ABN experience. This pilot study measured perceived stress, coping, and resilience of the ABN student while they experienced a stressor—the ABN program, Term four. HRVB is introduced in this study as an adaptive coping strategy to help mediate appraised threats as the ABN student attempts to successfully cope with the stressor of the ABN program.

While the focus of this pilot study was to provide a new adaptive coping strategy, HRVB, to ABN students, the exploratory research aims highlighted another coping strategy that may be affecting ABN students and their ability to cope: marital status. According to Lazarus and Folkman (1984), social resources are another coping strategy that an individual may use if this is an available resource to him or her. The area of

marital status, i.e. social support, is, as noted earlier, an area of needed future study for ABN students.

Limitations

The primary limitation to this study was the sample size, which decreased the power of the study. The sample size of 32 was less than the desired 52 (or 26 per group) to fully power the study. A larger sample size would increase the likelihood of detecting the effects of the HRVB intervention. Another limiting factor was that the demographic homogeneity of the sample: 97% identified themselves as White; 78% were female; 94% had no children; 69% were single; and 75% were in the age range of 23-27 years old. This homogeneity limits generalizability of the study findings to more diverse student cohorts. The use of a larger university and/or multiple sites may have produced a larger, more diverse sample.

The sample was limited to ABN students enrolled in one cohort in one university in the Midwestern U.S. The choice of a convenience sampling methodology for this study, as well as the inability to truly randomize the participants, limits the generalizability of study findings to populations similar to ABN students in the Midwest. Additionally, the participants in this study may have entered the ABN nursing program with stressors due to factors outside of the ABN program itself, as it is well documented that ABN students have more stress than their traditional-BSN peers (Cangelosi & Moss, 2010; Hegge & Larson, 2008; Rouse & Rooda, 2010).

Since the survey data was self-reported, results depended on the effort and honesty of each participant. The participants in the HRVB intervention group had to self-initiate the daily use of their HRVB technology. The reliability of the study's findings is

dependent on the HRVB intervention participants' consistent use of HRVB and its associated technology device. The HRVB intervention participants were not mandated to use HRVB daily, but only encouraged to do so by providing a simple reminder calendar. Additionally, using the study's HRVB technology and techniques takes time, which is already limited in the lives of ABN students in a condensed curriculum. The feasibility pilot study conducted by the PI (Harmelink, 2015) highlighted the ABN students' desire to utilize the HRVB intervention during Term 4, as was used in this study. Due to statistically significant results in the data analysis, the dose and timing of the HRVB intervention seems appropriate for ABN students.

The same surveys were given at the beginning and the end of the study; so repeated testing may lead to familiarity and/or pre-test sensitization of the surveys by the participants. The study participants also gained knowledge as to what the PI may be expecting for results, which may have influenced participants' answers on the post-surveys. This is known as the Hawthorne effect; a placebo-type effect caused by participants' expectations in a study (Polit & Beck, 2012).

A potential limitation was the length of the study. HRVB interventional studies have a wide range of suggested time frames for desired results; varying from a one-time session to eight-week sessions or longer. This pilot study procedure was informed by two HRVB interventional studies: 1) a study on 60 baccalaureate nursing students attending one nursing program in Thailand (Ratanasiripong, Ratanasiripong, & Kathalea, 2012); and 2) study on 40 staff physicians in Canada (Lemaire, Wallace, Lewin, De Grood, & Schaefer, 2011), both which successfully utilized a four-week HRVB intervention time period. However, there is the possibility of natural maturation of the ABN students as

they progressed through the four-weeks of their ABN coursework, which may limit internal validity of this study.

Finally, interaction between the HRVB participants and the wait-list control participants was possible due to both groups attending classes and clinical settings together. Although the PI asked the intervention group to not discuss the HRVB techniques with the wait-list control group, potential cross-contamination may still have affected the study results.

Conclusions

Despite the stressors and demands of the ABN curriculum, findings from this interventional pilot study support the use of HRVB as an adaptive coping strategy that can assist ABN students in managing stress and increasing resilience. When ABN nursing students can learn to mange their stress and increase resilience while in nursing school, the more likely they will graduate and be successful, resilient, members of the nursing profession. During this era of a nursing shortage, the results of this pilot study indicate that HRVB is an effective and efficacious tool to potentially help retain BSN-prepared nurses in the healthcare settings, where they are so desperately needed.

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clinical practice. *International Journal of Nursing Practice, 21,* 401-409. doi:10.1111/ijn.12273

Appendix A: Study Timeline

Recruitment Emails sent: 4/4/16 and 4/7/16

Study visits

Study Activity	Enrollment (Pre-Test)	*HRVB Group Training	HRVB emWavePro with PI	HRVB Personal Practice	Conclusion (Post-Test)
Date(s)	4/8/16	4/14/16	4/21/16	4/22/16-5/16/16	5/17/16
Informed Consent	C/I				
Demographic Information	C/I				
PSS, CSE, & RS	C/I				C/I
HeartMath HRV Biofeedback		I	I^	I^	

C= Control Group (wait-list); I= Intervention Group

^Weekly check-ins (via email, phone, or in-person) made with each participant regarding use of the HRVB technology.
**** Included training on emWave2 and Inner Balance portable HRVB devices***

Appendix B: Participant Consent Form

Participant Consent Form
Participation in a Research Project
South Dakota State University
Brookings, SD 57007

Department of Graduate Nursing

Project Director: Andrea Harmelink, PhD Student Phone No. 605-310-2322

E-mail: andrea.harmelink@jacks.sdstate.edu Date: April 8, 2016

Please read (listen to) the following information:

