

**An Exploration into the Relationship between Indices of Autonomic Nervous
System Health and Wellness**

**A Dissertation Presented for the
Doctor of Philosophy
Degree
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ABSTRACT

The maintenance and promotion of wellness proves to be vital to health. Over the years, existing literature has de-emphasized the contributions of objective health to the phenomenon of wellness, and has emphasized subjectively measured wellness concepts. However, due to the complexity of wellness and its importance in regard to individual and societal health, it is imperative to examine wellness not only from a subjective basis, but also in conjunction with objective explorations. A uniform index of wellness should be established in order to reduce the ambiguity associated with the concept. Therefore, this paper had two major aims that were addressed in three experiments testing college students' self-report and physiological responses. Aim 1 was to develop a wellness model useful in a wide array of research domains. This was done through rigorous testing of components of my proposed Oliver Health Factor Wellness. Aim 2 was to establish an objective measure of wellness. This was done by correlating subjective wellness responses to wellness measures with objective physiological activity indicative of health. More specifically, I assessed Autonomic Nervous System (ANS) function as a means to explore the health and wellness status of individuals. In this paper, I addressed these aims and posit that my findings will advance scientific knowledge regarding a more steadfast way to measure wellness from an objective standpoint, as well as, a way to evaluate the efficacy of a given therapy by examination of changes in function/autonomic balance. In addition, my findings suggest a more reliable way to measure wellness, specifically, with its inclusion of ANS parameters. Finally, my findings suggest that Heart Rate Variability, in particular, can be utilized as an objective index of Holistic wellness and Optimum Health.

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CHAPTER I
INTRODUCTION

Human instinct is to pursue a better quality of life. Quality of life represents the general well-being of both individuals and society and can manifest itself in numerous ways. For example, efforts such as: increasing physical fitness, emotional stability, spiritual growth, financial stability, and social connectedness can be targeted in attempts to enhance one's quality of life. Although seemingly ambiguous, the process of improving all of the aforementioned aspects, as well as a variety of others, can be clumped together into a term known as wellness. As currently defined by the World Health Organization, wellness is the active process of becoming aware of and making choices toward a more successful existence. Thus, it is the process of first identifying aspects of one's life that can be improved (i.e. physical fitness), then choosing to actively strive toward enhancing that particular deficit in one's life (i.e. regular physical activity). Wellness promotion augments health, which in turn, can lead to the enrichment of one's quality of life. An individual's quintessential quality of life is reflective of an optimal state of health. Notwithstanding, the phenomenon of wellness signifies the relationship between quality of life and health.

Dating back to its earliest definitions, the concept of health has seen numerous characterizations relating to the body's ability to function. It was thought that to be in good health, one must be able-bodied and disease free. However, in 1948 the World Health Organization (WHO) revisited this definition and constructed a new definition that added a novel piece to the conceptualization of health, the linkage of health to wellness. This definition is one that has been at the forefront of health and wellness promotion for years. Health, as defined by WHO is "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity". This definition facilitated the conceptualization of wellness as a multi-faceted construct. As a result, Dr. Bill Hettler, co-founder of the National Wellness Institute,

defined wellness as “an active process through which people become aware of, and make choices toward a more successful existence” (1984). This definition of wellness is the one most utilized today and is still the official operational definition of wellness according to WHO. Nonetheless, consensus is lacking regarding a concrete definition and definitive structure of wellness (Miller & Foster, 2010a, b).

In the wellness literature, numerous models have been proposed introducing various dimensions believed to significantly affect human existence; however, there are three main models that have been most pivotal in terms of expanding directions of research: Dunn’s (1961) High-level wellness model (see Figure 1), Hettler’s (1984) Holistic Wellness Model (see Figure 2), and Witmer and Sweeney’s (1992) Wheel of Wellness and Prevention Model (see Figure 3). Wellness models have either emphasized health as a result of life events in terms of physical concepts out of individual control, health as a result of active choices made by the individual, or practical applications of lifestyle choices and how they impact health based upon therapeutic interventions. Regardless of the specific research direction in the literature, these particular models of wellness have provided theoretical underpinnings for new wellness models over the past 50 years. Therefore, it is critical to review these pivotal models in order to grasp the history embedded in the timeline of wellness research.

Regarded as the “father” of the modern wellness movement, Halbert Dunn (1961) coined the term “high-level wellness”. High-level wellness refers to disease and health on a graduated scale. This scale, also known as the “health grid”, is made up of a health axis and an environmental axis. The environmental axis includes physical, biological, and socioeconomic components affecting the health of the individual, whereas the health axis ranges from death on one spectrum to peak wellness or absence of disease on the other. High-level wellness is

achieved if both environmental, as well as health, are on the positive end of the continuum. Likewise, being low on the environmental and high on the health axes or vice versa constitutes average wellness. However, an individual who is low on both components yields low level wellness according to this wellness matrix. One's health status is a result of a combination of how favorable one's environment is, as well as his/her individual health status or being able-bodied and disease free.

From an existentialist perspective, Hettler (1984) defined wellness as “an active process through which people become aware of, and make choices toward a more successful existence”. His definition of wellness incorporates a holistic interdependent approach in which all aspects of wellness are seen to work together to contribute to a healthy lifestyle. Fully optimizing the six domains of wellness (e.g. physical, social, emotional, spiritual, occupational, and intellectual) is what constitutes the health status of an individual. Therefore, wellness is an “active” process of self-enrichment by appropriate decision making. This alludes to a wellness state in which individuals have the opportunity to become “more well” based upon healthy lifestyle choices. Thus, the individual is responsible for his/her own health via individual actions. Hettler's definition fostered a major shift in wellness composition towards a general examination of all factors that could potentially influence holistic health, as opposed to merely the physical aspects.

From a counseling perspective, Witmer & Sweeney (1992) introduced a model based upon a multi-disciplinarian approach that included specific character traits of individuals who were healthy and had a high quality of life. Their wheel of wellness and prevention model emphasized spirituality as its central tenet and most significant characteristic of a healthy individual. Furthermore, the authors highlight five interrelated life tasks that they believe encompass individual wellness (e.g. spirituality, self-direction, work and leisure, friendship, and

love). This particular model focused on the unity of the mind, body, and spirit with nature and the environment.

In summary, the aforementioned models suggest that wellness can be conceptualized as a multi-dimensional construct with practical and therapeutic benefits (Horton & Snyder, 2009) deriving from the unity of the body, mind, and spirit (Edlin & Golanty, 1992; Hettler, 1984; Priest, 2007; Weaver, 2002). Furthermore, wellness aids in achieving individual potential by way of recognizing the person in his/her entirety, as well as, operationalizing the individual's positive qualities and strengths to his/her advantage (Du Plessis & Botha, 2012). Additionally, as stated by Myers, Sweeney, and Witmer (2000), "wellness is a way of life oriented toward optimal health and well-being, in which body, mind, and spirit are integrated by the individual to live life more fully within the human and natural community...ideally, it is the optimum state of health and well-being that each individual is capable of achieving". Therefore, the concept of wellness proves to be vital to individual health given the vast connections between the self and external factors influencing quality of life and subsequent health.

Many wellness models have been established in accordance with the WHO definition of health in attempts to identify factors of life leading to both health care promotion and disease prevention. As models have expanded throughout the years, and our understanding of the interconnectedness of various facets of life has substantially improved, there has been a shift towards creating a model of wellness that encompasses more subjective rather than objective indicators of quality of life. Existing models have been very effective in their assessments of subjective perceptions of life (Hettler, 1976; Myers & Sweeney, 2004; Myers, Sweeney, & Witmer, 2000). Moreover, often these subjective self-perceptions of various phenomena inform

research and clinical practice on health outcomes associated with these feelings. However, there is a gap in the literature in terms of an agreed upon objective measure of wellness.

Statement of the Problem

Thus, in order to address this gap in the literature, it is critical to examine wellness domains as they correlate with overall health. More specifically, due to the complexity of wellness and its importance in regard to individual and societal health, it is imperative to examine wellness not only from a subjective basis, but also in conjunction with objective explorations. By identifying the copious number of components and theoretical models of wellness, researchers can start to examine themes useful in the development of a succinct, but comprehensive model. Over the years, existing literature has de-emphasized the contributions of objective health to the phenomenon of wellness, and has emphasized subjectively measured wellness concepts. The universal concept that the WHO avowed is that wellness is a subjective notion to be utilized in conjunction with the objective notion of health. However, no uniform objective index of wellness has been identified. By identifying an objective index of wellness, it will generate a more unified picture of the phenomenon of wellness. Furthermore, it will facilitate the development of specific interventions (i.e. behavioral and therapeutic programs) which would better address wellness deficits as a whole.

Statement of the Purpose

Thus, for the scope of this paper, the overarching goal is to advance science by identifying a means to link wellness dimensions with objective physiological measures. This project has two major aims that will be addressed in three experiments testing college students' self-report and physiological responses. Aim 1 is to develop a wellness model useful in a wide array of research domains. This will be done through synthesizing components of previous

models and testing dimensions of my model in conjunction with objective health indices to explore if relationships between components exist. I hypothesize that my proposed model will prove to be an effective synthesis of previous wellness models and will reflect a positive relationship with health. Aim 2 is to establish an objective measure of wellness. This will be done by correlating subjective wellness responses to wellness measures with objective physiological activity indicative of health. The central hypothesis of this paper is that an objectively measured index of wellness will amount reflecting the correlation between objective indicators of health, and subjective measures of wellness (self-report).

Significance of the Study

Addressing these aims will advance scientific knowledge regarding a more consistent way to measure wellness from an objective standpoint. Findings from this project will provide insight into an effective way for researchers to combine various models into one universal multidisciplinary theoretical model of wellness. In addition, I will introduce a more reliable way to measure wellness, specifically, with its inclusion of objective measures improving validity. Moreover, through my studies, I aim to address gaps in the wellness literature with respect to measurement issues, detecting relationships useful for client tailored interventions, providing validation for self-report methodology frequently used in literature, and correlating both objective and subjective measures of wellness. Finally, I posit that I will be able to provide support suggesting that physiological measurements may indeed reflect objective indices of holistic wellness.

CHAPTER II
REVIEW OF THE LITERATURE

Chronological Evolution of Wellness Models

Models of wellness have evolved throughout the years due to advancements in our understanding of factors influencing health, as well as, novel theories incorporating new components of wellness. Throughout this evolution, each model of wellness in some way or another, builds upon previously theorized models in hopes of proposing the model of best fit. Given the ambiguous nature of wellness, a plethora of models have been proposed attempting to encompass all life domains that entail subsequent influences on health. Therefore, the following is a brief synopsis of the major wellness models to date over the last 60 years presented in chronological order:

Dunn (1961) described wellness as the balance between one's physical health status and their external environment (see Figure 1). Depending on how favorable one's environment is, wellness is impacted subsequently. He postulated that true vitality could only be achieved if people were "healthy" in a number of areas in their lives (i.e. physical, biological, and socioeconomic). Additionally, the capacity of an individual to be able-bodied and disease free impacted wellness. Individuals in a very favorable environment who were both able-bodied and disease free, were considered to be in a state of high-level wellness. This state of high-level wellness is considered by Dunn to be the optimal state of health.

Ardell (1977) described a wellness system in terms of medical care and health promotion. In his system of wellness, he advocated for the transitioning from primarily physical aspects of disease, to a model that takes into account the inter-relationships of the whole person. He argued for a holistic model that balances relationships with the self, the environment, and the universe. Specifically, he proposed a system that concerned itself with the holistic person, not simply aspects of physical disease within the individual. His model incorporated inter-relationships

among emotional, physical, social, and spiritual facets and how such aspects intertwined to affect one's medical condition in terms of disease prevention.

Although the avoidance of illness/disease was thought to be indicative of wellness, Lafferty (1979) argued that individuals must take responsibility for their health and make the proper decisions to improve health. Thus, a model was established in hopes of providing more understanding of health behaviors in an attempt to ultimately improve quality of life by identifying positive health choices. **Lafferty (1979)** described wellness as a dynamic construct that has an active and essentially, never-ending existence in life. This is based upon the notion that the goal of maximal health is virtually unattainable and individuals will have to constantly strive to increase health. He proposed a model of wellness known as the “*total person concept*”. In terms of his model, he suggests that humans are multidimensional beings who possess five major dimensions: emotional, intellectual, physical, social, and spiritual. What is important to note in this model is that he explicitly states that none of these dimensions function independently, but instead, are all interrelated and dependent upon one another as the balance amongst dimensions promotes wellness.

Hettler (1980) added to the previous model in which dimensions of wellness were defined in terms of what affects the health of an individual. He devised a model which included the dimension of *occupational wellness*. Occupational wellness refers to personal satisfaction and enrichment in one's life through work. It reflects one's attitude about one's work. Hettler believed this added dimension, paired with the others, fully captured the concept of wellness. Furthermore, optimization of all factors simultaneously, would subsequently lead to optimal health. As the co-founder of the National Wellness Institute, he contrived six dimensions of wellness (physical, emotional, social, intellectual, spiritual, and occupational) of which he

deemed the “holistic wellness model. Holistic wellness refers to the condition of being in optimal health in which aspects of wellness contribute to overall wellness. Furthermore, Hettler posits that wellness is the active process of making choices toward an optimal living and successful existence. Hettler’s model further solidified the transition away from a definition of health as merely the lack of illness, but instead included various other components of everyday life.

Greenberg (1985) emphasized illness and health as separate entities in his model. It was proposed that one can be well and still possess an illness. Likewise, one can be free from illness, but not be well. This model, deriving its roots from Lafferty’s (1979) model, included the same five elements, but instead of intellectual wellness, introduced a new term: *mental health*. Mental health refers to the encompassing of intellectual health and wellness and also the ability to learn. Therefore, Greenberg conceptualized health as a multifaceted concept consisting of: social, mental, emotional, spiritual, and physical components that is separate from illness, not the lack of. Wellness is the integration of these components at any level of health or illness. Wellness and health are independent of one another in that even if one is physically sick, they can be well in other aspects (e.g. social, mental, emotional, and spiritual). Similar to Dunn (1961), Greenberg’s high-level wellness refers to the balance of these components. One is said to be high in wellness if they can balance these components evenly. Low wellness refers to an unequal balance of components such as an athlete who is high in physical wellness, but may be low in emotional or social wellness.

Croze, Nicholas, Gobble, & Frank (1992) established a systems model approach to wellness in which moderating variables were introduced ultimately affecting the strength and direction of the relationship between health and wellness. These variables are culture, age, and gender. In addition, a new dimension of wellness, *vocational wellness*, was proposed. In this

multidimensional systems model, four basic principles are emphasized: 1) health is multidimensional, 2) health is variable and not static, 3) health is self-regulating within life dimensions, and 4) health is self-regulating across life dimensions. The aspects of this model are: physical, emotional, social, vocational, spiritual, and intellectual. This model was introduced as an approach to counseling in which gender was highlighted as a main moderating variable to target in terms of explaining differences in health and wellness.

Witmer & Sweeney (1992) took into account the ideas and theoretical concepts of Alfred Adler's Individual Psychology, Carl Jung's Analytical Psychology, and Abraham Maslow's Humanistic Psychology, and developed a new model with the centralized theme that humans have an instinctual drive toward the pursuit of health. This "life span" wellness model emphasized the interconnectedness of all things. The major themes relate to totality in mind, body, spirit, and community. This "*wheel of wellness*" model aimed to demonstrate the interconnectedness of the characteristics of the healthy person, the life tasks, and the life forces. The five life tasks are: friendship, love, self-regulation, spirituality, and work. These life tasks interact with life forces and global events as individuals strive for well-being. Spirituality is the central focus of the wheel, with self-regulation as its primary affecting component. Eleven characteristics are discussed as what is desirable for optimal health and functioning and these characteristics influence the twelfth life task, self-regulation. They are as follows: physical fitness and nutrition, sense of worth, sense of control, realistic beliefs, spontaneous and emotional responsiveness, intellectual stimulation, problem solving, and creativity, sense of humor, spiritual values, success in the work task, satisfying friendships and a social network, and satisfaction in marriage or other intimate relationships. Furthermore, the degree of work, friendship, and love all affect the eleven characteristics. Additionally, the authors cite that this

particular model incorporates social, psychological, medical, and behavioral sciences as it outlines the aforementioned 12 dimensions of a healthy person throughout an individual's life span.

In order to establish a valid and reliable measure of perceived wellness from an individualistic approach as highlighted in Witmer & Sweeney's (1992) model, Adams and colleagues (1997), proposed a model based upon the works of several aforementioned wellness scholars. The authors tested their model as they proposed a survey designed to measure individual wellness perceptions. This perceived wellness approach is based upon the idea that wellness is made up of "subscales" or dimensions that interconnect and comprise overall wellness.

Adams, Bezner, & Steinhardt (1997) developed the perceived wellness model. Wellness is described as the intertwining of various subsystems of wellness that are innately affective or elicit an emotional connection. Unlike previous models, this perceived wellness model was based on the notion that perceptions of wellness are connected not by the ways in which they affect one's health, but instead, by their affective nature which subsequently influences health. The subscales included are: physical, spiritual, intellectual, psychological, social, and emotional. This instrument, examining perceived wellness, or the perception of one's state of health, was distributed to young college adults and working adults alike in its initial validation.

Durlak (2000) constructed a model of wellness targeting areas of health in youth in an attempt at promoting health and preventing the formation and development of disease. His conceptualization of wellness involved three main components: social, physical, and academic or intellectual. The model aims to promote health at a young age, primarily in school age children, so that future health could benefit from earlier wellness promotion techniques. This particular

model focused primarily on aspects of wellness that could be controlled and would subsequently reduce adverse effects on health in adult life if addressed in youth. Although previous models have included the component of intellectual wellness, this was the first model to include a term similar in concept, but different in applicability, *academic wellness*. Academic wellness in this model focuses specifically on wellness in an academic setting. The ability to learn, higher order thinking skills, underachievement, and test anxiety are some tenets of this wellness component.

Similar to previous models of wellness, Renger and colleagues (2000), identify that balance amongst lifestyle factors is what improves quality of life, or wellness. In this particular model, knowledge in each of the realms of wellness is highlighted. The authors state that in order to achieve a high level of wellness, one must be knowledgeable about how to improve skills in particular areas of wellness, as well as have the desire to improve individual quality of life. Although other models mention environmental health as contributing to other wellness domains, this is the first model to include environmental health and wellness as its own component independently contributing to the wellness model.

Renger et al. (2000) based their conceptualization of wellness on a theoretical model known as the “*Total Person Concept*”, a concept similar to Lafferty (1979), but with an added dimension of *environmental wellness*. The overarching viewpoint here is that “wellness embodies a way of living that encourages individuals to seek a balance in their lifestyle designed to improve the quality of life”. They highlight the importance of knowledge, perceptions, and skill in each individual area in order to improve wellness. It is stated that in order to achieve high-level wellness, individuals must care for their physical selves, use their minds constructively, channel stress energies positively, express emotions effectively, become creatively involved with others, be sensitive to their daily spiritual needs, and interact effectively

with their environment. The components of this model therefore are: physical, intellectual, emotional, social, spiritual, and environmental health and wellness.

In an attempt to keep older adults healthy and proactive toward aging, a comprehensive model was established by Montague and colleagues (2002). This model emphasizes increasing knowledge of older individuals in helping them recognize the benefits of a healthy lifestyle. In this health promotion model, it is important to work from the inside out. This model places personal wellness as its focus and notes that each dimension of wellness interacts with personal wellness to enhance quality of life and individual health. **Montague, Piazza, Peters, Eippert, & Poggiali (2002)** developed a wellness model called the “*whole-person*” wellness model. In this model, personal or individual wellness at the center of the model has a bi-directional interaction with each of the wellness dimensions. Similar to Crose et al. (1992), the six dimensions of wellness in this model are: physical, spiritual, vocational, emotional, social, and intellectual. All of these dimensions interact with personal wellness concepts, and each of the other wellness dimensions. Personal wellness concepts are defined as self-responsibility for: dimensions of health, optimism, self-direction, personal choice, and self-efficacy. In this model, it is important to acknowledge that individuals are complex and multidimensional beings. Furthermore, this model recognizes that a collaborative effort must be present among the older adult, his/her family members, the community, and healthcare providers in order to promote health and quality of life.

Expanding upon the earlier Witmer and Sweeney (1992) model, **Myers and Sweeney (2004)** created ‘The Indivisible Self’ model with the central tenet that wellness is more psychological in nature than physical. The authors state that wellness is a way of life oriented toward optimal health and well-being in the body. They focus on integration of the mind, body,

and spirit in terms of wellness promotion. Furthermore, the authors state that by identifying characteristics of healthy individuals, counselors will be able to assist people in developing and maintain healthy lifestyles and lifestyle choices that promote increased quality of life, and ultimately enhanced well-being. Thus, this model was developed with the intention of providing an assessment tool in psychological counseling effective in identifying targets areas for improvement in health and wellness. This model highlights 17 dimensions of wellness (e.g. stress management, exercise, nutrition, and emotions) that holistically comprise “the Indivisible Self”. The dimensions are comprised of those that enable healthy persons to interact with their environment effectively. These dimensions are further grouped into five 2nd order factors: Essential Self, Creative Self, Coping Self, Social Self, and Physical Self. This model has implications for mental health and counseling research in that it emphasizes lifestyle decisions as direct influential factors of health and wellness.

Similar to the Witmer and Sweeney (1992) wheel of wellness, Travis and Ryan (2004) also divided wellness into a multidimensional wheel in which each section had an impact on the other. Their wheel consisted of 12 categories that they defined as ongoing processes occurring in everyday life. The authors also highlighted the importance of not only the absence of negative elements of health, but additionally, the presence of positive elements contributing of a healthy lifestyle. The proposed model emphasizes the psychological contribution to wellness in that **Travis and Ryan (2004)** state that subjective growth in areas of wellness accounts for better overall wellness. Moreover, these scholars developed a Wellness Workbook that outlined various categories of wellness. The categories are divided into a 12 section wellness wheel consisting of: transcending, finding meaning, sex, communicating, playing/working, thinking, feeling, moving, eating, sensing, breathing, self-responsibility and love. Each of the sections implies that wellness

is an ongoing process that has implications on other variables (thus its holistic nature). Wellness is seen as more than just the absence of the negative elements (illness and disease), but also the presence of positive elements (physical health and happiness). Thus, it is the process of integrating awareness, education and growth of the subjective components that accounts for wellness. Dimensions of this model include: physical, emotional, social, intellectual, spiritual, occupational, and environmental.

Anspaugh, Hamrick, & Rosato (2006) developed their model as an integration of two of the prominent models of the time (i.e. the Wheel of Wellness and the Wellness Workbook). They described wellness as a holistic approach considering all aspects of influence on the body and not just health. They state that wellness is not just the lack of negative symptoms, but the presence of positive elements as well. It is the proactive and balanced approach of the mind, body, and spirit in terms of health and fitness. The concepts discussed in this model: physical, emotional, social, intellectual, spiritual, occupational, and environmental are referred to as areas of human needs. The authors emphasize the importance of self-responsibility for continual growth in these dimensions of human needs. Thus, this model was established in terms of providing students with the knowledge and understanding necessary to take life into their own hands and make subsequent behavioral changes to improve health and wellness.

Consistent with the emerging theme of the time, Hales (2006) incorporates a definition of wellness identifying the importance of both the positive and negative elements of wellness. Similar to Renger et al. (2000), this model states that the active process of seeking better health and maximizing wellness components leads to a high-level state of wellness.

Hales (2006) devised a holistic wellness model with an emphasis on wellness being perceived as the collective sum of the absence of the negative elements (illness and disease) and

also the presence of positive elements (physical health and happiness). Hales states that one must actively work at wellness since wellness is not a static state. High-level wellness can be achieved if one takes care of his/her physical self, constructively utilizes his/her mind, uses creativity to be involved with others, expresses emotions effectively, and is concerned about his/her psychological, physical, and spiritual environments. The components of this wellness model are: physical, emotional, social, intellectual, spiritual, occupational, and environmental.

Botha & Brand (2009) developed a model for managers in higher education institutions in an attempt to expand upon prior holistic wellness models and further their utilization to that of individuals in higher education. The authors note that by identifying the health risks of managers in tertiary institutions and calculating health risks via wellness behaviors, wellness interventions could be proposed that would improve wellness behaviors and reduce health risks. Although similar to previous models of wellness, this particular model was targeted and tested on a specific population in higher education, managers. This model included dimensions of: physical, social, emotional, intellectual, occupational, and spiritual wellness. This model was designed to serve as a theoretical foundation for the assessment of health levels and wellness behaviors by identifying unhealthy lifestyle behaviors.

Roscoe (2009) conducted a literature review synthesizing existing wellness models. In an attempt to develop a model useful in counseling and development, Roscoe utilized many of the preexisting wellness models to construct her model (i.e. Adams et al., 1997; Crose et al., 1992; Durlak, 2000; Greenberg, 1985; Hettler, 1980; Lafferty, 1979; Leafgren, 1990; Myers, Sweeney, & Witmer, 2000; Renger et al, 2000; Witmer & Sweeney, 1992). This model consisted of seven dimensions: social, emotional, physical, intellectual, spiritual, occupational, and environmental. Roscoe theorizes that her model is a synergistic and multidimensional construct that is

represented on a continuum, not as an end state. Similar to that of Witmer and Myers (1992) and Myers and Sweeney (2004), this model has implications for counseling and development.

In an effort at creating a new assessment to measure holistic wellness in young adults, Brown & Applegate (2012) established the Holistic Wellness Assessment. This assessment was proposed as a way of incorporating traditional wellness dimensions with a new wellness dimension of financial wellness. This measure explored aspects of other wellness instruments to date in order to gain an accurate reflection of the dimensions of wellness pertinent to today's young adults. **Brown & Applegate (2012)** created their holistic wellness model to be applicable to a college student sample. This model incorporates *financial wellness*, which is an important gap in the literature according to the authors. The Holistic Wellness Assessment is a way in which college students can self-assess their own individual health status based upon the evaluation of identified wellness dimensions pertinent to this specific population. The eight dimensions of this wellness model are: self-regard, self-awareness and responsibility, sustainability, relational, risk prevention, spirituality, physical health, and health care maintenance. The dimension of financial wellness is integrated within the self-regard, self-awareness and responsibility, and sustainability dimensions.

Summary

Although a plethora of wellness models have been constructed, one pivotal notion remains constant, wellness is a holistic concept comprised of various interrelated components of everyday life that are utilized to predict overall health. Wellness has several features including: being holistic, consisting of multidimensional constructs, focusing on lifestyle behaviors, being about actions or processes, and recognizing the inter-relatedness between person and environment (Rachele, Washington, Cockshaw, & Brymer, 2013). Although there is still some

ambiguity on the exact dimensional structure of wellness, it is the summation and balance of multiple dimensions that researchers have consistently agreed upon in terms of what encompasses, and ultimately defines wellness.

Dimensions have been presented stemming from a variety of backgrounds such as: healthcare, counseling, occupational health, etc. As such, there are inconsistencies in what comprises the dimensions of wellness and the number of wellness dimensions in general. For example, some researchers have proposed intellectual wellness (Botha & Brand, 2009; Crose et al., 1992; Hales, 2006; Hettler, 1980; Lafferty, 1979; Roscoe, 2009), others propose mental wellness (Brown & Applegate, 2012; Greenberg, 1985), while still others propose psychological wellness (Adams et al., 1997, Adams, Bezner, Drabbs, Zambarano, & Steinhardt, 2000; Miller & Foster, 2010a, b; Myers & Sweeney, 2004; Witmer & Sweeney, 1992). When investigating the conceptualizations of each of these dimensions, we see that all involve stimulating activity of the mind in order to promote better overall health. However, although similar in nature, these dimensions have been defined differently and are oftentimes confusing to differentiate by mere definition alone. There are conflicting theories as to which dimension represents what, and more importantly, to an actual definition of the construct of wellness. Therefore, the following section synthesizes the dimensions of wellness included in the major theoretical wellness models reviewed thus far (see Table 1 for a summary):

Dimensions of Wellness

Physical Wellness

Physical wellness is wellness of the physical body. It is the biological and physiological processes that compose the physical aspects of a person's development and functioning (Myers & Sweeney, 2008). It has been described as the maintenance of physical predictors of health,

such as blood pressure, muscle tone, and self-care, as well as, the optimization of positive health behaviors such as eating habits and exercise levels (Durlak, 2000; Myers & Sweeney, 2004; Roscoe, 2009). It is also defined as the degree to which one maintains and improves cardiovascular fitness, flexibility, and strength (Hettler, 1980). Optimal physical wellness is the combination of good exercise and eating habits, while striving to build strength, flexibility, and endurance and discouraging the use of harmful substances like tobacco, drugs, alcohol, etc. (Botha & Brand, 2009; Montague et al., 2002; Hettler, 1980; Renger et al., 2000).

In the discipline of exercise physiology, many of these same variables are the primary indicators used to determine physical fitness. These indicators are: cardiorespiratory endurance, muscular fitness, flexibility, and body composition. Thus, physical wellness can be described as the preservation and active continual improvement of physical health by engaging in appropriate physical activities that promote: stamina, strength, flexibility, and healthy body composition.

In terms of holistic wellness models, the physical dimension was regarded as having the most influential impact on overall wellness (Archer, Probert, & Gage, 1987). For example, exercise self-efficacy predicted perceived overall wellness among college students (Sidman, D'Abundo, & Hritz, 2009), thus indicating that belief in one's exercise ability is an influential factor of perceptions of overall wellness. Physical aspects of wellness are often targeted in interventions to improve individual and societal health (Cook, 2011). Models examining physical wellness have explored subjective health utilizing perceived views of physical fitness addressing an individual's physical health, physical activity level, nutrition, self-care, and vitality or longevity (Adams, Bezner, & Steinhardt, 1997; Brown & Alcoe, 2010; Miller & Foster, 2010a,b; Myers & Sweeney, 2005; Myers, Sweeney, & Witmer, 2000; Roscoe, 2009). Physical wellness

is important to establish when a person is young as it immensely affects future health (Cavallini, Wendt, & Rice, 2007; Hettler, 1984).

Roscoe (2009) and Adams et al. (2000) both highlight physical resilience as an important component of physical wellness. Physical resilience refers to the positive perception and expectation of physical health. Physical resilience is the capacity of the body to adapt to changes and meet the demands placed upon it. In conclusion, physical wellness tends to refer to an individual's knowledge about proper exercise habits, diet, and nutrition in order to make healthy lifestyle choices, and discourage bad ones, as well as, having high physical resilience.

Social Wellness

Social wellness emphasizes the importance of social relationships and how individuals can lead healthier lives and become contributing members of society (National Wellness Institute, 2016). Social wellness denotes relationships via interactions with others, the community, and nature (Foster & Keller, 2007). The National Wellness Institute states that for this dimension, it is better to contribute to the common welfare of one's community than to think only of oneself. It is also better to live in harmony with others and our environment than to live in conflict with them. Becoming more socially well is contributing to one's environment and community and becoming more aware of individual importance on society and individual impact on multiple environments, thus emphasizing the interdependence between others and nature (Hettler, 1976; Montague et al., 2002). Social wellness has been referred to as a humanistic concept (Montague et al., 2002), focusing on the various interactions in life with the whole person. Dimensions such as: environmental wellness and social awareness (Botha & Brand, 2009), social support (Adams, Bezner, & Steinhardt, 1997; Agneessens, Waeye, & Lievens, 2006), peer acceptance, attachments/bonds with others, and social skills (Durlak, 2000; May,

2007), social connectedness (Adams et al., 2000), and friendship and love (Witmer & Sweeney, 1992; Myers & Sweeney, 2004, 2008; Myers, Sweeney, & Witmer, 2000) have been cited in research as reflective of social wellness.

Being socially well also has various positive health implications. For example, in Myers & Sweeney's (2004) wellness model, the continuum of friendship and love are representative of social wellness. The authors found that friendships and intimate relationships enhanced both quality and length of life. In addition, Agneessens, Waeghe, & Lievens (2006) state that social support is positively correlated with lower stress levels, emotional and psychological well-being, physical well-being, and health and longevity of individuals. Although various components have been proposed examining multiple components of social wellness, there is a common theme among them, social wellness encompasses the quality and extent of interactions with others and the interdependence between the individual, others, the community, and nature (Roscoe, 2009). It is the ability to develop and maintain meaningful relationships, to contribute to the community in an effective and productive way, and to balance the various life interactions between the individual, society, environment, nature, and work.

In conclusion, social wellness is broad in domain because it includes interactions with individuals and others, the community, nature, and work. Furthermore, the quality and extent of such relations are affected by motivation, action, intent, and perception of oneself and others to the interactions (Miller & Foster, 2010b). With its emphasis on creating and maintaining healthy relationships in all domains of life, social wellness proves to be very important in wellness research as we live in an increasingly social world.

Emotional Wellness

Emotional wellness gives one the ability to get through the rigors of life (National Wellness Institute, 2016). It is the continual process that includes the awareness and management of feelings, and a positive view of self, the world, and relationships (Helliwell, 2005). Some of the aspects that emotional wellness encompass are: self-acceptance, self-confidence, self-control, happiness, life satisfaction, coping skills, and trust. Emotional wellness helps one to have a better outlook on life and consequently so, enjoy life to the fullest. Hettler (1976) states that an individual who is emotionally well should be aware of and accept one's own feelings rather than deny them. Likewise, an individual should be an optimist in one's approach to life, rather than pessimist. Awareness and acceptance of one's own feelings is central to emotional wellness (Adams, Bezner, & Steinhardt, 1997; Botha & Brand, 2009; Foster & Keller, 2007; Helliwell, 2005; Hettler, 1976; Leafgren & Elsenrath, 1986; Miller & Foster, 2010b; Montague et al., 2002; Myers, Sweeney, & Witmer, 2005; Ryff & Singer, 2006; Roscoe, 2009).

Feelings play an important role in emotional wellness. It is the control and expression, rather than suppression, of these feelings that promotes one being emotionally well. Positive and optimistic outlooks on life, paired with constructive coping mechanisms to life stressors are reflective of emotional wellness (Miller & Foster, 2010b). Botha & Brand (2009) state that emotional wellness is divided into the categories of emotional management and emotional awareness, with sexual health being a component of emotional awareness. In terms of emotional management, the ability to effectively cope with aspects of life such as stress, burnout, anxiety, and depression are essential to emotional management (Botha & Brand, 2009). Furthermore, self-esteem plays an important role as confidence in oneself and one's abilities can alter one's emotional state, ultimately impacting other domains of life. In fact, according to Adams, Bezner,

& Steinhardt (1997), self-esteem is a key factor in emotional wellness and it is thought to be one of the more robust predictors of general well-being. The authors further the importance of self-esteem in reference to emotional wellness by conceptualizing emotional wellness as the control of a personal sense of identity and positive sense of self-regard, both of which are defining characteristics of self-esteem.

Emotional awareness is the acceptance of a broad spectrum of feelings in oneself and others (Hettler, 1976). Myers, Sweeney, & Witmer (2000) posit that the ability to experience emotions and utilize them to guide one's behavior in an effective and productive way is an indicator of healthy functioning. Emotional awareness is an interaction between oneself and others in which the individual is able to recognize, feel, and express both positive and negative emotions. It is this awareness and control of feelings both internally and externally, as well as, the sustainment of a positive view of the self and gratifying relationships with others that promotes one's ability to cope with stress and other life circumstances (Adams et al. 1997). In conclusion, emotional wellness is the ability to both recognize and manage emotions and subsequent behaviors in a positive and healthy manner, while maintaining an optimistic approach to life and to be emotionally aware of and accept the various feelings about oneself and others.

Intellectual Wellness

The intellectual wellness dimension addresses creativity, stimulating mental activities, and the ability to be open to new ideas (National Wellness Institute, 2016). People who are intellectually well continually try to expand their knowledge and skills, while remaining willing to share their knowledge and skills with others. It is better to stretch and challenge our minds with intellectual and creative pursuits than to become self-satisfied and unproductive (Hettler, 1976). Intellectual wellness is the optimal amount of intellectually stimulating activity (Adams,

Bezner, & Steinhardt, 1997; Adams et al., 2000) that an individual undergoes and it involves personal growth through means of education, achievement, and creativity (Renger et al., 2000). This stimulation, which includes problem solving, learning, and creativity, is necessary for the functioning of a healthy brain across the life span (Myers, Sweeney, & Witmer, 2000). Intellectual stimulation has been shown to promote the use of one's mind to create a greater understanding and appreciation of oneself and others as it involves the ability to think creatively and rationally by actively learning about current issues and ideas. This dimension also encourages individuals to expand their knowledge and skill base through a variety of resources and cultural activities (Montague et al., 2002). As we can see, education and literacy are important elements of intellectual wellness. Griffin (2005) states that the ability to problem solve, improve writing and verbal skills, keep abreast of social and political issues, and read books, magazines, and newspapers is one fundamental way to assess intellectual wellness. Roscoe (2009) posits that one achieves an optimal level of stimulating intellectual activity by both continual acquisition, and the use of, sharing of, and application of knowledge in a creative and critical manner. One who is intellectually well is one who shows a personal commitment to lifelong learning and an interest in sharing one's knowledge with others (Brown & Alcoe, 2010). Utilizing both intellectual and cultural activities causes one who is intellectually well to value both intellectual growth and stimulation while remaining eagerly curious to learn (Hettler, 1976).

Interestingly, Miller & Foster (2010b) conceptualize intellectual wellness as more closely tied to emotional wellness than its own dimension. They state that intellectual wellness assesses cognitive ability, and cognitive functioning is part of the psychological aspect of wellness which they believe is controlled by emotional wellness. Therefore, the authors contend that this dimension should actually be considered a component of emotional wellness.

In conclusion, intellectual wellness is the active and continual process of pursuing and retaining knowledge via stimulating intellectual activity. It involves problem solving, creativity, learning new skills and information, and a commitment to both sharing with and learning knowledge from others. One who is intellectually well will utilize such information to identify problems and/or critical issues, make sound judgments, propose potential solutions, and act in a way that promotes personal growth and the betterment of society.