1. This is an invitation for you as an accelerated baccalaureate-nursing student to participate in a research project under the direction of Andrea Harmelink, PhD Student.
2. The project is entitled *Pilot Study of the Effects of Heart Rate Variability Biofeedback on Perceived Stress, Perceived Coping Ability, and Resilience in Accelerated Baccalaureate Nursing Students.*
3. The purpose of the project is to test the effectiveness of Heart Rate Variability biofeedback (HRVB) on Accelerated Baccalaureate Nursing (ABN) students' perceived stress, perceived coping ability, and resilience over four weeks during an academic term of ABN coursework.
4. If you consent to participate, you will be involved in the following process which will take about 1 hour to 10 hours of your time, depending on if you are randomly chosen for the HRVB intervention group (9-10 hours) or the wait-list control group (1 hour). The study will take place at a classroom at the SDSU Sioux Falls Campus on days you are already on campus for classes. If you consent to participate, you will be involved in the following process, which will occur in two to three sessions (depending on which group you are assigned in the study):

    1) The Principal Investigator (PI) will come to one of your SDSU ABN classroom times at the Sioux Falls, SD location, and you will fill out the following demographic items: age, gender, marital/relationship/family status, race, original baccalaureate degree, and current medications list. Participants who are currently trained in Heart Rate Variability Biofeedback will not be able to participate in this study.

    2) Participants who meet the inclusion/exclusion criteria will be asked to participate in the study, and current contact information will be gathered (email and phone number). The eligible participants will be divided into two groups: the Heart Rate Variability biofeedback (HRVB) intervention group and the wait-list control group. The wait-list control group will be offered the HRVB training and intervention after the HRVB intervention group completes their portion of the study.

    3) All eligible participants will meet with the PI at a classroom at the SDSU nursing program, Sioux Falls campus, to sign the consent, fill out the Perceived Stress Survey (PSS-10), the Coping Self-Efficacy Scale (CES), and

the Resilience Scale (RS) (Group Session One). The following week, those in the HRVB intervention group will attend a 2.5-hour training on Resilience building, which includes learning how to use the portable HRV emWave2 or Inner Balance device. The HRVB intervention participants will be given instructions on how to incorporate HRVB techniques on a daily basis for following four weeks (Training Session). The PI will come to campus during week two of the HRVB Intervention timeframe and meet with each participant in the HRVB group for HRVB practice on the PI's emWavePro HRVB computer program. The PI will also contact each participant in the HRVB group on a weekly basis for all four weeks, via email, phone, or in-person, to discuss any questions or concerns with the HRVB techniques or technology.

4) Four weeks after Session One, the PI will meet with all participants, again at a classroom at the SDSU ABN Sioux Falls, SD campus. At this meeting, each participant will again fill out the PSS-10, CSE, and RS. Compensation will be given at this time (Group Session Two). Participants in the HRVB intervention group will return the emWave2 or Inner Balance portable HRVB devices at this time.

5. Participation in this project is voluntary and will not affect your grades in your SDSU nursing courses. You have the right to withdraw at any time without penalty. If you have any questions, you may contact the project director at the number listed above.

6. There are no known risks to your participation in the study. If you have ongoing anxiety or health issues after or during the study, you may contact SDSU Counseling Services at 605.688.6146.

7. The benefits to you may include decreased perceived stress, increased coping ability, and increased resilience.

8. There is compensation for your participation in this study. All participants, whether in the HRVB intervention group or the wait-list control group, will receive a free week of classes at Form Fitness Studio, 2210 West 69th St. Suite 150, Sioux Falls, SD, 57108, as well as be entered in drawings for the following: $75 VISA gift card and $75 Form Fitness gift card (the same participant cannot win both gift cards). In order to receive the compensation, you must: Complete the pre and post-HRVB intervention sessions of the above-described study.

9. Your responses are strictly confidential. When the data and analysis are presented, you will not be linked to the data by your name, title or any other identifying item.

As a research participant, I have read the above, have had any questions answered, and agree to participate in the research project. I will receive a copy of this form for my information.

Participant's Signature _____ Date _____

Project Director's Signature _____ Date _____

If you have any questions regarding this study you may contact the Project Director. If you have questions regarding your rights as a participant, you can contact the SDSU Research Compliance Coordinator at (605) 688-6975 or SDSU.IRB@sdstate.edu.

This project has been approved by the SDSU Institutional Review Board, Approval No.: IRB-1604002-EXP

Appendix C: Human Subjects Approval Request

South Dakota State University

_____Exempt __X__Expedited Review _____Committee Review

1. Principal investigator __Andrea Harmelink_____ Phone No. __605-310-2322_____

E-mail address of principal investigator _andrea.harmelink@jacks.sdstate.edu_____

____Faculty __X__Graduate Student ____Undergraduate Student ____Not SDSU Researcher

If student, faculty advisor __Mary Minton, PhD, RN, CNS_____

College/School _Nursing_____ Department ___Graduate Nursing_____

(Please use an additional sheet to list names and contact information for others involved with the project).

2. Project title: Effects of Heart Rate Variability Biofeedback on Perceived Stress, Perceived Coping Ability, and Resilience in Accelerated Baccalaureate Nursing Students___

3. Sponsoring agency _N/A_____

4. Project Period (contact with participants): From __03___/__30__/__2016_ To ___5___/__30__/__2016_

5. Location of study __SDSU_____

6. Number of human participants to be selected ____20-50 participants_____

7. Types of participants to be selected:

_X_Normal Adults ___Pregnant Women ___Prisoners

___Minors ___Fetuses ___Mentally Disabled or Delayed

8. Exemption from Committee Review Requested? ___X___ Yes _____ No

If "yes", indicate basis for exemption:

_X__Common Educational Setting ___Educational Tests ___Study of Existing Data

___Survey/Interview Research ___Observational Research

(The above do not automatically make a project exempt; it may require expedited or full committee review.)