Spiritual Wellness

The dimension of spiritual wellness focuses on meaning and purpose in life as it is thought to be better to ponder the meaning of life for ourselves and to be tolerant of the beliefs of others than to close our minds and become intolerant (National Wellness Institute, 2016). It is a belief in a unifying force, integrative force between mind and body, or a positive perception of meaning and purpose in life (Adams, Bezner, & Steinhardt, 1997). Myers & Sweeney (2008) state that these personal beliefs are fundamental for the recognition that a person is more than just material aspects of the mind and body. Thus, aspects of spiritual wellness include: the ability to forgive, to show compassion, and to love. Renger et al., (2000) furthers this notion by conceptualizing spiritual wellness as the rudimentary purpose in life. The ability to give and/or receive love, joy, and peace, pursue a fulfilling life, and help others is vital to this spiritual dimension. Montague and colleagues (2002) add that finding both purpose and meaning in the existence of humans involves an appreciation for life itself. Becoming spiritually well requires finding a sense of meaning and purpose for one's own life in order for one to find purpose and meaning in others. For example, in Roscoe's (2009) review, spiritual wellness is conceptualized as an innate, continual process of finding meaning and purpose in life by developing one's own values and beliefs and sharing a connection with others, nature, the universe, and a higher power.

As we actively search for our purpose in life, we develop a sense of appreciation of life in general and of the connectedness of the vast natural universe (Hettler, 1976; Myers, Sweeney, & Witmer (2000).

Spiritual wellness is also conceptualized as a deep appreciation and feeling of connection with a higher power. It involves learning more about oneself and recognizing core values (Alcoe, 2010; Brown & Alcoe, 2010). It is also important to note that developing spirituality can result in one being more religious, whereas religion may not deepen one's spirituality (Adams et al., 2000). Therefore, spirituality is not synonymous with religion; however, religious beliefs can be included in the spiritual dimension. Furthermore, the spiritual dimension recognizes that there are multiple spiritual paths that all teach basic human principles. Hence, regardless of spiritual path or religious beliefs, all can achieve spiritual wellness.

Personal beliefs (Koenig, 2004) and values (Botha & Brand, 2009) are also very important to establish when seeking a sense of spirituality. If individuals live each day in a way that is consistent with their values and beliefs and also develop fulfilling relationships with others, the natural environment, the universe, and a higher power in an attempt to search for meaning and purpose in life, they will live a spiritually well life. Thus, spiritual wellness is the continual process of seeking and finding a positive sense of meaning and purpose in life, while appreciating the intricacies of life itself. It is understanding that the world and universe are both very complex and that everything was created for a reason and has a specific purpose in life. It is developing a personal belief system and a system of faith in something that is beyond oneself (i.e. higher power) and living by those systems to govern everyday actions.

Occupational/Vocational Wellness

Occupational wellness refers to the personal satisfaction one obtains from one's career (National Wellness Institute, 2016). It includes a sense of fulfillment in one's work, and the balance between work and leisure time (Foster & Keller, 2007). It recognizes satisfaction and enrichment in one's life through work (Hettler, 1976). Therefore, the attitude, thoughts, and feelings about one's work and/or vocation, choices of profession and career ambitions, all play an important role in an individual's level of occupational wellness. Botha & Brand (2009) define job satisfaction and the work-life balance as the main tenets of one's occupational wellness. Furthermore, job satisfaction has a positive relationship with both psychological and physical factors of well-being (Botha & Brand, 2009) and work aids in the attainment of some of the major functions of life such as economic support, psychological purposes, and social benefits (Herr & Cramer, 1988). Thus, it is better to choose a career/vocation that is consistent with one's own personal values, interests, and/or beliefs than to select one that is not in line with one's core values. By doing so, it will promote a feeling of meaningfulness in the workplace environment that can foster greater health and well-being (Gallagher, Muldoon, & Pettigrew, 2015). Moreover, feeling that one's skills are utilized appropriately and valued by the community, and the ability to cope with various workplace stressors, are all traits of a well individual (Miller & Foster, 2010b; Myers & Sweeney, 2008). It is better to develop practical, transferable skills through structured involvement opportunities at work from which an individual will gain personal satisfaction and find enrichment in one's life (Leafgren & Elsenrath, 1986). Job satisfaction will increase as one is able to contribute learned skills that are both meaningful and rewarding to benefit the workplace. In conclusion, occupational or vocational wellness is dependent on one's feelings about work and whether or not one feels work is meaningful and

enriching and is a safe and positive environment contributing to personal growth. It is also related to the ability to balance occupational and other responsibilities, express personal values openly, have financial stability, and provide skills beneficial for enhancing the workplace atmosphere.

Environmental Wellness

Environmental wellness encompasses the relationship between an individual and the global environment. It is balancing relationships between the self, environment, and nature (Ardell, 1977). Miller & Foster (2010b) posits that environmental wellness focuses on interactions of individuals with their home, work, community, and nature. Similarly, Renger et al. (2000) and May (2007) defined environmental wellness to include the balance between home and work life through an individual's relationship with both nature and community resources. One becomes environmentally well by respecting one's global and nature environment and being cognizant of the impact one's actions have on the natural environment and local community. In addition, Reese & Myers (2012) introduced the wellness component of "EcoWellness", which is fairly analogous to previous conceptualizations of environmental wellness. EcoWellness is a feeling of connectedness with the natural environment resulting from a sense of appreciation and respect for, and awareness of nature.

Physical infrastructures and environmental features such as: recreational areas, good public transportation, and smoke-free public areas are some elements associated environmental wellness. The natural environment includes phenomena in nature related to human actions such as: exposure to pollutants, safe food supplies and drinking water, well-being of wild species living in the local environment, etc. Thus, environmental wellness includes interactions with home, work, the community, and nature (Miller & Foster, 2010b) and focuses on the extent of

control over and an individual's reciprocal interaction with such environment (Roscoe, 2009). In conclusion, it is taking a responsibility in creating and maintaining sustainable living communities that can positively impact the global environment and reduce negative environmental hazards.

Psychological/Mental

Psychological wellness is wellness of the mind and the subsequent behavioral actions. It is the ability to have personal control over one's life and cope with every day stressors in a positive and affirming manner. More specifically, it is controlling one's behavioral response to life stressors by way of conscious restraint. Adams, Bezner, & Steinhardt (1997) define psychological wellness as a general perception that one will experience positive outcomes to the events and circumstances of life. This positive confidence about life and the future is known as optimism. Adams et al. (2000) discuss optimism as a central tenet representative of psychological wellness. The authors state that dispositional optimism and a sense of coherence about the world around us are crucial for one's psychological wellness.

Various researchers have conceptualized psychological wellness similarly to emotional wellness as they both encompass feelings, behaviors, relationships, goals, and personal strengths (Hamilton & Redmond, 2010). However, there is some debate regarding the dimension of psychological wellness because it is closely related conceptually to emotional wellness, that it may actually be a dimension of emotional wellness. For example, Miller & Foster (2010b) conceptualized psychological/emotional wellness as one dimension and noted that this form of wellness develops as one matures. Mental wellness has also been thought of as a factor of emotional or psychological wellness. Greenberg (1985) discusses the component of mental health or wellness as the ability to learn, as well as the encompassment of intellectual

capabilities. Being that psychology is defined as the study of behavior and the mind, this definition of mental wellness fits nicely in either a dimension of psychological or intellectual wellness. Indicators such as happiness, life satisfaction, and positive mental health have been discussed as encompassing components that are indicative of one being psychologically well. In conclusion, psychological wellness is wellness of the mind and it includes feelings and behaviors that are reflective of a stable mental and emotional state. It includes having an element of control over one's life and the ability to cope with the demands and stressors of life in a positive and constructive manner.

The aforementioned dimensions have been explored as a subjective way to assess health and wellness. Although there are benefits to subjective measures such as being non-invasive, cost-effective, and quick, human error still poses a great risk in terms of validity and generalizability (Northrup, 1997). For example, what one individual may perceive to be emotionally draining, another may not. Something psychologically taxing on one, may pose no such discomfort for another. As such, a more concrete methodology for exploring the effects that dimensions of wellness have on health is warranted to address these issues with both generalizability and validity with respect to self-report. Moreover, individual differences in perception cause individuals to respond with much variability. Accordingly, there is a gap in the literature in terms of an objective, more generalizable way to link health and wellness.

The Autonomic Nervous System

One way to assess the link between wellness and health is to examine objective measures of health and correlate them to the subjective concept of wellness. There are numerous ways in which health status can be assessed; however, given the link between the Autonomic Nervous System (ANS) and health, explorations into ANS functioning can prove to be beneficial in

understanding the connection between health and wellness. Our understanding of the ANS has grown over the last 20 years, specifically on how its functioning relates to the health of individuals (Carnethon et al., 2003; Carney, Freedland, & Veith, 2005; Thayer, Åhs, Fredrikson, Sollers III, Wager, 2012). The ANS is regulated by the hypothalamus in the brain (Buijs & Van Eden, 2000). The hypothalamus, part of the limbic system, is an important area of the brain that functions as the link between the ANS and the endocrine system via the pituitary gland. The hypothalamus also governs various physiological changes in the body such as: body temperature, sleep and circadian rhythms, emotion, and hunger. The main role of the hypothalamus is to maintain homeostasis in the body by controlling of the production and release of hormones in the body. Due to the link between the ANS and this important brain region that has a multitude of behavioral, endocrine, and metabolic effects on the entire body, it is critical to examine ANS functioning as it relates to the concept of wellness.

The ANS regulates key involuntary functions of the body and is appropriately named “autonomic” due to its autonomous nature (i.e. working automatically without conscious effort). The ANS acts in response to external information about the body and/or the external environment. The ANS is divided into two main divisions: the Sympathetic Nervous System (SNS) and the Parasympathetic Nervous System (PSNS). The SNS is important in the regulation of the fight-or-flight response to stress, while the PSNS branch of the ANS governs the opposing rest and digest response (Beissner, Meissner, Bär, & Napadow, 2013). Both divisions play key roles in regulating physiological responses in the body such as: heart rate, respiratory rate, salivary rate, and ciliary muscle control by acting in opposition to one another in response to changes from homeostasis.

Referred to as the “fight or flight” response system in the body, the SNS prepares the body for both stressful encounters and/or threatening situations. For example: heart rate increases, stored energy is released from the liver, muscular strength increases, pupils dilate, and the airways widen making breathing easier. Additionally, the SNS manufactures and releases catecholamines (epinephrine and norepinephrine) which act as neurotransmitters. The purpose of these neurotransmitters is to activate both the brain and body when the body dissuades from homeostasis. Consequently, an overactive SNS, or state of autonomic imbalance (i.e. reduced vagal function), has been shown to be associated with pathological conditions leading to ill health and mortality (Parati & Esler, 2012; Thayer & Lane, 2007).

The parasympathetic division of the ANS is referred to as the “rest and digest” system. This system is more dominant during normal body functioning or homeostasis. The parasympathetic division performs functions such as: slowing heart rate, decreasing blood pressure, stimulating the digestive tract, and storing energy. The PSNS is associated with the neurotransmitter acetylcholine (ACh). This neurotransmitter is found at the neuromuscular junction and signals smooth muscles to relax, leading to vasodilation. Additionally, ACh has been associated with the promotion of REM sleep. The PSNS has also been associated with sleep, therefore implying a relationship between ACh and the PSNS, specifically related to the “rest” and rejuvenation component of this division. Additionally, decreased PSNS tone has been shown to be linked to ill health (Thayer & Brosschot, 2005).

Taken together, stimuli from the environment stimulate body processes and either the sympathetic division, or the parasympathetic division, responds accordingly. The two divisions work in tandem to ensure that the body responds appropriately to stimuli. Oftentimes having opposite effects in the body, both the SNS and PSNS work to attend to various stimuli, as well

as, maintain homeostasis in the body. These two divisions are important in the functioning of the ANS. Deficits in one of these divisions causes autonomic dysfunction or autonomic imbalance, which can be detrimental to overall health.

ANS Modalities

Skin Conductance

One way to examine ANS functioning is to examine Skin Conductance (SC), a measure of arousal. Higher SC Response is associated with enhanced memory consolidation, emotional processing, and attention (LaBar & Cabeza, 2006). Additionally, higher levels of SC have been connected to increased stress (Liu et al., 2015; Oliver, Datta, & Baldwin, 2017b). Also known as Galvanic Skin Response (GSR), SC is an indicator of sympathetic nervous system activity and has been used to examine the ANS response to stress and other psychophysiological stimuli (Hall, 2015). As an index of autonomic arousal, it is measured via changes in electrical resistance of the skin. Arousal to stimuli increases sweat gland activity via the ‘fight or flight’ response. The secretion of sweat is controlled by the SNS, and these nerves are cholinergic fibers (Hall, 2015). When the sweat glands become activated, they fill-up and SC increases before the sweat is removed. Thus, bursts of SNS activity lead to changes in SC (Storm et al., 2002). Therefore, given the activation of the SNS in response to arousal, a link between SC and health can be inferred.

Many studies have been conducted which indicate the effectiveness of SC as a reliable measurement for SNS activity. Increases in skin responses are positively correlated with increases in levels of stress as demonstrated by Perala & Sterling (2007). In this study, an armband designed to allow for the obtainment of physiological activity outside of a laboratory setting was utilized. This armband was used to gather GSR in soldiers as they were subjected to

daily stressors in a more natural setting. Participants wore this armband and were evaluated on aspects of target detection, recognition, and identification as they moved through military operations on urbanized terrain (MOUT) and a movement route. Results showed that GSR levels were less in the movement route than the MOUT trials. The authors suggested that this might be due to the fact that the unpredictable nature of the targets and more confined space led to more stress in the participants. They also examined GSR in comparison to self-report measures of stress. GSR and self-report measures were in the same general direction and were higher at night. The authors posit that this may be due to the fact that night scenarios could be more stressful from the lack of resources available in the daytime. In a study by Bach, Flandin, Friston, and Dolan (2010), the authors found that the variance in skin conductance could be explained by differing event-related skin conductance responses. That is, examining the onset of the event in relation to whether the stimulus evoked the response or a non-stimulus-locked skin conductance response has occurred. Event-related SC responses tend to peak in seconds, whereas non-stimulus-locked SC responses can vary up to minutes. Future research should assess the differing SC time courses to assess the mechanism of action related to SC and SNS activity in regard to psychosocial stressors. For example, Bach et al. (2010) reported that the variance in skin conductance could be explained by differing event-related skin conductance responses. Event-related SC responses tend to peak in seconds, whereas non-stimulus-locked SC responses can vary up to minutes. As noted in Oliver, Datta, & Baldwin (2017b), although stimuli may be stressful enough to stimulate immediate responses [i.e. salivary alpha-amylase (sAA) reactivity], it may not be strong enough to evoke immediate SC responding. This suggests a time parameter continuity in the SNS in which sAA is activated due to an immediate stressor. However, the ruminating effects of the stressor may later activate SC. Thus, explorations into SC can provide

important information regarding ANS arousal, specifically in relation to health and wellness.

Electroencephalogram

Electroencephalograms (EEG) are used to measure and record electrical activity of the brain. Electrodes are placed along the scalp and electrical brain potential are measured from voltage fluctuations within neurons of the brain. Measured in Hertz (Hz), the most common waves explored are: Delta (≤ 4 Hz), Theta (4-8 Hz), Alpha (8-13 Hz), and Beta (>13 Hz) (Teplan, 2002). Normal delta waves are associated with adult slow-wave sleep, while theta is higher in children and represents “idling” in adult and teens. Alpha waves reflect relaxation, is normal when the eyes are closed, and is associated with inhibition control. Alternatively, beta is associated with active thinking, focus, vigilance, and/or anxiety. In terms of measurement, typically different brain regions are identified based upon the research question and EEG waves are explored in order to identify relationships.

In a study conducted by Tang et al. (2009), an integrative body-mind training protocol was explored. The authors found increases in high frequency heart rate variability and EEG power in the theta frequency band in the experimental group when compared to controls. The authors attribute these findings to greater involvement of the ANS and more specifically, the PSNS branch of the ANS. This finding indicates that both increases in heart rate variability and theta frequency are critical in the activation of the PSNS. Similarly, another study found changes in EEG and HRV to be evident during meditation in a college student sample when compared to controls (Takahashi et al., 2005). In terms of EEG, both slower frontal alpha power and faster frontal theta power were found. An analysis of HRV revealed decreases in LF and LF/HF ratio and an increase in HF HRV during meditation utilizing mindfulness techniques. Taken together, the authors posit that meditation led to an inhibition of the SNS and an activation of the PSNS.

Moreover, less alpha power and more theta power seem to indicate less sympathetic dominance and more vagal activity (parasympathetic dominance). Thus, an exploration into EEG activity in conjunction with other parameters of the ANS proves to be beneficial when exploring the effects that both have on health.

Heart Rate Variability

Heart Rate Variability (HRV) represents the physiological variation in time intervals between successive beats of the heart. Also known as the beat-to-beat interval, HRV can be used as an indicator of both physiological and pathological health conditions (Malik, 1996). For example, Kleiger, Miller, Bigger, & Moss (1987) found in their examination of patients after survival of an acute myocardial infarction, that decreased HRV was correlated with increased sympathetic or decreased vagal tone. In a study by Hansen, Johnsen, & Thayer (2003), higher HRV was associated with better task performance on cognitive tasks that involved executive function when compared to non-executive tasks. Previous research also suggests that decreased vagal tone may reflect damage to intrinsic cardiac nerves (Airaksinen et al., 1991; Minisi & Thames, 1989) or coronary artery disease due to the inability of the vagus nerve to regulate heart rate, lungs, and the digestive tract effectively. Additionally, decreased vagal tone has been associated with increased risk for cardiovascular disease and mortality (Thayer & Lane, 2007; Thayer, Yamamoto, & Brosschot, 2010).

Thus, the results of the aforementioned studies suggest a direct link between HRV and cardiovascular health. In a review of HRV and its effects on health and disease, Kristal-Boneh, Raifel, Froom, & Ribak (1995) found that HRV is an effective tool and powerful predictor of both cardiovascular morbidity and mortality. Additionally, higher HRV is indicative of a healthy functioning heart, whereas lower HRV can be reflective of autonomic imbalance (Thayer,

Yamamoto, & Brosschot, 2010). Indicators including, but not limited to: coronary artery disease, cardiac arrhythmia, aging, diabetic neuropathy, physical activity, stress, and sleep have all been shown to impact HRV and/or its encompassing components (Acharya, Joseph, Kannathal, Lim, & Suri, 2006). Most of the aforementioned indicators can be either be prevented and/or treated in one way or another (e.g. biofeedback protocol reducing stress, medication for blood sugar, regular physical fitness program, healthy diet) therefore acting as a buffer against autonomic imbalance. As such, HRV can also be used to assess ANS health as higher HRV at rest is associated with more parasympathetic tone, also indicative of better health.

As one of the most important systems in the body in terms of stress and responses to stress, which ultimately impacts health, providing correlations with self-report data to measures of the autonomic nervous system would be very beneficial in terms of health, and ultimately, health promotion. Given the nature of the ANS and its relationship with health, it can be seen as a potential objective lens for a closer examination of the phenomenon of wellness. Although ANS functioning is a concept that is assessed objectively, the phenomenon of wellness is not. Thus, in order to address my goal of identifying an objective measure of wellness, I decided to examine ANS function. Wellness is a subjective concept that has yet to be objectively measured, therefore, I aim to illuminate the ANS as an index of wellness. However, in order to develop a way to correlate objective measures of health to wellness, an operational definition of wellness must first be identified. Thus, the following is a proposed model of wellness that aims to provide the basis for objective and subjective explorations into health and wellness. This model is designed as a testable way to explore ANS functioning in conjunction with wellness in hopes of providing relationships between the two.