9. Will any drugs, chemical or biological agents be administered to human subjects?

___ Yes __X__ No *If Yes, include documentation regarding safety from a source other than the manufacturer in METHODS.*

10. Will specimens or samples of tissues, body fluids, or other substances be collected from participants?

____ Yes _X_ No *If Yes, include details of collection, storage, labeling, use, and disposal in METHODS.*

11. Has each investigator involved in the study completed the CITI on-line training and filed a copy of the certificate with

Carolyn Curley in the Office of Research and Sponsored Programs? __X_ Yes ____ No

12. ***Research Protocol:*** Complete a description of the proposed study following instructions.

13. ***Informed Consent:*** Attach copies of all forms which will be used to obtain the legally effective informed consent of human subjects or their legal representatives, or justification why informed consent should be altered or waived.

14. ***Additional Materials:*** Attach a copy of all surveys, recruitment materials, and any other relevant documents.

Authorized Signatures:

Principal Investigator __*Andrea J. Harmelink*_____ Date _____3/29/16_____

I ____ do __X__ do not wish to appear before the committee

Advisor (if student project)_____Date _____

Department Head or Dean _____ Date _____

Research Protocol

A. Objectives: The purpose of this dissertation study is to test the effectiveness of Heart Rate Variability biofeedback (HRVB) on Accelerated Baccalaureate Nursing (ABN) students' perceived stress, perceived coping ability, and resilience over four weeks during an academic term of ABN coursework. The study aims are:

1. Determine what effect, if any, a HRVB intervention has on ABN students' perceived stress over four weeks during an academic term of ABN coursework.

2. Determine what effect, if any, a HRVB intervention has on ABN students' perceived coping ability over four weeks during an academic term of ABN coursework.

3**.** Determine what effect, if any, a HRVB intervention has on ABN students' resilience over four weeks during an academic term of ABN coursework.

4. Determine the difference, if any, in perceived stress scores between ABN students who participate in the HRVB intervention compared to those in the wait-list control group.

5. Determine the difference, if any, in perceived coping ability scores between ABN students who participate in the HRVB intervention compared to those in the wait-list control group.

6. Determine the difference, if any, in resilience scores between ABN students who participate in the HRVB intervention compared to those in the wait-list control group.

7 (Exploratory): In ABN students who participate in the HRVB intervention, determine the associations/relationships, if any, between the demographic variables (age, gender, marital status, number of children, and race) and perceived stress.

8 (Exploratory): In ABN students who participate in the HRVB intervention, determine the associations/relationships, if any, between the demographic variables (age, gender, marital status, number of children, and race) and perceived coping ability.

9 (Exploratory): In ABN students who participate in the HRVB intervention, determine the associations/relationships, if any, between the demographic variables (age, gender, marital status, number of children, and race) and resilience.

B**. Participants:** The chosen study population is accelerated baccalaureate nursing (ABN) students admitted to the 2015-2016 accelerated nursing cohort at SDSU's College of Nursing: Sioux Falls, South Dakota in Term Four (participant sample range of 20-50 ABN students). Eligible participants must be: full-time students currently enrolled in the SDSU ABN program, Sioux Falls, SD location; male or female; at least 18 years of age; and able to read, write, and understand English. Participants must not be under a current medically supervised treatment for depression or anxiety during the time of the study. Participants trained in HRVB will be excluded from this study.

C. **Time Required for Individual Participants:** All eligible participants will meet with the PI for a formal recruitment visit at a classroom at the SDSU Sioux Falls campus in the nursing department to sign the consent, fill out the Perceived Stress Survey (PSS-10), the Coping Self-Efficacy Scale (CSE), and the Resilience Scale (RS): **20-30 minutes**. After the pre-study forms are complete, the participants will be randomly assigned to either the HRVB intervention group or the control group by simple random sampling technique. The participants randomly assigned to the HRVB intervention group will receive a **2.5-hour** group training session one week after the recruitment visit. Each participant will be instructed to practice the learned HeartMath HRVB training methods with the portable HRVB device (either the emWave2 or Inner Balance) for five minutes at least three times daily for the remainder of the four-week study **(approximately 7 hours total)**. During week two of the study, the PI will return to the ABN campus and meet individually with each HRVB participant to practice the learned heart-rhythm patterns on the PI's emWavePro. Each individual session will last approximately **10 minutes.** At the conclusion of the four-week study, all participants will meet to fill out the post-study surveys (PSS-10, CSE, and RS): **20-30 minutes.**

D. **Compensation to Participants:** All participants, whether in the HRV biofeedback intervention group or the wait-list control group, will receive a free week of classes at Form Fitness Studio, 2210 West 69th St. Suite 150, Sioux Falls, SD, 57108, as well as be entered in drawings for the following: $75 VISA gift card and $75 Form Fitness gift card (the same participant cannot win both gift cards). In order to receive the compensation, you must: Complete the pre and post-HRVB intervention sessions of the above-described study.

E. **Benefits to Participants:** The participant may experience decreased perceived stress, increased coping ability, and increased resilience.

F. **Methods:** All eligible participants will meet with the PI for a formal recruitment visit at a classroom at the SDSU Sioux Falls campus in the nursing department to sign the consent, fill out the Perceived Stress Survey (PSS-10), the Coping Self-Efficacy Scale (CSE), and the Resilience Scale (RS). After the pre-study forms are complete, the participants will be randomly assigned to either the HRVB intervention group or the control group by simple random sampling technique. The PI will be inform each participant via email