CHAPTER III

OVERVIEW OF THE PRESENT STUDIES

A Novel Research Direction for Models of Health & Wellness

As a result of the plethora of models and accompanying dimensions that have been theorized throughout the years, the need for a model of wellness with more general applicability is warranted. The ambiguity and expansive nature of the numerous models is oftentimes dependent on the area of research. As such, wellness models should be constructed in such a way that will allow generalizability across all domains of research. It is important to develop a unified definition of wellness and its constituent factors so that communities, and ultimately society, can support the growing field of holistic wellness that is fundamental in the promotion of health (Dolan, Peasgood, & White, 2008).

Numerous attempts to define the concept of wellness has resulted in a failure to produce a uniform operational definition of wellness. Furthermore, I postulate that this synthesis of wellness domains will provide an effective way for researchers to combine various models into one theoretical model useful across various disciplines and areas of wellness research. In order for this synthesis to occur, common characteristics in which these dimensions can be combined must amount based upon their conceptual underpinnings. The aforementioned review supports the notion that there are often inconsistencies seen within conceptualizations of wellness and the proposed wellness indicators. For example, emotional wellness and psychological wellness are often seen as the same wellness dimension (Hamilton & Redmond, 2010; Miller & Foster, 2010b; Roscoe, 2009). Emotional wellness has been defined as the affective response to a stimulus and the ability to control resulting behaviors. Similarly, psychological wellness has been defined as the ability to cope with stressors in a positive and adaptive manner, as well as the feelings and behaviors reflective of a stable mental and emotional state. Thus, theoretically one could combine Emotional and Psychological wellness into one construct given the consistencies

in the conceptualizations across the domains. Another example is with the dimensions of Occupational and Vocational wellness. These wellness domains are similar in the fact that they both adhere to a definitive structure involving an individual and the extent to which they feel the workplace is meaningful and enriching to his/her life as well as the feeling that they provide skills beneficial to improving the workplace environment. In summary, a synthesis of domains may be an effective means of combining various dimensions into similar constructs allowing for more generalizability. Moreover, it may extricate the copious amount of wellness dimensions and promote the use of common agreed upon components of wellness. It is important to define wellness and its comprising factors so that communities, and ultimately society, can support the growing field of holistic wellness which proves to be fundamental in the promotion of health (Dolan, Peasgood, & White, 2008).

Given the fact that the previous theoretical models of wellness have been based solely on self-report data, there is a gap in the literature in terms of objective measures of wellness. Researchers have used objective ways to measure wellness by correlating physiological, psychological, behavioral, and biomolecular responses to integrative medicine treatment (Knowles et al., 2015) and by correlating objective measures of physical health (e.g. cholesterol, pulse rate, blood pressure, body composition) to perceived wellness measures (DeStefano & Richardson, 1992). However, none to date have examined whether or not multiple dimensions of wellness correlate specifically with objective measures of health and overall body functioning. Moreover, no objectively measured index of wellness has been established. I argue that the current wellness literature has de-emphasized the contributions of health-related factors on the phenomenon of holistic wellness. Although the concept of wellness is subjective in nature (Miller & Foster, 2010a), the WHO linked this subjective concept to the phenomenon of health,

which is objectively measured. Thus, objective measures of health and wellness will be very beneficial in terms of wellness promotion and tailored interventions. Moreover, by identifying an objective index of wellness, this would theoretically reduce measurement error in assessing wellness domains, provide support and validity for subjective responses, provide a gold standard for objective wellness assessment, and enhance science by uncovering a new research direction for wellness research. Finally, in developing this understanding of the effects that alterations in dimensions of wellness plays on health, therapeutic interventions across various settings (i.e. work, school, home) can amount specifically targeting aspects of wellness in adolescents, college students, working professionals, and elderly adults alike, that can improve individual and societal health.

The ANS is important for fight or flight responses via the sympathetic nerves, as well as maintaining homeostasis by means of the parasympathetic nerves. It is one of the most important systems in the body in terms of stress and responses to stress, which ultimately impacts health. Providing correlations between self-report data and measures of ANS function will be beneficial in terms of disease prevention, and ultimately, health promotion. It is my goal to produce a synthesized wellness model which is more inclusive, yet with fewer constructs that incorporates a wide variety of components. I aim to correlate this streamlined wellness model with ANS functioning to establish an objective index of wellness. My hypothesis is that my model, comprised of three primary dimensions, (i.e. physical health, psychological health, and relational health) will encompass all parameters of wellness utilized in existing literature and will be positively correlated with ANS functioning.

Oliver Health Factor Wellness Model: A New Model of Health & Wellness

The Oliver Health Factor Wellness Model represents the synthesis of previous wellness models, and this model will be examined in this paper as a method for correlating self-report and physiological measures of health and well-being. My proposed model will consist of the following dimensions, hereby referred to as “health factors” because they all impact health and well-being. One health factor is **physical health**. Components of physical health include diet, exercise, personal care, hygiene, and Body Mass Index (BMI) to name a few. These components specifically affect the physical health status of an individual. The next health factor is **psychological health**. This health factor is a combination of components such as, emotional wellness (e.g., the control over one's emotions and the ability to cope with stress), intellectual wellness (e.g., stimulation of the mind), mental wellness (e.g., soundness of mind), and psychological wellness (e.g., cognitions and behaviors). The final health factor is **relational health**. Relational health is comprised of social wellness, environmental wellness, occupational wellness, and spiritual wellness. All of these domains incorporate a relational connection whether it be with others, nature, or a higher power. Thus, relational health is a fitting construct that each of these components can represent. See Figure 4 for a depiction of the Oliver Health Factor Wellness Model.

Principle Study Aims and Hypotheses

This paper will provide a framework of studies used to test my proposed model of wellness from both a subjective and objective perspective. Three studies are discussed in this paper that test the *Oliver Health Factor Wellness Model*. Study 1 examines the **psychological health factor** of this model in connection with cognitive performance (acquisition and retention), perceived wellness domains, and ANS functioning at rest in college students. Study 2

examines the **relational health factor** of this model and incorporates a mental imagery social task. In addition, another self-report measure of relational health is introduced. Like Study 1, this investigation will also correlate perceived wellness with ANS functioning at rest in college students. Finally, Study 3 will be an extension of a preliminary study and it will examine the **physical health factor** of the Oliver Health Factor Wellness Model. This study focuses on physical fitness indicators, perceived wellness domains, and ANS functioning at rest in college students.

In the aforementioned studies, I aim to provide support for my wellness model as a synthesis of existing models, as well as, in terms of a link between ANS function and wellness. In addition, I aim to identify relationships between autonomic balance and wellness in hopes of elucidating the ANS as an objective index of wellness. The central hypothesis of this paper is that the ANS will be identified as an objectively measured index of wellness given the expected correlation between indices of ANS functioning, reflective of the balance between sympathetic and parasympathetic tone, and subjective measures of wellness (self-report). More specifically, it is hypothesized that ANS function and perceptions of wellness will be positively correlated. Moreover, by examining alpha-electroencephalogram (aEEG), Skin Conductance (SC), and Heart Rate Variability (HRV) at rest, I expect higher wellness scores to relate to better ANS function/autonomic balance.

CHAPTER IV

STUDY ONE

Introduction

Achieving Psychological wellness is pivotal in order to advance holistic wellness and enhance one's quality of life. One way to assess psychological wellness, wellness of the mind, is to examine cognitive ability and/or performance. There are a variety of factors that affect cognitive performance such as: nicotinic agents (Newhouse, Potter, & Singh, 2004), aerobic fitness (Etnier, Nowell, & Landers, 2006; Hillman, Erickson, & Kramer, 2008), sleep loss (Curcio, Ferrara, & De Gennaro, 2006), and stress (Lieberman, Tharion, Shukitt-Hale, Speckman, & Tulley, 2002). Nevertheless, music has received a substantial amount of attention with respect to correlates of cognitive performance (Corrigall, Schellenberg, & Misura, 2013). Moreover, a wealth of evidence supports the use of music as an intervention for anxiety and stress reduction (Pavlov et al., 2017; Smith & Joyce, 2004; Yehuda, 2011). Therefore, music in many ways is a factor that can influence cognitive performance and overall well-being. However, whether sound intensity or lyrical presence negatively impacts cognitive performance is still a matter of debate. The aim of the present study was to examine the role of sound intensity and music type content on cognitive performance (attention, detection, distraction, acquisition and retention) in adults. The relationship between perceived wellness and resting autonomic nervous system (ANS) modalities was also examined.

The effects of music have been widely examined in the context of cognitive performance. For example, Ho, Cheung, and Chan (2003) tested the hypothesis that music training improves cognitive abilities in children. They found children with music training demonstrated better verbal but not visual memory than their non-musically trained counterparts. More specifically, Schellenberg, Nakata, Hunter, & Tamoto (2007) reported in two studies that exposure to different types of music (up-tempo Mozart and slow tempo Albinoni) enhanced performance on

a variety of cognitive tests in adults and children. Cassidy and Macdonald (2007) assessed whether or not background noise affected task performance in a sample of college students. Results indicated that performance on all of the tasks were poorer while listening to background music than it was for those completing the tasks in silence. In a similar study, Jancke and Sandmann (2010) exposed participants to different background music with varying tempo and consonance. The number of learned words served as the dependent variable, and they found no significant effect of background music on learning outcomes. More recently, Jarraya and Jarraya (2017) reported that tennis players who listened to music before performing the cognitive tasks (e.g., the barrage test and trail-making test) performed better on the cognitive tasks than players who were not exposed to the music prior to the task. Although research is mounting regarding the positive impact of music on cognition, the effects of particular musical features (e.g., sound intensity) are still in question.

The power of music to alter various autonomic nervous system (ANS) modalities such as blood pressure, respiration, and skin conductance is well documented (Kolsch, Schroger, & Gunter, 2002; Krumhansl, 1997). According to Bartlett (1999), fast tempo and loud dynamic music tends to increase heart rate and muscle tension. However, slow tempo and soft dynamic music tends to decrease heart rate, muscle tension, and skin conductance (SC), as well as evoke increases in skin temperature. In a study by Khalfa, Isabelle, Jean-Pierre, & Manon (2002) the hypothesis or whether or not emotional reactions to music could induce responses of the sympathetic nervous system was examined. The researchers exposed 34 participants to previously validated emotional stimuli via musical clips as SC was recorded simultaneously. Results of the study suggest that musically-evoked emotion induces changes in SC in accordance to the level of arousal of the stimuli. Thus, a greater SC response is related to more stimulating

emotions. Given that SC is a relatively direct (i.e., with a lag of only 2 seconds) reflection of the sympathetic nervous system (Cacioppo, Tassinary, & Berntson, 2007), the aforementioned study highlights music as a method of evoking physiological arousal.

Additionally, Iwanaga, Kobayashi, & Kawasaki (2005) demonstrated the effects of music on heart rate variability (HRV). These researchers exposed thirteen undergraduate and graduate college students to three different music conditions (e.g. sedative, excitative, no music) in an attempt to assess heart rate variability (HRV) in response to music type. The results suggest that music that is more excitative in nature decreases the activation of the parasympathetic nervous system as measured via HRV. Similarly, Archana & Mukilan (2016) found that listening to 10 minutes of preferential music post exercise tended to minimize increases in both high and low frequency components. Moreover, exposure to music post exercise significantly minimized increases in LF/HF ratio in medical students indicating a shift towards relaxation. The above studies clearly demonstrate the impact listening to music has on neurophysiological responses in relation to relaxation and wellness. Although ample research has been conducted in terms of the characteristics of music on health and well-being, the effects of sound intensity and lyrical presence itself remains unexplored in relation to psychological wellness.

A wealth of evidence suggests that music is an influential variable on cognitive and physiological outcomes. More specifically, previous research lends support to the notion that non-lyrical music is more beneficial from a cognitive perspective than lyrical music (Anderson & Fuller, 2010; Perham & Currie, 2014). Furthermore, many studies examining musical features focused primarily on background music; sound intensity nor music type have not been adequately studied with respect to cognitive performance or ANS functioning. Therefore, the purpose of the current study was to: 1) Examine the influence of musical characteristics

(intensity and type) on cognitive performance (attention, detection, distraction, acquisition and retention) and ANS modalities [skin conductance (SC), heart rate (HR) & HRV], and 2) Explore if perceived wellness (PWS) scores correlate with ANS functioning at rest. Our main hypotheses were as follows:

Hypothesis 1: Sound intensity would negatively influence cognitive performance as operationalized by the flanker task and the retention questionnaire. I expect that higher sound intensity will be associated with worse performance on the flanker task and worse performance on the retention questionnaire.

Hypothesis 2: Participants exposed to lyrical music would perform worse on the cognitive task (flanker task) than their non-lyrical counterparts. I expect lyrical music to impede the lexical response time and accuracy on the flanker task, thus indicating worse cognitive performance.

Hypothesis 3: Better cognitive performance (assessed via the flanker task and retention questionnaire) would be associated with greater holistic wellness as operationalized by the PWS.

Hypothesis 4: Higher wellness scores on the PWS would show better ANS functioning as assessed by SC, HR, and HRV at rest. Better ANS functioning is operationalized by: lower SC, indicating less sympathetic arousal; lower HR, indicating a better physical fitness state; and higher HRV, indicating better overall physical health.

Method

Participants

Participants consisted of 141 undergraduate students (52 males and 89 females) with a mean age of 20.716 (SD = 3.256) who were recruited online from undergraduate psychology classes for partial fulfillment of course credit. In order to participate, all participants had to be at

least 18 years of age, speak fluent English, not classified as learning disabled or legally “Deaf”. No other exclusion criteria were noted. All participants signed the letter of informed consent prior to data collection and participation was strictly voluntary. This study was approved by the university’s Institutional Review Board (UTK IRB-16-03463-XP).

Materials and Procedure

A desktop Dell computer with two 22-inch color dual-monitors was used to administer the surveys, provide the music, and run the physiological software program used in this study. The physiological measures (SC, HR, & HRV) were sampled via the multichannel Procomp Infiniti™ and Biograph software system (Thought Technology Ltd., Montreal, Canada). All sensor leads were connected to this 8 channel encoder, and the physiological data were exported into a data file. SC was measured using cuffs with sensors fastened around the middle and index fingers of the non-dominant hand. SC is measured in micro-Siemens units, and these data were collected at 32 Hz. A higher level of skin conductance indicates a higher level of arousal. HR (beats per minute) and HRV were measured via 3-lead electrode sensors placed on the wrists and forearm of the participant, and these data were collected at 256 Hz. The raw inter-beat interval (IBI) data were analyzed in the time and frequency domains. More specifically, HRV was assessed via the following frequency domains: very low frequency (VLF) power between the limits of 0.003 Hz and 0.04 Hz, low frequency (LF) power in the range of 0.04 Hz and 0.15 Hz, high frequency (HF) power in the range of 0.15 Hz and 0.40 Hz, and LF/HF ratio. According to Koenig and Thayer (2016), the HF component reflects parasympathetic cardiac control and LF is indicative of baroreflex activity. Finally, the LF/HF ratio indicates autonomic balance. The time-domain measure also included the standard deviation of normal-to-normal intervals (SDNN). These data were recorded continuously for 5 minutes.

Demographics. A self-report questionnaire was used to obtain information on age, race, gender, relationship status, and other demographic information.

Perceived Wellness. This survey was used to assess perceptions of wellness in various dimensions. This 36-item survey was developed by Adams, Bezner, & Steinhardt (1997) to measure wellness perceptions in adults. Responses range from 1 (very strongly disagree) to 6 (very strongly agree). There are 6 dimensions that comprise this survey: physical, spiritual, intellectual, psychological, social, and emotional. The dimensional scores are integrated into a wellness composite score, and the scores range from 3 to 29. Higher composite scores indicate greater perceived wellness. Adams et al. (1997) reported a Cronbach's alpha of 0.88 in their adult sample.

Health. To obtain a measure of physical health in our sample, diet and exercise habits were assessed using the modified Health Behavior Profile (Rice, 1992). This instrument consists of 14-items and participants are asked to consider how accurately each item describes their health habits. Responses range from 1 (never) to 5 (daily). High scores suggest that diet and exercise habits are fairly good. In a study examining 197 college students, a Cronbach's alpha of 0.70 was reported (Oliver, Datta, & Baldwin, 2017a).

Music Variables. To assess the effects of music on our sample, we examined both music intensity and music type. Music intensity was operationalized in the current study by change in dB level. Optimal level was intensity that the participant indicated as the most comfortable listening volume. Low intensity was music adjusted 10 dB down from the participant's indicated optimal intensity. High intensity music was music adjusted 10 dB up from the participant's optimal intensity. All participants were asked to indicate their preference and intensity was either left the same or adjusted up or down depending on group assignment. Music type was

operationalized by either lyrical or non-lyrical music. Lyrical music was selected based upon self-reported musical genre preference. Non-lyrical music was classical music that was used for all participants in the non-lyrical music type condition. Classical music was chosen as the non-lyrical music genre based upon the plethora of existing literature utilizing this particular genre.

Procedure

Upon arrival to the lab, all participants were asked to read and electronically sign the informed consent document. The experiment utilized a 2 (lyrical vs non-lyrical) x 3 (low, optimal, or high sound intensity) factorial study design. Once consent was given, participants were randomly assigned to one of six groups: Lyrical High, Lyrical Optimal, Lyrical Low, Non-Lyrical High, Non-Lyrical Optimal, or Non-Lyrical Low. All participants were asked to complete a survey package (demographics, wellness, & health behaviors surveys) and after completion, they were prepared for physiological recordings using the sensors (Thought Technology, Ltd., Montreal Canada) interfaced with the software program. Participants were seated in a comfortable chair in a quiet room away from office noise. Baseline measures of SC, HR, and HRV, were measured simultaneously for 5 minutes in order to assess basic ANS activity at rest.

After baseline readings, the music manipulation was introduced. A set of headphones were given to each participant for the music manipulation portion of the study. The PI tested for optimal music listening preference via speaker volume. Once an optimal level was indicated by the participant, music intensity was adjusted in accordance with group assignment. Participants in the high or low intensity groups were adjusted 10 dB up or down according to group assignment, whereas participants in the optimal group remained at their optimal volume preference level. After this adjustment, participants in the lyrical condition were allowed to listen

to their favorite genre of music via satellite radio station (Pandora Radio), while participants in the non-lyrical condition listened to the same classical music via satellite radio. During the music session, all participants were asked to read a vignette to reflect a real-life scenario often seen in students studying for a test. The vignette provided a brief overview about the history of music, a topic typically unfamiliar to most non-music majors. It took approximately 10 minutes to complete, and participants were later asked questions about this vignette the next day. This manipulation was used to measure cognitive performance with respect to acquisition and retention.

Immediately following the vignette, all participants were asked to complete the “flanker task”, a widely used protocol to test cognitive processes such as attention, detection, recognition, and distraction (Eriksen, & Eriksen, 1974). Participants viewed stimuli presented one at a time surrounded by either distracting or facilitating items. Distracting items are typically associated with an opposite response (“incongruent” = pointing in opposite direction to target stimulus), whereas facilitating items are typically associated with the same response as the target stimulus (“congruent” = pointing in the same direction as the target stimulus). In other words, the “flanking” images were congruent or incongruent with the target image. Participants were given instructions and asked to make a quick and simple lexical response (pressing the appropriate key on the keyboard) targeting congruent responses. The “flanker task” was administered while the participant listened to the same type of music as in the vignette segment of the study. Finally, participants were asked to return the following day and answer a few questions (e.g., vignette information) in an attempt to address acquisition and retention. No other measures were taken at this time, and all participants were thanked for their service.

Data Analysis

All Flanker responses, retention scores, survey responses, and physiological data were exported into a data file. Artifacts from the physiological data were removed via the auto-edit functions of the Biograph (Physiological Suite) software program (Thought Technology Ltd., Montreal Canada). The frequency domains of the HRV indices were analyzed by fast Fourier transformation. The time domain of the HRV indices were computed from the IBI of the raw EKG signals. All data were analyzed using SPSS version 24 (SPSS, Chicago, USA). Multivariate Analysis of Variance (MANOVA) and correlational analyses were performed on the data where appropriate. The alpha levels were set at 0.05 for all analyses.

Results

Means and standard deviations for the study variables are provided in Table 2. To examine the interaction between musical type (lyrics vs no lyrics) and sound intensity (low, optimal, or high) on cognitive performance, separate 2 X 3 ANOVAs were computed. There was no significant interaction effect for the flanker task, $F(2, 141) = 0.481, p = 0.619$ (see Fig. 5), nor performance on the retention test, $F(2, 139) = 1.606, p = 0.205$ (see Fig. 6). However, there was a main effect of music type (lyrics vs no-lyrics) on the Flanker task $F(1, 141) = 6.469, p = 0.012$ (see Fig. 7), but not on the retention test $F(1, 138) = 0.001, p = 0.978$ (see Fig. 8). The lyrical group performed significantly worse on the flanker task than the non-lyrical group. In terms of sound intensity, there was no significant main effect on either the flanker task $F(2, 141) = 0.032, p = 0.969$ (see Fig. 9) or performance on the retention test $F(2, 139) = 2.403, p = 0.094$ (see Fig. 10).

Pearson correlation analyses were performed to explore the relationships between perceived wellness (composite score) and cognitive performance (flanker task and retention test).

Results revealed no association between perceived wellness and cognitive performance [flanker task ($r = 0.081$, $p = 0.341$), nor retention test ($r = 0.090$, $p = 0.294$)] (see Figs. 11-12). However, when parceling out the domains of perceived wellness, only *intellectual wellness* was significantly correlated with performance on the retention test ($r = 0.196$, $p = 0.021$) (see Fig. 13). Thus, better performance on this task reflected greater intellectual wellness. In addition, Pearson correlation analyses were performed to explore the relationships between perceived wellness and indices of ANS functioning at rest (see Table 3). Results revealed a significant association between perceived wellness and the ANS modality of LF/HF HRV ($r = 0.173$, $p = 0.043$). When examining the wellness domains separately in conjunction with indices of ANS functioning at rest, only the cardiovascular measures yielded significant results (HR and HRV). Perceived *physical wellness* was significantly negatively correlated with HR mean ($r = -0.238$, $p = 0.005$). Thus, a slower HR at rest was reflective of greater physical wellness.

In terms of HRV, Intellectual wellness was significantly negatively correlated with HF% ($r = -0.188$, $p = 0.026$), and SDNN ($r = -0.265$, $p = 0.002$). Intellectual wellness was also significantly positively correlated with LF% ($r = 0.198$, $p = 0.020$) and LF/HF ($r = 0.185$, $p = 0.030$). Emotional wellness was significantly positively correlated with LF% ($r = 0.177$, $p = 0.037$). Social wellness was significantly positively correlated with VLF% ($r = 0.192$, $p = 0.024$) (see Table 4). These findings seem to indicate HRV as a significant index of perceived wellness.

Discussion

The purpose of the current study was to examine the influence of musical characteristics (intensity and type) on cognitive performance (attention, detection, distraction, acquisition and retention) and ANS modalities [skin conductance (SC), heart rate (HR) & HRV]. Additionally, we aimed to explore if perceived wellness scores correlated with ANS functioning at rest.

Principle findings of the study were as follows: 1) a main effect of music type (lyrics vs no-lyrics) on the Flanker task, 2) a significant positive correlation between intellectual wellness and performance on the retention test, 3) a significant negative correlation between physical wellness and mean heart rate, and 4) significant relationships between HRV and indices of wellness.

It was hypothesized that sound intensity would influence cognitive performance. However, this hypothesis was not supported. In opposition with the findings of the Thompson, Schellenberg, & Letnic (2012) study, intensity of music in the current investigation does not play an important role in one's ability to process information. This inconsistency could be due to a variety of factors. First, our study examined both lyrical and non-lyrical music at differing intensities. However, Thompson et al. (2012) examined background music intensity, and did not incorporate lyrical content. Second, these researchers also manipulated tempo and reported both fast and loud music disrupted cognitive performance. Nevertheless, findings from both studies suggest that sound intensity alone may not be influential enough to evoke significant differences in performance.

Our second hypothesis was that participants who were exposed to lyrical music would perform worse on the cognitive task than participants in the non-lyrical condition. This hypothesis was supported. The lyrical group performed significantly worse on the Flanker Task in comparison to the non-lyrical group. Our findings do corroborate that of Anderson and Fuller (2010) who also reported that individuals listening to lyrical music performed significantly worse on the reading comprehension task than participants in the non-lyrically condition. Additionally, according to Avila, Furnham, & McClelland (2012), lyrical music interferes with an individual's ability to process verbal information during cognitive tasks. Collectively, these findings suggest that the lyrical nature of music, similar to the process of reading, places demands on cognitive

resources and may alter one's mental processing abilities (Carretti, Borella, Cornoldi, & De Beni, 2009). Although, Dolegui (2013) found no differences in performance between the lyrical and non-lyrical conditions, we posit that the lyrical nature of music negatively affects performance on some cognitive tasks.

Our third hypothesis was that better cognitive performance would be associated with greater perceived wellness. When examining the associations between cognitive performance and perceived wellness as a whole, no significant correlations were found. Although not what we expected, significant findings did emerge on the individual wellness domain of *intellectual wellness*. Wellness has been shown to be correlated with healthy cognition, as well as prevention of cognitive decline that oftentimes manifests during aging (see review: Strout & Howard, 2012). We found *intellectual wellness* to be positively correlated with cognitive performance. Participants who reported higher levels on intellectual wellness performed better on the retention task compared to their counterparts. Given that intellectual wellness is associated with stimulating mental activity, problem solving, and the pursuance of knowledge (Roscoe, 2009), a positive relationship between intellectual wellness and cognitive performance is expected.

Our fourth and final hypothesis was that individuals who scored higher on perceived wellness would show better ANS functioning as assessed by SC, HR, and HRV at rest. Overall perceived wellness was significantly associated with LF/HF ratio. Additionally, a number of wellness domains were significantly associated with HR and HRV. In the current investigation, perceived *physical wellness* had a significant negative correlation with mean HR. Physical wellness is defined as the degree to which one maintains and improves cardiovascular fitness, flexibility, and strength (Croese et al., 1992). It has been described as the maintenance of physical

predictors of health, such as blood pressure, muscle tone, and self-care, as well as, the optimization of positive health behaviors such as eating habits and exercise levels (Chang, Labban, Gapin, & Etnier, 2012; Gerber, Börjesson, Ljung, Lindwall, & Jonsdottir, 2016). Our findings support previous studies that indicate that fit individuals tend to display lower HR (Carter, Banister, & Blaber, 2003; Rimmelé et al., 2007).

HRV provides a readily available index of ANS functioning, and it is assessed via frequency and time domains. According to recent research (Koeing & Thayer, 2016; Peschel et al., 2016), the interpretation of some of the components of HRV are controversial. Although we found significant correlations between wellness domains and numerous HRV parameters, this discussion is limited to the well-articulated components of HRV (LF/HF, HF, LF, and SDNN).

Both perceived *emotional* and *intellectual wellness* domains were positively correlated with the LF component. Greater emotional wellness is reflective of a greater control over one's emotions and subsequent behaviors (Roscoe, 2009). According to Reyes del Pasco and colleagues (2013), the LF component provides information about blood pressure control mechanisms, and it is mainly determined by the parasympathetic nervous system. Our findings suggest that individuals who are able to self-regulate their emotions and seek out cognitive activities display better cardiovascular health. Perceived *intellectual wellness* was also negatively correlated with HF%, and SDNN. According to researchers, increases in the above HRV components are indicative of parasympathetic dominance (Peschel et al. 2016; Porges, 2001; Stein, Bosner, Kleiger, & Conger, 1994). Thus, individuals who are actively pursuing stimulating mental activity, tend to display greater resting HRV. Furthermore, there was also an observed positive relationship between both *overall perceived wellness* and *intellectual wellness* with LF/HF ratio. The LF/HF ratio is considered to reflect autonomic regulation, and increases in

this ratio are assumed to reflect a shift towards sympathetic dominance (Lombardi, Malliani, Pagani, & Cerutti, 1996). Thus, increases in LF/HF ratio would presumably relate to higher levels of intellectual stimulation, as well as, overall wellness perception. However, it must be noted that taken together, Miličević's (2005) and Billman's (2013) previous research posit that the LF/HF ratio is not a reliable measure of the sympatho-vagal balance. The authors argue that inconsistent findings in regard to a linear relationship between sympathetic and parasympathetic nerve activity, in addition to influence that respiration has on the LF component, discredits use of the LF/HF ratio as a measure of sympatho-vagal balance. Nonetheless, our results suggest that HRV may be a pivotal index for assessing domains of wellness. To our knowledge, this is the first study to examine aspects of wellness as a function of ANS activity at rest. This association is important as it is the first that demonstrates the relationship between wellness domains and indices of ANS health.

A few study limitations should be noted. First, we employed the perceived wellness survey to assess aspects of wellness. This survey includes the component of psychological wellness and in the current study, this component did not yield significant associations with cognitive performance. This could be due to the close association between psychological and intellectual wellness given the similarities in the theoretical constructs. However, future explorations should employ other wellness models that do not include this component such as: Hettler's (1984) Holistic Wellness Model or Roscoe's (2009) Wellness Model for Counselors in order to garner a better association between cognitive performance and wellness. Next, it is possible that participants in this study gleaned from the informed consent that they would be completing a cognitive task. Thus, when participants were asked to pick their optimal listening intensity, they may have chosen a lower than optimal intensity in order to compensate for the

cognitive task. This may have affected the results of this study as we may not have obtained a true optimal level for all participants. Finally, we only assessed a baseline measure of SC in this study. Given the finger placement of SC sensors, we could not record simultaneous SC measurements during the task. In order to explore the SC response to a cognitive task, future studies should find a way to employ a verbal cognitive task, as opposed to a task involving physical movement that may cause artifacts in the data.

In conclusion, when collapsed across lyrical and non-lyrical conditions, intensity of music does not negatively impact cognitive performance. However, we found a significant main effect of music type on cognitive performance via the flanker task. The lyrical group performed significantly worse on the flanker task when compared to the non-lyrical group. This finding suggests that the lyrical nature of music is detrimental to the processing of information associated with performance on a cognitive task. Finally, findings from the current study suggest that HRV may be a useful way to objectively assess factors of wellness in relation to overall health and well-being.

CHAPTER V
STUDY TWO

Introduction

The vast construct of wellness is important to explore as we try to pursue a happier and more fulfilling lifestyle. Due to the importance and prevalence of relationships in today's society, it is critical to examine relational aspects of wellness. Whether the relationship is defined as platonic, romantic, parental, religious, or environmental, all forms have the potential to impact one's quality of life and subsequent happiness. For example, previous researchers have found the quality of relationships and social networks plays a vital role in well-being (Dush & Amato, 2005; Feeney & Collins, 2015; Schwerdtfeger & Friedrich-Mai, 2009). Moreover, social isolation, social disconnectedness, and loneliness have been shown to have negative effects on health (Cornwell & Waite, 2009; Shankar, McMunn, Banks, & Steptoe, 2011). Further, individuals who are socially isolated tend to display not only psychological, but also, physical consequences such as: increased risk of inflammation and hypertension (Yang et al., 2016) and greater vascular resistance, slower wound healing, and poorer sleep efficiency (Cacioppo & Hawkley, 2003). Additionally, MacDonald and Leary (2005) found the effects of social isolation on individuals is similar to physical pain. In a study by Mellor and colleagues (2008), the researchers surveyed participants about their relationship satisfaction, need to belong, life satisfaction, and level of loneliness. Results showed that loneliness mediated the relationship between need for belonging and well-being (i.e. life satisfaction). Therefore, the level of loneliness affected the emotional state of individuals which ultimately affected well-being. Consistent with Baldwin, Towler, Oliver, & Datta (2017), aspects of social well-being (i.e. need to belong) had a greater negative impact on college-aged females when compared to males. When collapsed across institution type, females reported a greater need to belong indicating the importance of belongingness within this population. Finally, studies have shown that positive

peer relationships contribute to individual well-being (Roffey, 2010, 2011; Zins, Bloodworth, Weissberg, & Walberg, 2004). That is, when an individual perceives that relationships with their peers are positive and affirming, enhanced well-being is evident. As such, if perceptions about peer relations are negative, unfavorable effects on individual well-being may amount.

Social support has also been proven to impact individual well-being (Cohen & Wills, 1985). In a meta-analysis (Chu, Saucier & Hafner, 2010), the authors report a positive association between social support and well-being. An individual's perception of social support was found to account for their perception of a higher state of well-being. Additionally, social support is positively associated with favorable physical health outcomes such as lower blood pressure when compared to individuals with no or low perceived social support (Uchino, 2004), as well as negatively associated with depressive symptoms (Cohen & Hoberman, 1983; Lin, Dean, & Ensel, 2013; Stice, Ragan, & Randall, 2004). Therefore, these findings indicate the importance that social support has on individual quality of life.

In another study, interpersonal relationships were associated with stress and a sense of coherence in a college student sample (Darling, McWey, Howard, & Olmstead, 2007). The authors found that females were more stressed from romantic relationships, relationships with their parents, and quality of peer relationships when compared to their male counterparts. Moreover, lower levels of social support predicts higher reactivity to stressors (Misra, Crist, & Burant, 2003). In Uchino's review (2006), he posits that positive social support is linked to positive biological profiles in that social support protects against the negative effects of changes in cardiovascular, neuroendocrine, and immune function. Furthermore, social support has been shown to buffer against the negative effects of life stressors (Cohen & Wills, 1985). In a meta-analysis exploring the effects of social relationships (Holt-Lunstad, Smith, & Layton, 2010), it

was suggested that lack of quality and quantity of social relationships is a risk factor for mortality. Therefore, there is agreement in the literature that the preservation of social support is a protective factor against negative health outcomes. Given that relationships may play an important role in the connection between stress and coping (Seiffge-Krenke, 2013), it is important to consider types and quality of relationships when exploring the effects that stress has on health.

In terms of the effects that relationships play on health, in a neuroimaging study examining the effects of social exclusion on health, results show that “social pain is analogous in its neurocognitive function to physical pain” (Eisenberger, Lieberman, & Williams, 2003, pp. 292), thus reinforcing the notion that maintenance of relationships is vital to health. Furthermore, higher heart rate variability has been shown to reflect a psychophysiological state compatible with social interaction (Quintana, Guastella, Outhred, Hickie, & Kemp, 2012). In summary, social relationships are important for both health and wellbeing (see review: Cohen, 2004). The aforementioned studies suggest that the quality of the relationships have both psychological (Umberson, Crosnoe, & Reczek, 2010; Umberson & Montez, 2010), as well as physiological (Heaphy & Dutton, 2008; Robles & Kiecolt-Glaser, 2003; Seeman, Singer, Ryff, Love, & Levy-Storms, 2002) ramifications on health.

In order to better understand the health and wellness of an individual, one should consider his/her relationship qualities and characteristics. Although much is known about the positive and negative consequences that relationships have on individual health such as: the effects that social isolation and loneliness has on mortality (Holt-Lunstad, Smith, & Layton, 2010; House, Landis, & Umberson, 1988), and the effects that social support has on aspects of the cardiovascular, endocrine, and immune systems (Cacioppo & Hawkley, 2003; Uchino,

Cacioppo, & Kiecolt-Glaser, 1996; Yang et al., 2016), research is lacking regarding its connection between the ANS and domains of wellness (i.e. physical, social, emotional, spiritual, psychological, intellectual). It is critical to examine the mind-body connection and ultimately, health and wellness.

This study aimed to explore the correlation between aspects of relational wellness and indicators of ANS functioning at rest. Our main hypotheses were as follows: (A) overall wellness will be positively correlated with number of meaningful relationships, (B) higher wellness scores will be negatively correlated with Skin Conductance (SC), positively correlated with Heart Rate Variability (HRV), and negatively correlated with alpha Electroencephalogram (aEEG), (C) there will be a negative correlation between the measure of perceived stress and the number of meaningful relationships, and (D) there will be a positive association between the degree of perceived social support and the number of meaningful relationships.

Methods

Participants

Participants consisted of 160 college students attending a large southeastern university, and ranged in age from 18 – 25 years of age ($M = 18.63$, $SD = 1.17$). The majority of the students were Freshmen (73.1%), followed by 16.9% Sophomores, 8.1% Juniors, 1.3% Seniors, and 0.6% Graduate. The majority of students reported their race as Caucasian (85%). African-Americans were 3.1%, Asian 8.8%, Latino/Hispanic 1.3%, and Middle Eastern 1.9%.

Participants were recruited online from undergraduate Psychology courses for partial fulfillment of course credit. In order to participate, all participants were required to be at least 18 years of age and not clinically diagnosed with any social disorders or personality disorders (e.g. antisocial personality disorder, borderline personality disorder, general anxiety disorder, and major

depressive disorder). No other exclusion criteria were noted. All participants signed the letter of informed consent prior to data collection and participation was strictly voluntary. This study was approved by the university's Institutional Review Board (UTK IRB-16-03463-XP).

Apparatus and Materials

A desktop Dell computer with a 22-inch color monitor was used to administer the surveys. In an adjacent examination room, an additional Dell desktop computer with two 22-inch color monitors was used to run the physiological software program used in this study. The physiological measures (SC, aEEG, HR, & HRV) were sampled via the multichannel Procomp Infiniti™ and Biograph software system (Thought Technology Ltd., Montreal, Canada). All sensor leads were connected to this 8-channel encoder, and the physiological data were exported into a data file. SC was measured using cuffs with sensors fastened around the middle and index fingers of the non-dominant hand. SC is measured in micro-Siemens units, and these data were collected at 32 Hz. A higher level of skin conductance indicates a higher level of arousal. aEEG recordings (8-12 Hz) were measured by placing a ground and reference electrode on each ear (clip). The signal electrode was located at Fpz, according to the international 10-20 system using conductive paste. HR (beats per minute) and HRV were measured via 3-lead electrode sensors placed on the wrists and forearm of the participant, and these data were collected at 256 Hz. The raw inter-beat interval (IBI) data were analyzed in the time and frequency domains. More specifically, HRV was assessed via the following frequency domains: very low frequency (VLF) power between the limits of 0.003 Hz and 0.04 Hz, low frequency (LF) power in the range of 0.04 Hz and 0.15 Hz, high frequency (HF) power in the range of 0.15 Hz and 0.40 Hz, and LF/HF ratio. The HF component reflects parasympathetic cardiac control and LF reflects

sympathetic/para- sympathetic balance (Stein & Kleiger, 1999). The time-domain measure included the standard deviation of normal-to-normal intervals (SDNN).