within two business days after the recruitment visit regarding which group they were randomly assigned to. The participants randomly assigned to the HRVB intervention group will receive a 2.5-hour group training session one week after the recruitment visit. The training session will occur on the campus where the ABN students attend classes. The PI will lead the HRVB training and provide snacks for the participants. The HRVB intervention group will be instructed on how to use the HeartMath HRVB techniques, as well as the emWave2 and Inner Balance portable HRV biofeedback devices. Participants with an acceptable iPhone device will be given the Inner Balance for the remainder of the study, while those without iPhone devices will be given emWave2 devices. The emWave2 and Inner Balance measure the participant's HRV and provides visual and auditory feedback needed to learn to control the HRV. Each HRVB intervention group participant will receive a handbook with detailed information on how to most fully utilize HeartMath HRVB techniques. Each participant will be instructed to practice the learned HeartMath HRVB training methods with the portable HRVB device (either the emWave2 or Inner Balance) for five minutes at least three times daily for the remainder of the four-week study. The participants will be instructed how to record their practice time into a printed calendar provided to each participate at the initial training session. During week two of the study, the PI will return to the ABN campus and meet individually with each HRVB participant to practice the learned heart-rhythm patterns on the PI's emWavePro. The HRVB intervention participants will receive an email reminder from the PI two days before the PI is on campus regarding the emWavePro practice session. There will be a sign-up sheet in the ABN nursing program's main office for students to sign up for specific times for their individual emWavePro session. Each individual session will last approximately 10 minutes. The participants in the HeartMath HRVB intervention group may contact the PI at any time during the four-week study to meet for additional individual sessions to view their heart-rhythms on the emWavePro. The participants in the wait-list control group will not receive any training on HeartMath techniques or the portable HRVB devices during this time. At the conclusion of the four-week study, all participants will meet to fill out the post-study surveys (PSS-10, CSE, and RS). At this point the study, participants who have completed all the required sessions will receive compensation. The HRVB intervention group will return the emWave2 or Inner Balance portable device to the PI. The wait-list control group will be offered information on future HRVB training available to them free of charge.

G. **Risks to Participants:** Participation in this study is voluntary and poses minimal risk to participants. Study participants may recall stressful life situations when completing the PSS-10, CSE, or RS.

H. **Risk Reduction:** No risk reduction steps are required. If participants have ongoing anxiety or health issues after or during the study, the participants may contact SDSU Counseling Services at 605.688.6146.

I. **Confidentialit**y: Participants' confidentiality will be ensured. Survey and HRV data will be uploaded and stored on the PI's laptop computer that is password protected. After completion of the post-intervention meeting with the PI, the participant's names will be de-identified by assignment of numbers to each participant. The PI will keep the final de-identified data, and individual participants will not be identified in any study reports.

J. **Recruitment:** Consent to invite SDSU ABN students for participation has been obtained from the

SDSU College of Nursing, Nursing Research Committee. SDSU nursing students' names, addresses, and jacks email addresses will be obtained through the undergraduate nursing office via Professor Raether, the undergraduate Term Four Coordinator for the SDSU Sioux Falls Campus. After the PI receives approval from nursing university's IRB, potential participants for this study will be given the opportunity to participate in this study at one of their pre-scheduled course dates during their fourth term in their ABN program. Since the PI does not have access to the students' contact information as part of the Family Educational Rights and Privacy Act (FERPA) (U.S. Department of Education, 2015), recruitment emails will be sent to all students in the 2015-2016 ABN cohort via Professor Raether, the undergraduate Term Four Coordinator for the SDSU Sioux Falls Campus. The recruitment emails will briefly describe the study, the exclusion criteria, as well as compensation if they participate and complete the study requirements. The exclusion criteria are listed to inform potential participants the reasons they would not qualify for this study so that they would not attend the PI's recruitment visit, thus further protecting their privacy. The emails will be sent one week and two days prior to the PI's official recruitment visit to the 2015-2016 ABN SDSU Accelerated nursing cohort.

Appendix D: Approval Letter

South Dakota State University

Office of Research/Human Subjects Committee
SAD Room 200
Box 2201 SDSU
Brookings, SD 57007

To: Andrea Harmelink, College of Nursing

Date: April 5, 2016

Project Title: Pilot Study of the Effects of Heart Rate Variability Biofeedback on Perceived Stress, Perceived Coping Ability, and Resilience in Accelerated Baccalaureate Nursing Students

Approval #: IRB-1604002-EXP

The committee approved your project using expedited procedures as described in 45 CFR 46.110. The research activity was deemed to be no greater than minimal risk, and the following expedited categories from 63 FR 60364-60367 were found to be applicable to your activity:

(4) Collection of data through noninvasive procedures; and
(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

One-year approval of your project will be dated starting 4/5/16. If you require additional time to complete your project, please submit a request for extension before 4/4/17. Protocol changes must be approved by the Committee prior to implementation. Forms may be found on the Human Subjects web page. If there are any unanticipated problems involving risks to subjects or others, please contact the SDSU Research Compliance Coordinator. At the end of the project please inform the committee that your project is complete.

Sincerely,

Norm

Norman O. Braaten
SDSU Research Compliance Coordinator

Appendix E: Demographic Form

Pilot Study of the Effects of Heart Rate Variability Biofeedback on Perceived Stress, Perceived Coping Ability, and Resilience in Accelerated Baccalaureate Nursing Students

Demographic Data Form

Name_____ Date _____

Preferred email_____

Cell Phone # _____Ok to text? ____Yes ____No

1. Age: ____18-22
   ____23-27
   ____28-32
   ____33-36
   ____37-41
   ____42-26
   ____47-51
   ____52+

2. Gender: _____Male
   _____Female

3. Marital Status:
   _____ Single
   _____ Married
   _____ Partnered
   _____Separated
   _____Divorced
   _____Widowed

4. Number of children: ____0
   ____1-2
   ____3+

5. Race: _____ African Indian or Alaskan Native
   _____ Asian or Pacific Islander
   _____ Black
   _____ White
   _____ Other

6. Original Baccalaureate Degree:
   Bachelor of Arts in _____
   Bachelor of Science in _____
   Other _____
7. Please list all the current medications you take: (if none, write "None")
   _____ _____
   _____ _____

_____ _____
_____ _____
_____ _____

13. Do you own a “smartphone”?
___Yes ___No

If Yes; What brand and type? (i.e. iPhone 6)_____

Thank you for filling out the Demographic Data Form.