Instrumentation

Demographics. A self-report questionnaire was used to obtain information on age, race, gender, relationship status, and other demographic information.

Perceived Wellness. The Perceived Wellness Survey (Adams, Bezner, & Steinhardt, 1997) was used to assess perceptions of wellness in various dimensions. This 36-item survey was designed to measure wellness perceptions in adults. Responses range from 1 (very strongly disagree) to 6 (very strongly agree). There are 6 dimensions that comprise this survey: physical, spiritual, intellectual, psychological, social, and emotional. Higher total scores indicate higher perceived wellness. Adams et al. (1997) reported a Cronbach's alpha of 0.88 in their adult sample. The current study reports a Cronbach's alpha of 0.94.

Perceived Stress. This Perceived Stress Scale (Cohen & Hoberman, 1983) was used to assess global non-specific stress levels during the last month. This survey is comprised of 14 items of which 7 are positively formulated (i.e. "In the last month, how often have you felt things are going your way?"), and 7 items which are negatively formulated (i.e. "In the last month, how often have you felt that you were unable to control the important things in your life?"). This is a widely used instrument, and higher scores indicate greater stress levels. Coefficient alpha reliability for this measure was 0.84, 0.85, and 0.86 in a test of three student samples (Cohen, Kamarck, & Mermelstein, 1983). The current study reports a Cronbach's alpha of 0.86.

Social Support. The Social Provisions Scale was (Cutrona & Russell, 1987) was employed to assess the dimensions of social support via participant social relationships. This scale consists of twenty-four items that measure either measure the presence or absence of a type

of social support. Attachment, Social Integration, Reassurance of Worth, Reliance Alliance, Guidance, and Opportunity for Nurturance are all explored. Responses range from 1 (strongly disagree) to 4 (strongly agree). Higher scores indicate a greater degree of perceived support. Internal reliability for this measure was 0.70 in a test of one hundred elderly subjects (Russell, Cutrona, Rose, & Yurko, 1984). The current study reports a Cronbach's alpha of 0.93.

Procedure

Upon arrival to the lab, all participants were asked to read and sign the informed consent document. Once consent was given, participants were asked to complete a survey package (demographics, wellness, perceived stress, and relationship satisfaction). Once completed, participants were asked to sit quietly for 5 minutes prior to obtainment of physiological measures. After this acclimation period, participants were prepared for physiological recordings using the Thought Technology sensors interfaced with their software program. A measure of skin conductance occurred in which two finger cuffs were attached to the pointer and ring fingers of the participants' non-dominant hand. Measures of heart rate variability were assessed via electrocardiogram (EKG). Electrodes were attached to the participants' wrists and forearm. Finally, conductive paste was applied to the participants' ears and scalp as ear clips were applied to each ear and an electrode was attached to the scalp of the participant to assess alpha EEG. These baseline physiological readings were measured simultaneously for 5 minutes.

After baseline readings, the social manipulation was introduced. First, participants were asked to list all of the important relationships currently in their lives and indicate the significance/roles of the aforementioned relationships. Next, they were asked to indicate the most important relationship to them. After this indication, participants were asked to think about the most important relationship that they indicated previously and to create an image of this

relationship in their mind with their eyes closed and maintain this image until further notice. During this time, SC, aEEG, and HRV recordings were taken simultaneously for two minutes. Upon completion of this task, participants were thanked for their service.

Data Analysis Techniques

All survey responses and physiological data were exported into a data file. Artifacts from the physiological data were removed via the auto-edit functions of the Biograph (Physiological Suite) software program (Thought Technology Ltd., Montreal Canada). The frequency domains of the HRV indices were analyzed by fast Fourier transformation. The time domain of the HRV indices were computed from the IBI of the raw EKG signals. All data were analyzed using SPSS version 24 (SPSS, Chicago, USA). Regression analyses, correlational analyses, and paired-samples T-tests were performed on the data where appropriate. The alpha levels were set at 0.05 for all analyses.

Results

Means and standard deviations for the study variables are provided in Table 5. Pearson correlation analyses were performed to explore the relationships between the self-report surveys (wellness, perceived stress, and relationship satisfaction) and the total number of reported significant relationships. Results revealed that the number of reported significant relationships yielded no significant correlation between feelings of perceived stress ($r = 0.001$, $p = 0.989$), nor the degree to which one feels his/her relationships provide social support ($r = 0.035$, $p = 0.697$). However, results did reveal a significant positive correlation with perceived wellness ($r = 0.184$, $p = 0.039$). Thus indicating that a higher number of significant relationships reflects higher perceptions of overall wellness (see Table 6). In addition, Pearson correlation analyses were performed to explore the relationships between perceived wellness and indices of ANS

functioning at rest (see Table 7). Results revealed a significant negative association between perceived wellness and baseline heart rate ($r = -0.263, p = 0.003$). When examining the wellness domains separately in conjunction with indices of ANS functioning at rest, both perceived *intellectual wellness* ($r = -0.267, p = 0.002$) and perceived *spiritual wellness* ($r = -0.200, p = 0.022$) were significantly negatively correlated with baseline HR. Thus, indicating that lower HR at rest was reflective of better wellness. Furthermore, SDNN was positively correlated with intellectual wellness ($r = 0.176, p = 0.046$) (see Table 8).

Paired samples T-tests were run to explore differences between ANS modalities at rest compared to after the visualization task. Results reveal no differences between pre- and post-measures of: HR [$t(158) = 1.755, p = 0.081$], VLF [$t(158) = 0.253, p = 0.801$], LF/HF ratio [$t(158) = 0.569, p = 0.570$], or aEEG [$t(159) = 1.279, p = 0.203$]. Significant differences between the visualization task and baseline did exist on the variables of: LF HRV [$t(158) = 3.165, p = 0.002$], HF HRV [$t(158) = -3.105, p = 0.002$], SDNN [$t(158) = 15.138, p < 0.001$], and SC [$t(159) = -7.074, p < 0.001$] (see Table 9, Fig. 14). The measures of LF HRV and SDNN significantly decreased during the visualization task, while both HF HRV and SC, significantly increased during the visualization task when compared to baseline.

Regression analyses were run to explore if the number of self-reported significant relationships predicts perceived wellness. The number of significant relationships significantly predicted perceived wellness, $F(1, 124) = 4.356, p = 0.039$. Higher numbers of significant relationships predicted better wellness. Results also revealed significant associations between the number of relationships reported and overall perceived wellness ($r = 0.184, p = 0.039$), and the domains of social ($r = 0.188, p = 0.036$) and intellectual wellness ($r = 0.201, p = 0.024$) (see Table 10).

Discussion

The purpose of this study was to provide insight into the relationship between autonomic health, aspects of social relationships, and perceived wellness. Findings indicate that relationships play important roles in the health status of college students as assessed by ANS activity and perceived wellness. Our findings support those of previous studies that have shown the effects that relationships have on health (House, Landis, & Umberson, 1988; Umberson, Crosnoe, & Reczek, 2010). Principle findings of the current study were as follows: 1) the number of significant relationships revealed a significant positive correlation with perceived wellness and predicted perceived wellness, 2) lower HR was associated with higher perceived wellness, 3) higher HRV was associated with higher perceived wellness, 4) LF HRV and SDNN significantly decreased during the visualization task, while HF HRV and SC significantly increased in response to the visualization task.

It was hypothesized that higher perceived wellness would correlate with higher numbers of meaningful relationships. Results of the current study support this hypothesis. This indicates that the greater number of relationships is indicative of greater perceptions of overall wellness. Consistent with Cohen (2004), our study supports the notion that individuals who maintain meaningful relationships have a better quality of life. Moreover, the number of reported significant relationships was a predictor of perceived wellness in this study, as well as, social and intellectual wellness. Given that positive relationships have been associated with better quality of life (Myers, 2003), higher need to belong (Baumeister & Leary, 1995), and mental health (Kawachi & Berkman, 2001), our findings suggest that the inherent nature of social interactions acts as a buffer to negative perceptions of health. Higher numbers of reported significant relationships may lend individuals to feel as though they have more social support, which has

been shown to increase happiness (Chan & Lee, 2006). Thus, results of the current study suggest that the more significant relationships one has, the better quality of life as operationalized by perceptions of wellness.

Our second hypothesis was that individuals who report higher wellness scores will show better ANS functioning at rest as assessed by aEEG, SC, and HRV. In terms of aEEG, there was no relationship between wellness scores and aEEG activity. This null finding could be attributed to the idea that perceptions of wellness may not actively influence baseline alpha wave activity. All participants were in a wakeful state with their eyes closed during assessment of aEEG activity. Alternatively, the employment of event-related potentials (ERPs) could have been explored in terms of which types of questions regarding dimensions of wellness evoked the highest electrical responses. This in turn, could give insight into which dimensions of wellness result in the highest perception given the autonomous brain response. SC at rest yielded significant negative correlations with both perceived emotional and psychological wellness. Our findings support that of existing literature that show that SC is affectively influenced (Critchley, Elliott, Mathias, & Dolan, 2000). The negative association found in this study suggests that as SC decreases (i.e. a decrease in sympathetic activity), a better state of emotional and psychological wellness amounts. If the body is less sympathetically activated (lower SC), then presumably emotional and psychological states will benefit. The higher wellness scores on the emotional and psychological components reported in this study suggest that our participants were less stressed.

In terms of the parameter of HRV, both HR and HRV were associated with perceptions of wellness. Higher HRV was positively associated with perceived wellness. Higher perceived wellness reflects the notion that one's quality of life, as well as their health, are presumably high.

Existing literature has shown that higher HRV is associated with better health (Thayer, Yamamoto, & Brosschot, 2010). Our study supports existing literature in that we show a significant positive relationship between HRV and perceived wellness. Additionally, findings of the current study yield a significant negative relationship between HR and perceived wellness. Lower resting HR is reflective of greater physical health (Fox et al., 2007). Again, our study supports the notion that cardiovascular health, in particular, is associated with higher perceptions of overall wellness. Given that overall wellness represents the balance between multiple aspects of life that can be seen to influence health, the findings of the current study suggest that the maintenance of physical health greatly impacts one's perception of their overall wellness.

Our final hypothesis was that the mental visualization task would amount in autonomic differences when visualizing the most significant relationship in the participants' lives when compared to baseline. To our dismay, no differences existed in terms of aEEG activity as a result of the visualization task. It is possible that the visualization task elicited beta wave activity. Future studies should employ both the use of ERPs, as well as the examination of alternative wave forms when conducting similar studies. Alternatively, significant differences were observed on both the variables of HRV and SC. Assessments were taken both at baseline and during the visualization task. Both the components of LF HRV and SDNN yielded significant decreases during the mental visualization task of one's most significant relationship, while HF HRV and SC saw increases. Increases in HF HRV indicate more parasympathetic modulation of the heart (control), a lower state of anxiety, and less emotional strain. Due to its highly sensitive nature in response to instantaneous emotional change, increases in SC during the task indicate enhanced memory consolidation, emotional processing, and attention (Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000). However, it is also plausible that the increases in SC were

due a stressful response to the visualization task. Future studies are needed to tease apart this finding. Alternatively, LF HRV is indicative of the sympathetic/parasympathetic balance in ANS activity. It has been shown to increase due to mental and/or physical stress as a consequence of sympathetic activation. Thus, decreases in LF HRV reflect less sympathetic, and more parasympathetic dominance suggesting a more relaxed state. Concordant with MacKinnon, Gevirtz, McCraty, & Brown (2013), the current study also reports lower SDNN during conscious emotional experiences when compared to baseline. As a result of positive and/or negative emotional stimuli SDNN has been shown to decrease, thus supporting the hypothesis that brain function is affected by vagal afferents. Moreover, Lane et al. (2009) posit that conscious emotional experiences increase brain activity due to the requirement of affective responses from the brain. These increases have modulating effects on the heart which allow for contextually appropriate responses to emotional stimuli. The authors suggest this Neurovisceral Integration Model as an explanation for physiological responding of the brain and heart in emotional regulation and dysregulation. Taken together, results of the current study suggest that when individuals ponder their most important relationship, they are more relaxed and less emotionally stressed. Thus, thoughts of significant relationships seem to reduce anxiety, emotional strain, and mental stress, therefore illuminating the positive effects of mentally visualizing those relationships that we find most near and dear to our hearts.

Although our study provides new findings in terms of the effects that relationships have on the ANS, specifically the components of SC and HRV, a few study limitations should be noted. In the current study, the majority of our sample identified as either Caucasian or of Freshman status. In order to explore whether this results vary by race, region, or even culture, a more diverse sample is warranted. Additionally, given that most of our participants identified as

freshman, an overwhelming majority identified a parental relationship (i.e. mom or dad) as their most significant. Future studies should target students from other classifications, cultures, and nationalities to see if this finding still exists. Our findings in terms of the effects during the visualization task could be due to the outpouring of love and respect that this population has toward their parents, especially since this is presumably their first time away from home. Older adults may have developed closer friendships with siblings, spouses, or even their own children, which might cause differential effects. Additionally, we did not ask post-visualization task if the participants found the task stressful. In order to examine the SC response in terms of whether or not the task was stressful, future studies should implement a post-task questionnaire. Furthermore, the number of significant relationships should drastically decline with age. Given that the current study boasts that the number of significant relationships predicts perceived wellness in college students, it would be interesting to explore if the current study's findings still hold in an older population.

In conclusion, relationships have significant impacts on health and wellness, which further corroborates existing literature. Furthermore, the current study lends support to our previous hypothesis that aspects of wellness are correlated with indices of the ANS. More specifically, components of wellness yielded significant relationships with HRV at rest and during the visualization task, as well as SC during the visualization task. Thus, the current study suggests that in terms of autonomic responses to stimuli, the parameters of SC and HRV can be utilized as assessment tools of relational components of wellness.

CHAPTER VI
STUDY THREE

Introduction

Physical wellness is defined as the degree to which one maintains and improves cardiovascular fitness, flexibility, and strength (Croose et al., 1992). It has been described as the maintenance of physical predictors of health, such as blood pressure, muscle tone, and self-care, as well as, the optimization of positive health behaviors such as eating habits and exercise levels (Chang, Labban, Gapin, & Etnier, 2012; Gerber, Börjesson, Ljung, Lindwall, & Jonsdottir, 2016). Numerous dimensions and models of wellness have been theorized as predictors of overall health (Adams, Bezner, & Steinhardt, 1997; Anspaugh, Hamrick, & Rosato, 2006; Archer, Probert, & Gage, 1987; Biddle & Mutrie, 2001; Cavallini, Wendt, & Rice, 2007; Chang et al., 2012; Cook, 2011; Croose et al., 1992; Durlak, 2000; Envick, 2012; Gerber et al., 2016). Although several components of wellness have been proposed, one major component is consistently included within every wellness model: physical wellness. Physical wellness during the early years has been shown to influence health in subsequent years (Adams, Bezner, & Steinhardt, 1997; Gieck & Olsen, 2007). Therefore, it is important to examine aspects of physical wellness in young adults in an attempt to modify behaviors that are detrimental to future health outcomes, as well as, promote those that facilitate health.

The incorporation of wellness models has been effective in increasing activity levels in college student populations (Grant, Wardle, & Steptoe, 2009), and the physical dimension was regarded as having the most influential impact on overall wellness (Hales, 2006). Furthermore, exercise self-efficacy has been shown to predict perceptions of overall wellness among college students (Hettler, 1980). This suggests that belief in one's exercise ability is an influential factor on perceptions of overall wellness. Thus, exploring factors of physical fitness may be critical in enhancing physical wellness, and subsequently, overall or holistic wellness.

Physical aspects of wellness are often targeted in interventions to improve individual and societal health (Hettler, 1984) and quality of life (Hopkins, Davis, VanTieghem, Whalen, & Bucci, 2012; Leafgren & Elsenrath, 1986). As such, there are four primary components of fitness (e.g. cardiorespiratory fitness, muscular fitness, flexibility, and body composition) that have been identified as having a substantial impact on health status (Caspersen, Powell, & Christenson, 1985; Fulton, Garg, Galuska, Rattay, & Caspersen, 2004; Hopkins et al., 2012). Optimizing one or more of these factors has been shown to improve academic performance (Esteban-Cornejo et al., 2014), reduce risk factors associated with disease (Vasconcellos et al., 2014), facilitate motor competency (Cattuzzo et al., 2016), and improve perceptions of psychological self-report measures (Sener et al., 2016). Thus, the primary components of physical fitness prove to be essential to both health and wellness.

Models examining physical wellness in previous literature have explored subjective health utilizing perceived views of physical fitness addressing physical activity, nutrition, etc. (Ansbaugh, Hamrick, & Rosato, 2006; Archer, Probert, & Gage, 1987; Envick, 2012; Gerber et al., 2016). However, none to date have examined how one's perceived view of his/her state of physical, and/or overall wellness state, correlates with actual physical ability in terms of objective measures of cardiorespiratory fitness, muscular fitness, flexibility, and body composition. Moreover, extant literature exploring components of fitness have individually explored body composition (Herzig et al., 2017; Peterson et al., 1988), the effects of cardiorespiratory exercise (Freeman, Dewey, Hadley, Myers, & Froelicher, 2006; Hautala, Kiviniemi, & Tulppo, 2009; Hsu, Hsieh, Hsiao, & Chien, 2015; Robinson, Epstein, Beiser, & Braunwald, 1966; Triposkiadis et al., 2009), and flexibility (Kanthack et al., 2017), but have yet

to determine the extent to which the four components of fitness collectively relate to health status from an Autonomic Nervous System (ANS) functioning perspective.

Given the clearly defined relationship between the ANS and health (Goldstein, Robertson, Esler, Straus, & Eisenhofer, 2002; Sleight, 1997; Thayer, Yamamoto, & Brosschot, 2010), research exploring the effects on ANS functioning proves to be vital to health promotion. Existing literature has shown that ANS dysfunction parlays into a plethora of negative health outcomes due to autonomic imbalances between the sympathetic and parasympathetic nerves (Brook & Julius, 2000; Jankowska et al., 2006; Thayer, Yamamoto, & Brosschot, 2010). Additionally, it has been agreed upon that greater vagal modulation (parasympathetic dominance) is more conducive to health, whereas a higher sympatho-vagal balance (sympathetic dominance) plays a more detrimental role (De Meersman & Stein, 2007; Thayer, Yamamoto, & Brosschot, 2010). As such, there are a variety of ways to assess the involuntary function of the ANS. For example, non-invasive assessments of skin conductance (Oliver, Datta, & Baldwin, 2017b), electroencephalogram (Tang et al., 2009), and heart rate variability (Sztajzel, 2004) have been shown to be effective. Therefore, we aim to utilize these indices of ANS functioning as a method of exploring involuntary functions of the body in relation to wellness components and physical fitness.