Appendix F: Perceived Stress Scale (PSS-10) with Scoring

The following questions ask about your feelings and thoughts during THE PAST MONTH. In each question, you will be asked HOW OFTEN you felt or thought a certain way. Although some of the questions are similar, there are small differences between them and you should treat each one as a separate question. The best approach is to answer fairly quickly. That is, don t try to count up the exact number of times you felt a particular way, but tell me the answer that in general seems the best.

For each statement, please tell me if you have had these thoughts or feelings: never, almost never, sometimes, fairly often, or very often. (Read all answer choices each time)

Never Almost Never Sometimes Fairly Often Very Often

B.1. In the past month, how often have you been upset because of something that happened unexpectedly? 0 1 2 3 4

B.2. In the past month, how often have you felt unable to control the important things in your life? 0 1 2 3 4

B.3. In the past month, how often have you felt nervous or stressed? 0 1 2 3 4

B.4. In the past month, how often have you felt confident about your ability to handle personal problems? 0 1 2 3 4

B.5. In the past month, how often have you felt that things were going your way? 0 1 2 3 4

B.6. In the past month, how often have you found that you could not cope with all the things you had to do? 0 1 2 3 4

B.7. In the past month, how often have you been able to control irritations in your life?

0 1 2 3 4

B.8. In the past month, how often have you felt that you were on top of things? 0

1 2 3 4

B.9. In the past month, how often have you been angry because of things that happened that were outside of your control? 0 1 2 3 4

B.10. In the past month, how often have you felt that difficulties were piling up so high that you could not overcome them? 0 1 2 3 4

Perceived Stress Scale Scoring

Each item is rated on a 5-point scale ranging from never (0) to almost always (4). Positively worded items are reverse scored, and the ratings are summed, with higher scores indicating more perceived stress.

PSS-10 scores are obtained by reversing the scores on the four positive items: For example, 0=4, 1=3, 2=2, etc. and then summing across all 10 items.

Items 4, 5, 7, and 8 are the positively stated items.

Your Perceived Stress Level was _____

Scores around 13 are considered average. In our own research, we have found that high stress groups usually have a stress score of around 20 points. Scores of 20 or higher are considered high stress, and if you are in this range, you might consider learning new

stress reduction techniques as well as increasing your exercise to at least three times a week. High psychological stress is associated with high blood pressure, higher BMI, larger waist to hip ratio, shorter telomere length, higher cortisol levels, suppressed immune function, decreased sleep, and increased alcohol consumption. These are all important risk factors for cardiovascular disease.

Dr. Cohen's Scales:We welcome copies (e-mail is OK) of any in press or published papers using any of Dr. Cohen's scales that you are willing to share with us, and thank you in advance for your generosity. They will not be redistributed or linked without your permission.

Permission for use of scales is not necessary when use is for nonprofit academic research or nonprofit educational purposes. (Retrieved on February 25, 2016 from http://www.psy.cmu.edu/~scohen/scales.html)

Appendix G: Coping Self-Efficacy Scale

Coping Self-Efficacy Scale

When things aren't going well for you, or when you're having problems, how confident or certain are you that you can do the following:

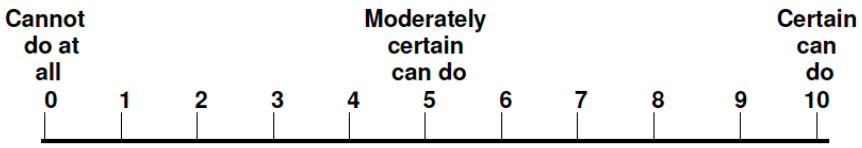
Cannot do at all					Moderately certain can do					Certain can do
0	1	2	3	4	5	6	7	8	9	10

For each of the following items, write a number from 0 –10, using the scale above.

When things aren't going well for you, how confident are you that you can:

1. Keep from getting down in the dumps. _____
2. Talk positively to yourself. _____
3. Sort out what can be changed, and what can not be changed. _____
4. Get emotional support from friends and family. _____
5. Find solutions to your most difficult problems. _____
6. Break an upsetting problem down into smaller parts. _____
7. Leave options open when things get stressful. _____
8. Make a plan of action and follow it when confronted with a problem. _____
9. Develop new hobbies or recreations. _____
10. Take your mind off unpleasant thoughts. _____
11. Look for something good in a negative situation. _____
12. Keep from feeling sad. _____
13. See things from the other person's point of view during a heated argument. _____
14. Try other solutions to your problems if your first solutions don't work. _____
15. Stop yourself from being upset by unpleasant thoughts. _____

When things aren't going well for you, or when you're having problems, how confident or certain are you that you can do the following:



16. Make new friends. ____
17. Get friends to help you with the things you need. ____
18. Do something positive for yourself when you are feeling discouraged. ____
19. Make unpleasant thoughts go away. ____
20. Think about one part of the problem at a time. ____
21. Visualize a pleasant activity or place. ____
22. Keep yourself from feeling lonely. ____
23. Pray or meditate. ____
24. Get emotional support from community organizations or resources. ____
25. Stand your ground and fight for what you want. ____
26. Resist the impulse to act hastily when under pressure. ____

Scoring: Summation of items. Higher scores indicate increased coping self-efficacy.

Chesney, M.A., Neilands, T.B., Chambers D.B., Taylor, J.M., & Folkman, S. (2006). A validity and reliability study of the coping self-efficacy scale. *British Journal of Health Psychology, 11*(3), 421-437.

Copies of manuscripts or conference presentations generated from the use of this scale to be sent to: Margaret A. Chesney, PhD, Director, Osher Center of Integrative Medicine, Box 1726, University of California San Francisco, San Francisco, CA 94143-17262, USA. (email: chesneym@ocim.ucsf.edu)

Appendix H: Wagnild and Young's Resilience Scale (RS)

Name_____Date_____

INSTRUCTIONS:

Please read each statement and circle the number to the right of each statement that best indicates your feelings about that statement. Respond to all statements.

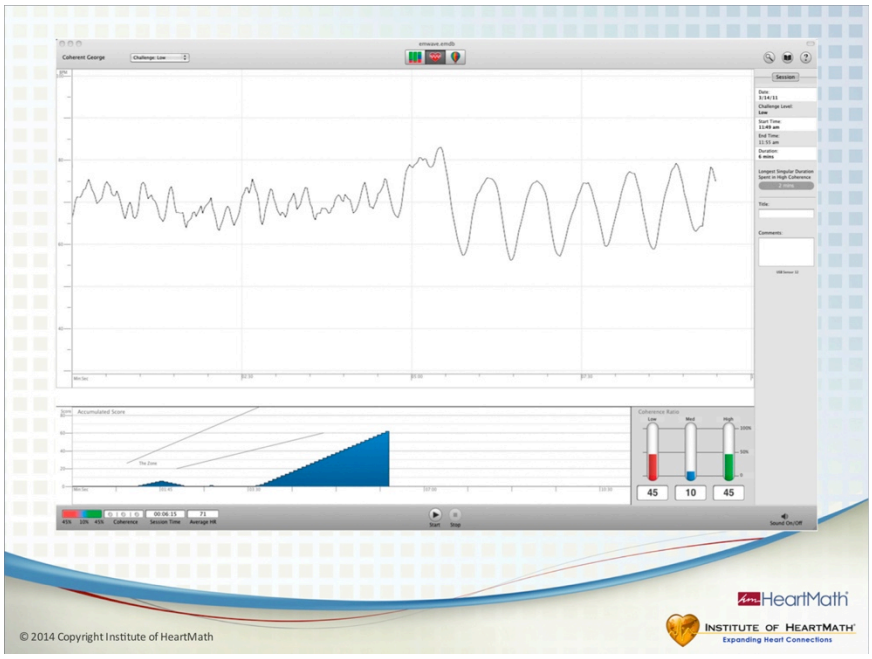
Circle the number in the appropriate column.	**Strongly Disagree**						**Strongly Agree**
1. When I make plans, I follow through with them.	1	2	3	4	5	6	7
2. I usually manage one way or another.	1	2	3	4	5	6	7
3. I am able to depend on myself more than anyone else.	1	2	3	4	5	6	7
4. Keeping interested in things is important to me.	1	2	3	4	5	6	7
5. I can be on my own if I have to.	1	2	3	4	5	6	7
6. I feel proud of the things I have accomplished in life.	1	2	3	4	5	6	7
7. I usually take things in stride.	1	2	3	4	5	6	7
8. I am friends with myself.	1	2	3	4	5	6	7
9. I feel that I can handle many things at one time.	1	2	3	4	5	6	7
10. I am determined.	1	2	3	4	5	6	7
11. I seldom wonder what the point of it all is.	1	2	3	4	5	6	7
12. I take things one day at a time.	1	2	3	4	5	6	7
13. I can get through difficult times because I've experienced difficulty before.	1	2	3	4	5	6	7
14. I have self-discipline.	1	2	3	4	5	6	7
15. I keep interested in things.	1	2	3	4	5	6	7
16. I can usually find something to laugh about.	1	2	3	4	5	6	7
17. My belief in myself gets me through hard times.	1	2	3	4	5	6	7
18. In an emergency, I'm someone people can generally rely on.	1	2	3	4	5	6	7
19. I can usually look at a situation in a number of ways.	1	2	3	4	5	6	7
20. Sometimes I make myself do things whether I want to or not.	1	2	3	4	5	6	7

21. My life has meaning.	1	2	3	4	5	6	7
22. I do not dwell on things I can't do anything about.	1	2	3	4	5	6	7
23. When I'm in a difficult situation, I can usually find my way out of it.	1	2	3	4	5	6	7
24. I have enough energy to do what I have to do.	1	2	3	4	5	6	7
25. It's okay if there are people who don't like me.	1	2	3	4	5	6	7

Scoring:

Resilience Scale (RS) scores range from 25-175. Scores greater than 145 indicate moderately high-to-high resilience, scores from 116-144 indicate moderately-low to moderate levels of resilience, and scores of 115 and below indicate very low resilience. (Wagnild, 2014, p.82)

Appendix I: emWave Pro Computer Hardware and HRV Monitor Reading



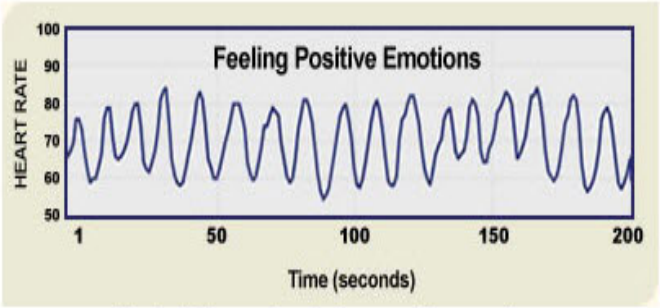
(Institute of HeartMath, 2015)

Appendix J: emWave2 and Inner Balance HRVB Portable Devices

(Institute of Heartmath, 2016)

Appendix K: Example of HRVB Heart Rhythms

Heart rhythms when stressed



Heart rhythms when feeling a positive emotion

(Institute of HeartMath, 2016)

Appendix L: Recruitment Email Example

To: SDSU Accelerated Nursing students

From: Andrea Harmelink, SDSU PhD Nursing Student

SDSU Accelerated Nursing students,
Congratulations on your on-going progress and success in the SDSU Accelerated Nursing program! I am excited for you and your nursing futures. I am also a SDSU student nearing the end of my PhD in Nursing program. At this point in the program, I am doing my dissertation study using an stress-reduction intervention I was trained in called Heart Rate Variability biofeedback (HRVB). HRVB is a non-invasive intervention that incorporates breathing and heart rhythms. Studies have shown that HRVB can increase decision-making skills and academic success, as well as decrease stress and increase resilience. I am hoping that each of you will consider volunteering for this study. If you are willing to participate in this study, I will be visiting your classroom on _____(date) to collect demographic information and confirm eligibility. The exclusion criteria for this study includes anyone who is already trained in HRVB. For those of you eligible for this study, I will be dividing you into two groups: a HRVB group and a wait-list control group (which means you will be offered the same HRVB intervention after the first group completes their HRV biofeedback intervention). This study will take four weeks, but you will be able to do the vast majority of it on your own time. Please read the attached information sheet, which also describes the compensation for those who are willing and eligible to participate.