Purpose and Hypotheses

Thus, this study aimed to explore the correlation between perceived physical wellness and objective indicators of health, ANS at rest and fitness levels. In addition, physical health was examined from an experimental perspective using various physical tasks (e.g. flexibility task, cardiorespiratory fitness, muscular fitness, and body composition). The primary purpose of this study was to examine the relationship between perceived physical wellness and the four primary

components of fitness. It was hypothesized that: 1) the components of physical fitness will be positively correlated with physical health, and ultimately, overall wellness, 2) the composite of these components of fitness will significantly predict overall wellness and that cardiorespiratory fitness will be the best individual predictor of overall wellness, 3) individuals who report higher perceived wellness scores will show better ANS functioning as assessed by alpha-electroencephalogram (aEEG), Skin Conductance (SC), and Heart Rate Variability (HRV), and 4) a positive correlation between components of physical fitness and ANS functioning as assessed by alpha-electroencephalogram aEEG, SC, and HRV will result.

Methods

Participants

Sixty-seven participants were recruited from The University of Tennessee – Knoxville. This study took place in the Health and Physical Education Building (HPER) in an exercise testing laboratory. Exclusion criteria included: pregnancy, orthopedic or musculoskeletal issues limiting physical activity, cardiorespiratory disease, or use of medication utilizing beta-blockers. All participants were at least 18 years of age. Participants were asked to wear workout clothing and running shoes for participation. All were asked to sign consent forms approved by the University's Institutional Review Board (IRB). We planned our sample size based upon a sample size calculator (Machin, Campbell, Tan, & Tan, 2011). We estimated that with a total sample size of 67 we would have 80% power to detect a moderate effect size, $r = 0.30$, given a one-tailed test and alpha level of 0.05.

Apparatus and Materials

A desktop Dell computer with a 22-inch color monitor was used to administer the surveys. In an adjacent examination room, an additional Dell desktop computer with two 22-inch

color monitors was used to run the physiological software program used in this study. The physiological measures (SC, aEEG, HR, & HRV) were sampled via the multichannel Procomp InfinitiTM and Biograph software system (Thought Technology Ltd., Montreal, Canada). All sensor leads were connected to this 8-channel encoder, and the physiological data were exported into a data file. SC was measured using cuffs with sensors fastened around the middle and index fingers of the non-dominant hand. SC is measured in micro-Siemens units, and these data were collected at 32 Hz. A higher level of skin conductance indicates a higher level of arousal. aEEG recordings (8-12 Hz) were measured by placing a ground and reference electrode on each ear (clip). The signal electrode was located at Fpz, according to the international 10-20 system using conductive paste. HR (beats per minute) and HRV were measured via 3-lead electrode sensors placed on the wrists and forearm of the participant, and these data were collected at 256 Hz. The raw inter-beat interval (IBI) data were analyzed in the time and frequency domains. More specifically, HRV was assessed via the following frequency domains: very low frequency (VLF) power between the limits of 0.003 Hz and 0.04 Hz, low frequency (LF) power in the range of 0.04 Hz and 0.15 Hz, high frequency (HF) power in the range of 0.15 Hz and 0.40 Hz, and LF/HF ratio. The HF component reflects parasympathetic cardiac control and LF reflects sympathetic/para- sympathetic balance (Stein & Kleiger, 1999). The time-domain measure included the standard deviation of normal-to-normal intervals (SDNN).

Demographics. A self-report questionnaire was used to obtain information on age, race, gender, relationship status, and other demographic information.

Wellness. The Perceived Wellness survey is used to assess perceptions of wellness in various dimensions. This 36-item survey was developed by Adams, Bezner, & Steinhardt (1997) to measure wellness perceptions in adults. Responses range from 1 (very strongly disagree) to 6

(very strongly agree). There are 6 dimensions that comprise this survey: physical, spiritual, intellectual, psychological, social, and emotional. Higher total scores indicate higher perceived wellness. Adams et al. (1997) reported a Cronbach's alpha of 0.88 in their adult sample.

Skin-fold calipers. To obtain a quantifiable measure of body fat percentage, a skin fold measurement technique was employed. Measurements were obtained in accordance with the guidelines set forth by American College of Sports Medicine's (ACSM) Guidelines for Exercise Testing and Prescription, 9th Edition (2014). For example, as noted by Barreira, Renfrow, Tseh, & Kang (2013), measures were obtained by the following methodology: "Firmly but gently, pinch the skin and subcutaneous fat between the thumb, forefinger, and middle finger. Open the skinfold caliper and measure the skinfold approximately 1 cm below your fingers and approximately 1 cm deep into the skinfold. Do not release the skinfold while taking the measurement. Once you have obtained the skinfold measurement, release the caliper from the skinfold. Take a minimum of 2 measurements at each site. If the measures do not agree within 1 millimeter, subsequent assessments should be taken until all values are within 1 millimeter."

Sit-and-reach box. The sit-and-reach test for lower back/hamstring flexibility was performed using the procedures outlined in the ACSM manual. A standard box was placed on the floor with the back of the box firmly against the wall. The participant was asked to sit on the floor with shoes off, and fully extended both legs so that the soles of the feet were flat against the end of the box. Participants were then asked to extend their arms forward (palms down), placing one hand on top of the other and reach as far along the measuring scale as far as possible without bending the knees of the extended legs. Three trials were performed, and the average of the three trials were used for subsequent analyses.

Polar heart rate monitor. A Polar Heart Rate Monitor model FT1, was used to measure heart rate during submaximal exercise. A chest strap with heart rate transmitter sent a signal to a wrist receiver that displays the heart rate (beats/min) at 6-sec intervals. This device has previously been validated against a 3-lead electrocardiogram (ECG).

Procedure

Participants were asked not to eat 2-4 hours prior to participation. Upon reporting to the testing laboratory, participants were administered an informed consent form indicating their willingness to participate fully in this study. After consent, a computerized wellness survey assessing various aspects of wellness was administered. Upon completion of the questionnaire, participants were asked to sit quietly for 5 minutes prior to obtainment of physiological measures. After this acclimation period, participants were prepared for physiological recordings using the Thought Technology sensors interfaced with their software program. A measure of skin conductance (SC) occurred in which two finger cuffs are attached to the pointer and ring fingers of the participants' non-dominant hand. Measures of heart rate variability were assessed via electrocardiogram (EKG). Electrodes were attached to the participants' wrists and forearm. Finally, conductive paste was applied to the participants' ears and scalp as ear clips were applied to each ear and an electrode was attached to the scalp of the participant to assess alpha electroencephalogram (aEEG). These baseline physiological readings were measured simultaneously for 5 minutes with the eyes closed.

Upon completion, participants were then assessed for body composition via skinfold testing. Three-site testing was used for both men and women. Calipers were placed in the abdominal region, suprailiac, and triceps for women, and chest, thigh, and the abdominal region for men in order to assess skin thickness. These values were saved and stored for later use in an

equation to assess body density and body fat percentage. Next, in order to assess heart rate, participants were fitted with a Polar heart rate monitor for obtainment of resting heart rate values, as well as, for continuous heart rate values during the ensuing exercise task. Participants were asked to complete a graded exercise test on the treadmill designed to estimate maximal cardiorespiratory fitness (VO₂max) to determine cardiorespiratory fitness level. Given the proven relationship between submaximal exercise and maximal effort exercise (Noonan & Dean, 2000), as well as, in order to reduce participant risk, the current study utilized the Bruce Submaximal Treadmill Exercise testing protocol. In this protocol, the test is administered in 3-minute stages until the participant reaches 85% of his/her age-predicted maximum heart rate. Age-predicted maximum heart rate (HR) is determined using the following formula: $[(208 - (0.7 \times \text{Age}) \times 85\%]$ as discussed by Tanaka, Monahan, & Seals (2001). The test began at 1.7 mph and a 10% incline. Each minute, HR and a rating of perceived exertion ratio (RPE) were assessed. After three minutes, the participant is subjected to the next stage of testing in which both the speed and % grade increased. Each stage last 3-minutes in duration and the test is performed until the participant's HR exceeds 85% of the age-predicted max. Upon completion of the test, a cool-down period occurred in which the participant was prompted to walk at a moderate speed until HR returned to normal (around 3-5 minutes). Next, participants were asked to complete a push-up test designed to measure muscular fitness. During this test, participants were asked to complete as many push-ups as possible in a one-minute time frame. One full push-up was classified as the completion of full extension of the arms, down to three inches from the ground, and back up to full extension. Women were asked to perform the modified version in accordance with the American College of Sports Medicine's (ACSM) Guidelines for Exercise Testing and Prescription, 9th Edition (2014). In this version, their knees were on the ground. Finally, in order

to measure flexibility, participants were asked to complete the sit-and-reach box test. They were asked to sit on the ground with no shoes and reach as far as possible on the box with the soles of their feet against the back of the box. The test was completed three times and the maximal number of centimeters that the participant indicated on the box was recorded. Upon completion, participants were thanked for their time in completing this study. The order of the obtainment of fitness measures was: 1) body composition, 2) cardiorespiratory fitness, 3) muscular fitness, and 4) flexibility. The aforementioned tasks were completed in continuous fashion and time for completion for each participant was approximately 1 hour.

Data Analytic Techniques

All self-report responses and physiological data were exported into a data file. Artifacts from the physiological data were removed via the auto-edit functions of the Biograph (Physiological Suite) software program (Thought Technology Ltd., Montreal Canada). The frequency domains of the HRV indices were analyzed by fast Fourier transformation. The time domain of the HRV indices were computed from the IBI of the raw EKG signals. All data were analyzed using IBM SPSS version 25 (SPSS, Chicago, USA). Regression analyses and correlational analyses were performed on the data where appropriate. The alpha levels were set at 0.05 for all analyses. A composite score was computed by coding all items in terms of performance, with a higher composite score relating to better physical fitness.

Results

Descriptive statistics are provided in Table 11. Additionally, given the sex differences due to biological makeup and methods of measurement, means and standard deviations for the physical fitness indicators are provided as a function of sex (see Table 12). A Pearson correlation analysis was performed to explore the relationship between perceived wellness and the four

primary components of physical fitness (see Table 13). Results revealed that both cardiorespiratory fitness and muscular fitness yielded significant correlations, while flexibility and body composition yielded no significant association with perceived wellness or components thereof. Cardiorespiratory fitness was significantly positively correlated only to the dimension of spiritual wellness ($r = 0.253, p = 0.039$). Muscular fitness yielded multiple significant positive correlations with overall wellness ($r = 0.401, p = 0.001$), and the components of psychological ($r = 0.281, p = 0.021$), emotional ($r = 0.388, p = 0.021$), social ($r = 0.241, p = 0.050$), physical ($r = 0.369, p = 0.002$), spiritual ($r = 0.328, p = 0.007$), and intellectual wellness ($r = 0.258, p = 0.035$). The aforementioned results indicate both increases in cardiorespiratory and muscular fitness to be indicative of a better perception of wellness state via the relationships mentioned above.

A linear multiple regression analysis was performed to explore if the four primary components of fitness were associated with perceptions of overall wellness. Results show that these physical fitness indicators significantly predict perceived wellness, $F(4, 60) = 3.228, p = 0.018$. Additionally, 12.2% of the variance in wellness can be explained by these fitness components (adjusted $r^2 = 0.122$). Thus, the positive relationship indicates that better physical fitness as assessed via the primary fitness indicators predicted higher perceptions of overall wellness. Furthermore, when parceling out which of the physical fitness components best predicted overall wellness, results revealed that only muscular fitness yielded significant results (e.g. muscular fitness, $t = 2.895, p = 0.005$; body composition, $t = 1.089, p = 0.281$; flexibility, $t = 0.878, p = 0.383$; cardiorespiratory fitness, $t = 1.063, p = 0.292$). In order to explore if our findings were subjected to multicollinearity, we explored the Collinearity Statistics for each of the independent variables. Results revealed that all variables had a high collinearity tolerance,

ranging from 0.859 – 0.913, and low Variance Inflation Factors (VIF) ranging from 1.095 – 1.164, indicating that when regressed on the other independent variables, each of our variables had a very low chance of being linearly predicted from the other independent variables (Tabachnick & Fidell, 2007), thus minimizing the effects of possible multicollinearity.

Finally, Pearson correlation analysis was performed to explore if composite physical fitness (e.g. the composite sum of the 4 fitness indicators) was positively correlated with perceived wellness (see Fig. 15). Results revealed a significant positive relationship between composite physical fitness and overall wellness perception ($r = 0.213$, $p = 0.044$) (one-tailed). However, the linear regression analysis exploring if physical fitness predicted perceptions of overall wellness yielded no significant association between the variables, $F(1, 63) = 2.996$, $p = 0.088$ (two-tailed) (see Table 14).

In terms of physiological functioning, another Pearson correlation analysis was performed to explore the relationships between perceived wellness and indices of ANS functioning at rest. Results revealed no significant correlations between the dependent measures in question ($p > 0.05$). See Table 15 for all intercorrelations between wellness components and ANS indices.

When examining the physical fitness components separately in conjunction with indices of ANS functioning at rest, only indices of HRV yielded significant results. Cardiorespiratory fitness yielded significant negative correlations with both mean HR ($r = -0.413$, $p = 0.001$) and HF HRV ($r = -0.261$, $p = 0.034$), and a positive relationship with LF/HF ratio ($r = 0.301$, $p = 0.014$). Body composition was negatively correlated with LF HRV ($r = -0.258$, $p = 0.039$) and LF/HF ratio ($r = -0.327$, $p = 0.008$), and positively correlated with HF HRV ($r = 0.277$, $p =$

0.027). Flexibility was not significantly correlated with any index of ANS functioning. Muscular fitness was significantly negatively related to mean HR ($r = -0.246, p = 0.047$).

Discussion

The purpose of this study was to provide insight into the relationships between perceived physical wellness, overall wellness, and objective indicators of health, ANS function at rest and physical fitness levels. Principle findings of the current study were as follows: 1) both muscular fitness and cardiorespiratory fitness were significantly correlated with perceptions of wellness and components thereof, 2) the physical fitness indicators taken collectively, significantly predict perceived wellness, 3) muscular fitness best predicted perceptions of wellness, 4) there was no reported relationship between perceived wellness and indices of ANS functioning, and 5) HRV was the only index of ANS functioning that was significantly related to physical fitness components.

It was hypothesized that components of physical fitness were positively correlated with perceived wellness. Results revealed that only the physical fitness components of cardiorespiratory fitness and muscular fitness yielded significant relationships. Neither body composition, nor flexibility, were significantly related to perceived wellness or wellness components. However, the physical fitness composite score was correlated with perceived wellness. Hence, our results support previous studies. For example, Hettler's Holistic Wellness Model (1976) discusses the process of striving to build physical strength, flexibility, and endurance to promote physical wellness. However, one of the main tenets that this specific dimension highlights in this model is the importance of maintaining physical fitness in opposition to being out of shape. Additionally, Myers & Sweeney's Indivisible Self model of wellness (2004) discusses the physical self as a 2nd order factor that is comprised of exercise and

nutrition. The authors state that both exercise and nutrition are so broadly endorsed, that oftentimes other components of holistic well-being are compromised as a result. Likewise, our results showed that the combination of the 4 primary components of physical fitness did significantly predict overall wellness. Additionally, 12.2% of the variance in overall wellness was explained by the model incorporating the combination of these components. Thus, the aforementioned seminal models of wellness suggest that physical exercise is vital to enhancing perceptions of physical wellness, and subsequently, overall wellness.

In the current study, it is possible that due to the limited variability in body type (BMI: $M = 23.31$, $SD = 3.54$), differences in both flexibility and body composition were not large enough to detect changes in subjective perceptions of wellness. However, existing literature has shown that physical activity, or exercise, improves mood (Biddle, 2000), quality of life (Penedo & Dahn, 2005), sleep (Kredlow, Capozzoli, Hearon, Calkins, & Otto, 2015), cognitive performance (Lautenschlager et al., 2008), etc. Thus, participating in any forms of physical activity may cause increases in wellness perceptions. Given the relationship between physical activity and quality of life, we argue that individuals who are engaging in more physical activity are the ones that endorse higher perceptions of wellness and better quality of life. Therefore, given that muscular fitness was the only variable associated with overall wellness, we posit that those who are actively participating in weightlifting or other forms of muscular fitness, feel best about their overall wellness state as a result. Our findings are supported by existing studies that have highlighted the benefits of muscular fitness in the form of strength training to: reduce depressive symptoms (Paluska & Schwenk, 2000), facilitate sensory processing and cognitive functioning (Özkaya et al., 2005), and reduce central adiposity, cardiovascular disease, and metabolic risk factors (Smith et al., 2014). Therefore, our results suggest that the maintenance and promotion of

muscular fitness is pivotal to both subsequent feelings of overall wellness, as well as, a buffer against negative health and disease outcomes.

Additionally, cardiorespiratory fitness was positively associated with spiritual wellness. Existing literature corroborates this relationship showing religion and spirituality to buffer against negative physical health consequences (Powell, Shahabi, & Thoresen, 2003). Individuals who are more spiritual or report higher spiritual wellness have been shown to be associated with a more dominant PSNS (Berntson, Norman, Hawkley & Cacioppo, 2008). Individuals with a more active PSNS have better cardiovascular control (Hu, Lamers, de Geus, & Penninx, 2017; Olshansky, Sabbah, Hauptman, & Colucci, 2008), which is a primary predictor used in the cardiorespiratory fitness. It is quite possible that spirituality is a buffer for a more active PSNS system, which in turn, helps control and suppress HR allowing for slower increases in HR and greater cardiorespiratory fitness. Thus, greater cardiorespiratory fitness is associated with better health and wellness. Another explanation is that spirituality has been linked to physical health due to the healthy lifestyle that it encourages (Powell, Shahabi, & Thoresen, 2003). Therefore, the inherent nature of being spiritual and optimizing factors in one's life to be his/her best self, subsequently leads to increases in physical health. Moreover, spirituality has been shown to be associated with cardiac autonomic regulation (Berntson, Norman, Hawkley, & Cacioppo, 2008). In this particular study, self-report assessments of individual spirituality were linked to enhanced parasympathetic and sympathetic cardiac control. Therefore, our results corroborate existing literature reflecting a significant positive relationship between one's spirituality and cardiovascular fitness.

We expected that cardiorespiratory fitness would be the best individual predictor of overall wellness. In opposition of our hypothesis, cardiorespiratory fitness was not the best

predictor of physical wellness or overall wellness. Instead, muscular fitness was shown to be the best predictor. This finding demonstrates that individuals in this college student sample base their perceptions of their wellness state more so on muscular fitness, rather than cardiorespiratory fitness. Interestingly, cardiorespiratory fitness is a better predictor of health status as it relates to heart health and mortality (Després, 2016; Powers, 2014; Wei et al., 1999). However, in this college student sample, muscular fitness was seen as a better indicator of overall wellness. As previously mentioned, the benefits of physical fitness manifest into greater feelings of wellness state. If an individual can actively increase even one of these 4 components of physical fitness, it may lead to increases in overall wellness. Similar to the premise of holistic wellness (Hettler, 1976), the active and continual process of maximizing individual components leads to a greater collective sum. Although, our results highlight that some components of physical fitness are more effective than others in increasing perceptions of wellness, when taken together and reviewing all components as a composite score, all play an active role in increasing perceptions of holistic wellness. Accordingly, our results lend support to the notion that optimizing physical fitness indicators increases quality of life and bolsters greater feelings of wellness.