I look forward to working with you!
Sincerely,
Andrea Harmelink
SDSU PhD Nursing Student

Appendix M: ABN Student Information Sheet

Information Sheet
Participation in a Research Project
South Dakota State University
Brookings, SD 57007

Department of Nursing

Project Director *Andrea Harmelink*_____ Phone No. *605-310-2322*___

E-mail *andrea.harmelink@jacks.sdstate.edu*_____ Date _____4/4/2016_____

Please read the following information:

1. This an invitation for you as a SDSU accelerated baccalaureate-nursing student to participate in a research project under the direction of the Andrea Harmelink, SDSU PhD student.
2. The project is entitled *Pilot Study of the Effects of Heart Rate Variability Biofeedback on Perceived Stress, Perceived Coping Ability, and Resilience in Accelerated Baccalaureate Nursing Students.*
3. The purpose of the project is to help reduce stress and increase resilience in nursing students.
4. If you consent to participate, you will be involved in the following process, which will occur in two to three sessions (depending on which group you are assigned in the study):

1) The Principal Investigator (PI) will come to one of your SDSU ABN classroom times at the Sioux Falls, SD location, and you will fill out the following demographic items: age, gender, marital/relationship/family status, race, original baccalaureate degree, and current medication list. Participants who are currently trained in Heart Rate Variability Biofeedback will not be able to participate in this study.

2) Participants who meet the inclusion/exclusion criteria will be asked to participate in the study, and current contact information will be gathered (email and phone number). The eligible participants will be divided into two groups: the Heart Rate Variability biofeedback (HRVB) intervention group and the wait-list control group. The wait-list control group will be offered the HRVB training and intervention after the HRVB intervention group completes their portion of the study.

3) All eligible participants will meet with the PI at a classroom at the SDSU nursing program, Sioux Falls campus, to sign the consent, fill out the Perceived Stress Survey (PSS-10), the Coping Self-Efficacy Scale (CES), and the Resilience Scale (RS) (Group Session One). The following week, those in the HRVB intervention group will attend a 2.5-hour training on Resilience building, which includes learning how to use the portable HRV emWave2 or Inner Balance device. The HRVB intervention participants will be given instructions on how to incorporate HRVB techniques on a daily basis for following four weeks (Training Session). The PI will come to campus during week two of the HRVB Intervention timeframe and meet with each participant in the HRVB group for HRVB practice on the PI's emWavePro HRV computer program. The PI will also contact each participant in the HRVB group on a weekly basis for all four weeks, via email, phone, or in-person, to

discuss any questions or concerns with the HRVB techniques or technology.

4) Four weeks after Session One, the PI will meet with all participants, again at a classroom at the SDSU ABN Sioux Falls, SD campus. At this meeting, each participant will again fill out the PSS-10, CSE, and RS. Compensation will be given at this time (Group Session Two). Participants in the HRVB intervention group will return the emWave2 or Inner Balance portable HRVB devices at this time.

5. Participation in this project is voluntary and will not affect your grades in your SDSU Nursing courses. You have the right to withdraw at any time without penalty. If you have any questions, you may contact the project director at the number listed above.

6. The risks to your participation in the study include possibly recalling stressful life experiences when filling out the surveys. If you have ongoing stress or anxiety during or after the study, you may contact the SDSU Counseling Services at 605.688.6146.

7. The benefits to you are potential decreased perceived stress, increased coping ability, and increased resilience, thus possibly increasing your decision-making abilities and academic performance.

8. There is compensation for your participation in this study. All participants, whether in the HRVB intervention group or the wait-list control group, will receive a free week of classes at Form Fitness Studio, 2210 West 69th St. Suite 150, Sioux Falls, SD, 57108, as well as be entered into a drawing for the following: $75 VISA gift card and $75 Form Fitness gift card (the same participant cannot win both gift cards). In order to receive the compensation, you must: complete all required sessions of the above-described study.

9. Your responses are strictly confidential. When the data and analysis are presented, you will not be linked to the data by your name, title or any other identifying item.

10. As a research participant, I have read the above and have had any questions answered. I will receive a copy of this information sheet to keep.

If you have any questions regarding this study you may contact the Project Director. If you have questions regarding your rights as a participant, you can contact the SDSU Research Compliance Coordinator at (605) 688-6975 or SDSU.IRB@sdstate.edu.

This project has been approved by the SDSU Institutional Review Board, Approval No.: IRB-1604002-EXP

Appendix N: Heart-Focused Breathing

Heart-Focused Breathing™Technique
Time: 5 minutes
Objective:
Learn and practice the Heart-Focused Breathing Technique.
Key Points: Let's practice the Heart-Focused Breathing Technique together as I read it to you.

• Read the step:
Focus your attention in the area of the heart. Imagine your breath is flowing in and out of your heart or chest area, breathing a little slower and deeper than usual.

Suggestion: Inhale 5 seconds; exhale 5 seconds (or whatever rhythm is comfortable.)
• Try practicing Heart-Focused Breathing with your eyes open. Soon you will be able to do it on the go and no one will know you are doing it.
• Ask:
Why do we focus our attention on the area of the heart? It has been demonstrated that when we focus our attention on a specific area of our body, it leads to measurable physiological changes in that area. In this case, shifting attention to the heart area helps shift our heart rhythms into a more coherent state. It also draws our focus of attention away from an issue, which further helps calm our thoughts and stabilize our emotions.
(Helpful tip:
If participants have difficulty focusing on the heart area, have them shift their focus to their left index finger and wiggle it. Then have them shift their focus to their right big toe and wiggle it. Explain that this is what we mean by focusing attention. Now have them focus in the area of the heart.)

• Heart-Focused Breathing creates an inner pause. In that pause you can become aware that you have a choice of how you want to respond. In other words, you don't have to respond in an automatic, knee-jerk kind of reaction or behavior. That new choice can change the trajectory of the moment and the outcome.
• Use Heart-Focused Breathing in the moment to help take the intensity out of or turn down the volume of a stress reaction. You can use it, for example, to increase your composure before a meeting or conversation.
• The Quick Step is simply Heart-Focused Breathing. Once you are comfortable doing the technique, that's all you will need to remember.

Appendix O: HeartMath Trainer Certificate

Appendix P: HRVB Reminder Calendar

Day of Week	**Sunday**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**
5 Min HRVB Practice at least 3x/day	***Check Box When Each Session Done**						
Week ONE: AM							
Midday							
PM							
*Extra							
Week TWO: AM							
Midday							
PM							
*Extra							
Week THREE: AM							
Midday							
PM							
*Extra							
Week FOUR: AM							
Midday							
PM							
*Extra							

Appendix Q: CITI Certification

SDSU ID: 1092666
DOB: 1-22-1975

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI)

BASIC/REFRESHER COURSE - HUMAN SUBJECTS RESEARCH CURRICULUM COMPLETION REPORT

Printed on 08/12/2014

LEARNER	Andrea Rasmussen (ID: 1973945) Harmelink (married 5/2014)
PHONE	605-310-~~7995~~ 2322
EMAIL	Andrea.Rasmussen@usiouxfalls.edu
INSTITUTION	South Dakota State University
EXPIRATION DATE	08/11/2017

SOCIAL/BEHAVIORAL RESEARCH COURSE

COURSE/STAGE:	Refresher Course/2
PASSED ON:	08/12/2014
REFERENCE ID:	10854064

REQUIRED MODULES	DATE COMPLETED	SCORE
SBE Refresher 1 – Defining Research with Human Subjects	08/12/14	2/2 (100%)
SBE Refresher 1 – Privacy and Confidentiality	08/12/14	2/2 (100%)
SBE Refresher 1 – Assessing Risk	08/12/14	2/2 (100%)
SBE Refresher 1 – Research with Children	08/12/14	2/2 (100%)
SBE Refresher 1 – International Research	08/12/14	2/2 (100%)
SBE Refresher 1 – History and Ethical Principles	08/12/14	2/2 (100%)
SBE Refresher 1 – Federal Regulations for Protecting Research Subjects	08/12/14	2/2 (100%)
SBE Refresher 1 – Informed Consent	08/12/14	2/2 (100%)
SBE Refresher 1 – Research with Prisoners	08/12/14	2/2 (100%)
SBE Refresher 1 – Research in Educational Settings	08/12/14	2/2 (100%)
SBE Refresher 1 – Instructions	08/12/14	No Quiz
South Dakota State University	08/12/14	No Quiz

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI Program participating institution or be a paid Independent Learner. Falsified information and unauthorized use of the CITI Program course site is unethical, and may be considered research misconduct by your institution.

Paul Braunschweiger Ph.D.
Professor, University of Miami
Director Office of Research Education
CITI Program Course Coordinator

Appendix R: SDSU Nursing Research Committee Approval Email

Dear Andrea and Dr. Minton,
The Research Committee (RC) met today, and you have the green light to go ahead with your project, once it is approved by SDSU IRB.

Additionally, here are comments and recommendations from the RC members related to participants recruitment:

1. In the consent form or the letter to invite participants, information about eligibility should be included. According to your IRB proposal, students who have been diagnosed and are being treated for an emotional or mental health disorder, or have already received the training, are not eligible to participated. It is best if students can self-select themselves without having to disclose this information.
2. We understand that this could reduce the sample size more, and as you have a limited time for recruitment and performing the project, you might need to look into other cohort of NACC to complete your research.

Thank you for submitting your project, and let the RC know if you have any further questions.
The best of luck in your project, with my best regards,
Cristina L.

Christina Lammers, MD, MPH
SDSU Undergraduate Nursing
Associate Professor

Appendix S: List of Study Definitions

Term	Conceptual Definition	Operational Definition (if applicable)
Accelerated Baccalaureate Students (ABN)	Second-degree students who attend a BSN school in a condensed curriculum (12-18 months) before taking NCLEX	N/A
Traditional Nursing Students	Nursing students who obtain their BSN in a typical four-year educational setting	N/A
Stress	Transaction between person and his/her environment that exceeds his/her internal resources, endangers his/her well-being, and burdens his/her coping resources	N/A
Perceived Stress	Measure of the degree to which one's life is appraised to be stressful, rather than if certain events happened	Perceived Stress Scale (PSS) by Cohen & Williamson (1988)
Coping	Constantly changing cognitive & behavioral efforts to manage external and/or internal demands appraised as taxing or exceeding the resources of the person	N/A
Perceived Coping Ability	Measure of an individual's confidence in his/her ability to cope effectively	Coping Self-Efficacy Scale (CSE) by Chesney et al. (2006)
Resilience	Ability to rise above a difficult situation in one's life, adapt better than expected, and go on to survive and thrive	Resilience Scale by Wagnild & Young (1993)
Biofeedback	Process of becoming more aware of the body's physiologic functions, such as heart rate or body temperature	N/A

Heart Rate Variability Biofeedback	Measures beat-to-beat heart rate variability; designed to reduce autonomic reactivity and regulate homeostatic physiologic mechanisms	HeartMath emWave technology (desktop version, as well as two handheld versions: emWave2 and the Inner Balance)