Additionally, we hypothesized that individuals who report higher perceived wellness scores will show better ANS functioning at rest as assessed by alpha-electroencephalogram (aEEG), Skin Conductance (SC), and Heart Rate Variability (HRV). There was no observed relationship, neither positive, nor negative, between indices of ANS health and perceptions of wellness. Healthier individuals in this particular study as assessed by ANS functioning did not perceive better overall health via various facets of life. One explanation could be due to the population recruited. Given the nature of the current study, many athletes and individuals who exercise regularly volunteered for this study. Thus, physical fitness level may not have differed

enough to detect a strong enough change between physical fitness and wellness perceptions. Future studies should focus their attention on exploring differences between trained and untrained individuals on this research question. It is possible that increased fitness levels due to training, bolsters greater perceptions of wellness that can be easily detected via changes in ANS functioning. Existing literature has demonstrated differences between trained and untrained individuals in terms of ANS activation (Boutcher, Cotton, Nurhayati, Craig, & McLaren, 1997; Buchheit & Gindre, 2006; Gregoire, Tuck, Hughson, & Yamamoto, 1996; Groehs et al., 2015; Naskar & Mondal, 2015). Therefore, given our findings, in conjunction previous literature, we would expect differences in wellness perceptions as a function of training state.

Finally, we expected a positive correlation between components of physical fitness and ANS functioning at rest as assessed by aEEG, SC, and HRV. In terms of flexibility, there were no significant relationships with any of the ANS modalities. We postulate that although individuals who are more flexible are generally in better shape, flexibility in itself is not a strong enough factor to affect perceptions of wellness. Alternatively, muscular fitness had a negative correlation with mean HR. Individuals who are trained and in a better physical state tend to display lower mean HR, as shown by findings in the existing literature (Bahrainy, Levy, Busey, Caldwell, & Stratton, 2016; Carter, Banister, & Blaber, 2003; Robinson et al., 1966). Thus, our finding was supported in the existing literature. Furthermore, body composition was negatively associated with both LF HRV and LF/HF ratio, and positively correlated with HF HRV. This finding was in opposition to our hypothesis. We expected an inverse association with vagally-mediated parameters suggesting that lower body composition would be correlated with higher PSNS activity and higher body composition would relate to more sympathetic predominance (Lindmark et al., 2005; Messina et al., 2013; Scherrer et al., 1994). Instead, our results suggest

that those with higher body composition have higher functioning PSNS and more suppressed SNS. One explanation could be due to the sex of participants examined. We collapsed across sex and did not parcel out for sex effects. This is important because women inherently have more body fat due to their biological and genetic makeup (Geer & Shen, 2009). In this study, there was disproportion in amount of female participants ($N = 41$) compared to male participants ($N = 26$). However, it was beyond the scope of our study to explore sex effects. Future studies would need to control for sex in relation to body composition.

Results also show that cardiorespiratory fitness was negatively correlated with mean HR and HF HRV, and positively related with LF/HF ratio. Although our findings for HR support previous research, our findings for both HF HRV and LF/HF seem to oppose the concept that higher cardiorespiratory fitness is indicative of better heart health and more parasympathetic nerve dominance as previously outlined (Carney, Freedland, & Veith, 2005; Kleiger, Miller, Bigger, & Moss, 1987; Kristal-Boneh et al., 1995; Thayer, Yamamoto, & Brosschot, 2010). A positive relationship between cardiorespiratory fitness and LF/HF ratio indicates more sympathetic dominance in the ANS. Our findings contradict those that have shown this sympathovagal balance (LF/HF ratio) to be inversely associated with cardiovascular autonomic function (Dütsch, 2007; Pagani et al., 1986). Interestingly, cardiorespiratory fitness was also inversely correlated with HF HRV. Although both findings are in opposition to the notion that PSNS dominance is associated with better cardiorespiratory fitness, existing literature provides an explanation for these findings. In the current study, participants knew prior to the day of participation that they would be enduring some sort of physical activity. Given this fact, we may have obtained participants who were more physically fit compared to the general population. In addition, given the design of our experiment, participants were asked to complete various

questionnaires about their well-being (i.e. perceptions of stress, overall wellness, sleep habits, and social support), then asked to sit quietly while physiological measures were taken, all prior to being subjected to the exercise portion of the study. It is possible that the prolonged anticipation of exercise (at least 48 hours) resulted in changes in autonomic functioning. For example, studies have shown that both mental and motor imagery are effective in eliciting similar ANS responses to the actual task (Bolliet, Collet, & Dittmar, 2005; Deschaumes-Molinaro, Dittmar, & Vernet-Maury, 1992; Oishi, Kasai, & Maeshima, 2000; Oishi & Maeshima, 2004). Therefore, changes in autonomic dominance may have been a result of the body preparing itself for the upcoming alteration in homeostasis (i.e. induction of exercise). Furthermore, although we aimed to assess resting ANS activity, we may have instead measured one's anticipatory response to exercise. This would indicate that we wouldn't have been able to make assumptions based upon resting state autonomic activity in the current study, but instead would have corroborated the existing literature citing anticipatory responses as the primary motivator of autonomic activity prior to exercise (van Paridon, Timmis, Nevison, & Bristow, 2017). Future studies may wish to incorporate an alternative research design in an attempt to eliminate such confounds by having participants come to the lab one day to take resting values, then come back for a follow-up assessing physical fitness on a separate day.

Alternatively, either the surveys evaluating quality of facets of life, or the anticipation of exercise may have served as a stressor to participants and may have resulted in a response associated with stress activation (e.g. suppressed parasympathetic, activated sympathetic nerves). Research has shown that acute psychological stress causes reductions in cardiac parasympathetic activity (Gianaros et al., 2005) and increases in sympathovagal balance (Delaney & Brodie, 2000). Concordantly, in a study exploring the effects of psychosocial factors on stress response,

a sample of 61 college students completed a task involving social evaluative threat (Bosch et al., 2009). Manipulations were made in the number of observers in order to evoke physiological activation in response to social evaluative threat (i.e. threat of evaluation from peers). Results revealed that social stress caused increases in physiological reactivity associated with more sympathetic activation (i.e. increased cortisol, sympathetic nerve dominance). Therefore, our results contend with the notion that individuals may have been inherently stressed due to the thought of being socially evaluated on their physical fitness levels. Moreover, instructions were to do as best as possible and the researchers would let participants know where they fell in comparison to their peers. These instructions may have evoked responses similar to social evaluative threat and thus evoked, autonomic imbalance prior to exercise.

Although greater cardiorespiratory fitness was related to this outcome associated with worse health, it is possible that during an actual exercise bout, ANS functioning would reflect greater vagal modulation which is associated with better cardiovascular health. This can be explained by a study by Tulppo and colleagues (1998) in which HRV was assessed both at rest and during exercise as a function of fitness group. There was no change in HR or other power-domain indices at rest. However, results show that the introduction of exercise caused gradual vagal withdrawal proceeded by sympathetic activation. Thus, the introduction of exercise caused an inhibition of PSNS activity. Individuals who were in a better fitness state reflected a slower rate of PSNS inhibition, thus allowing for better physical performance. In the current study, the positive observed relationship between cardiorespiratory fitness and LF/HF ratio, and inverse relationship with HF HRV at rest may indicate slower rates of parasympathetic nerve inhibition or enhanced sympathetic activation.

In summary, our results suggest that composite physical fitness (i.e. cardiorespiratory fitness, muscular fitness, flexibility, and body composition) is a good predictor of perceived wellness. Moreover, in this college student sample, higher muscular fitness is shown to reflect higher perceptions of wellness. In addition, cardiorespiratory fitness revealed a positive relationship with spiritual wellness. Our findings support the stance made by Susie Ellis, the Global Wellness Institute's Chairman. Ellis hypothesized that wellness will be soon firmly associated with health and prevention. Although extant wellness literature has explored concepts in association with health, our linkage of concepts to ANS function provides an operational way to explore wellness objectively.

The ANS is important for automatic responses to stimuli in response to changes from homeostasis. Particularly in college students, the ANS can be targeted as a potential mechanism to buffer against negative stress-related problems given the well-established link between the ANS and stress. Moreover, one such mechanism that has been shown to reduce stress and combat against negative effects of cardiovascular disease is physical health. As such, college student physical health should be explored as a potential mechanism of coping with the deleterious effects of life stress and increasing health status. Thus, given the well-established link between physical fitness and health, an examination into physical fitness indicators and their subsequent association with both health and wellness proves to be beneficial in health promotion and disease prevention. Results of the current study highlight the importance of physical fitness, and in particular, muscular fitness, in terms of improving one's health status, quality of life, and perception of wellness state.

CHAPTER VII
GENERAL DISCUSSION

The Oliver Health Factor model of Wellness was found to be an effective working model in synthesizing existing models of wellness. In my three studies I demonstrate that wellness can be measured objectively. Specifically, HRV was identified as the main index of objective wellness assessment; however, future studies should explore other indices of ANS function. The ANS is so complex that no single evaluation precisely reflects function for a specific branch of the system (Zygmunt & Stanczyk, 2010). My model highlighted three health factors (i.e. psychological, physical, and relational) that were all instantiated in ANS function, specifically HRV. Given this fact, my model can be utilized in various disciplines that either incorporate subjective or objective assessments of health and wellness. Moreover, this working model demonstrates the connection between health, via HRV assessment, and wellness. It is important to note that my theorized model still requires further testing for validation, specifically that of structural equation modeling. The current study did not provide enough data to conduct proper hierarchical linear modeling given the utilization of only one already validated measure of perceived wellness (PWS – Adams et al., 1997). Thus, although this working model is grounded in theory and supported by results of the aforementioned studies, more research is warranted for construct validity.

Wellness programs have been established to promote quality of life in public and private organizations. However, wellness providers often rely upon self-reported aspects of wellness rather than objective measures. We can understand a lot about individual perception of lifestyle given self-report responses to various questionnaires, surveys, etc.; however, what we may not know is how these factors of everyday life affect an individual's health from an autonomous biological standpoint. It is critical to examine one's involuntary biological health as this can be a sole indicator of both life expectancy (Hertzman, 1999; Rieker & Bird, 2005) and quality of life

(Torrance, 1987; Wilson & Cleary, 1995). There is a need for biological outcomes to complement self-report in order to enhance the validity of research (Brown & DiClemente, 2015).

Existing literature has explored individual factors of self-report in connection with biological health. For example, higher self-enhancing beliefs reduced baseline cortisol levels and lowered cardiovascular response to stress (Taylor, Lerner, Sherman, Sage, & McDowell, 2003), responses on the frailty index were directly correlated with survival and health status (Mitnitski, Song, & Rockwood, 2004), perceived emotional intelligence was inversely related to cortisol reactivity (Salovey, Stroud, Woolery, & Epel, 2002), positive emotions positively affected biological health outcomes (Fredrickson, 2017), difficulties in emotional regulation showed a positive association with lower resting HRV (Williams et al., 2015), and depression severity inversely related to vagal activity (Kemp et al., 2010). Although the extant research overwhelmingly demonstrates the relationship between self-report and biological health, research is lacking in terms of the connection between a subjective construct of holistic wellness and health outcomes assessed via ANS functioning. For example, Ryff & Singer (2006) explored the relationship between psychological well-being and ill-being with biological correlates. The authors found significant associations demonstrating how both psychological well-being and ill-being are represented in biology. However, only the construct of psychological well-being was explored and not in conjunction with parameters of ANS activity (i.e. stress response and brain activity). Furthermore, no objective index of wellness has yet to be established.

Empirical Support of HRV as an objective Wellness index

In three studies designed to test the working Oliver Health Factor Wellness Model, I examined the functioning of the ANS via explorations into SC, aEEG, and HRV in an attempt to

elucidate the ANS as an objective index of wellness perceptions. In terms of study one, results revealed that only HRV was significantly associated with wellness domains. The domains of Physical, Social, Intellectual, and Emotional wellness all yielded significant correlations with various aspects of HRV. Thus, indicating that HRV plays a substantial role in the manifestation of wellness. This association is important as it demonstrates the relationship between wellness domains and indices of ANS health.

Concerning HRV components, there has been a lot of confusion regarding the role of LF HRV (Reyes del Paso et al., 2013). Some scholars feel that LF HRV represents sympathetic dominance (Lombardi et al., 1996), while others feel it represents parasympathetic predominance and more baroreflex functioning (Moak et al., 2007). Results of the current study suggest that LF is actually more indicative of more parasympathetic dominance over the sympathetic nervous system in this autonomic balance. Various domains of wellness represented in this study (i.e. emotional, and physical) lend support to this theory. In conclusion, given the relationship between HRV and wellness components, findings of the current study suggest that HRV may be a useful way to objectively assess factors of wellness in relation to overall health.

An examination of study two revealed no significant relationship between components of HRV. HR resulted in a negative correlation with perceived wellness, but not with any of the PWS individually when parceled out. This relationship is supported in existing literature showing the association between HR and physical health (Haskell et al., 2007; Morseth et al., 2016; Warburton, Nicol, & Bredin, 2006). Furthermore, during the mental imagery task in an attempt to assess if the relational manipulation had any impact on the ANS, results revealed no association between pre- and post- HR, SDRR, VLF, or LF/HF ratio. However, significant differences did exist between LF HRV, HF HRV, and SDNN. These results suggest that when

individuals create an image of the most significant relationship in their lives, changes in ANS activity can result, thus indicating the effects that relationships can have on health as assessed by ANS activity. Therefore, the findings of this study suggest that the HRV is an effective tool in assessing changes in individual wellness domains (i.e. emotional wellness).

Results of study three revealed that upon examination of the physical fitness components separately in conjunction with indices of ANS functioning at rest, only indices of HRV yielded significant results. Results indicated that muscular fitness, cardiorespiratory fitness, and body composition all had significant correlations with HRV. Although unsupportive of the previous two studies in which HRV is implicated as an index of wellness explorations, my findings do suggest that HRV can be utilized as an index of physical fitness; therefore, further corroborating the utility of HRV as an indicator of health and wellness.

In summary, these three studies clearly show the utility of HRV as a meaningful index of holistic wellness. In Study 1, most of the dimensions of wellness were correlated with components of HRV. In Study 2, the visualization task caused changes in indices of HRV reflective of a more active SNS system or emotional dysregulation. In Study 3, the fitness indicators of muscular fitness, cardiorespiratory fitness, and body composition yielded significant relationships with HRV indices. However, results of these three studies yielded mixed results with regards to the overall utility of the ANS as an index of holistic wellness. For example, Study 3 (N= 67) found no relationship in terms of overall wellness and ANS indices, while Study 2 (N = 160) found a negative correlation between overall wellness and HR and Study 1 (N = 142) found a positive relationship between overall wellness and LF/HF. In terms of individual dimensions of wellness, Studies 2 and 3 found no relationship between components of wellness and indices of ANS activity, whereas Study 1 found multiple correlations with HRV. In

all 3 studies, only the domain of HRV yielded significant results with either components of wellness or tasks designed to assess components. Given that the findings in terms of ANS functioning and wellness yielded mixed results, I decided to collapse across all studies and explore baseline ANS function and wellness indices. With a much larger sample size and greater power ($N = 369$), I found results supportive of my hypotheses.

Findings collapsed across studies and support for my Model

When collapsed across all studies, both the time domain (NN) of HRV, as well as, HR amounted in significant relationships with wellness (see Table 16). HR was inversely related to 4 out of the 6 wellness dimensions, in addition to overall holistic wellness composite score. The finding corroborates the existing literature showing that lower resting HR reflects a better health state. Wellness is utilized as a subjective methodology of assessing health, so this relationship is supported in the literature. Similarly, NN is positively correlated with the physical dimension of wellness. NN reflects the normalized R-R interval. As such, higher NN is also reflective of better health. This positive association indicates that greater resting HRV, measured via normalized R-R in the current studies, is reflective of individuals with better perceptions of their physical health status.

In terms of my results regarding aEEG, methodological limitations are noted. the variability in aEEG was very high, and we only utilized one recording site. In my studies, we utilized a single lead EEG measured Fpz (Frontal polar site on the midline). Placement was in concordance with the 10/20 system positioning manual (10/20 System Positioning Manual, 2012). Thought Technology software only includes one lead measures with reference sites placed on both ears, therefore given the interest of the current paper to explore frontal alpha wave activity which can be assessed at this site (Kawada, Kiryu, Aoki, & Suzuki, 1992), we

placed the electrode accordingly. Moreover, a full EEG cap could be utilized as opposed to a 1-electrode model for more robust data. Finally, future studies incorporating cognition may wish to explore this waveform in the frontal lobe of the brain. In summary, aEEG was not an effective index of health in these studies.

In regards to SC, my results show that although there were components of wellness that were low for some individuals, there was no relationship with increased skin conductance as a sympathetic response at rest. However, SC is typically used as a measure of arousal. In that regard, we did find an increase in skin conductance in study two, as we asked participants to think about their most significant relationship. This was a form of emotional processing and this elicited an increased skin conductance response when compared to homeostasis. Future studies may wish to employ SC in studies examining arousal response to wellness domains, rather than correlations with wellness domains at rest. Given the null findings in regard to both aEEG and SC in the collapsed study, only components of HRV yielded significant relationships with dimensions of wellness.

Overall Limitations and Conclusions

A few study limitations are worthy of noting. I hypothesized a relationship between ANS functioning and perceptions of wellness. Although my findings were effective in demonstrating this relationship, not all indices of ANS function were correlated with all dimensions of wellness. For example, I also explored SC and aEEG in conjunction with HRV. My studies indicate that only HRV and its' corresponding indices can be seen as an index of wellness. As such, future studies should both further explore HRV in order to replicate my findings, as well as, incorporate additional measures of ANS functioning in an attempt to establish other connections with wellness. Additionally, my sample was limited to college students. Although this was the

population that I was interested in for the scope of this paper, future research is warranted to explore if this relationship exists in both younger and older populations. A more diverse sample could also show if this relationship is a function of race, sex, age, etc. Another limitation is that my model has not been explored from the standpoint of other models. I utilized the Perceived Wellness Survey (Adams et al., 1997) to assess perceptions of wellness and clumped them into three health domains. Thus, the incorporation of questions from other models may further validate my model and its impact on future research. More importantly, the Oliver Health Factor Wellness Model is a working model that needs to be validated through a series of studies using an instrument to measure the constructs of interest. My working model is very much theoretical in nature, and future studies are warranted.

The three experiments utilized in this study demonstrate that there is a relationship between subjective components of wellness and health. Objectively, health is measured by the involuntary actions of the autonomic nervous system in these studies. Because subjective instrumentation can be inherently biased due to its nature, objective measurements prove to be a both effective and efficient way to both test these phenomena and validate these subjective responses. As stated by Pavlov (1932), psychologists merely deduce and may not get a concrete answer, whereas physiologists strive for a concrete answer and will not rely solely on mere deduction. Thus, I took a psychophysiological approach to the phenomena of health and wellness. As a result, a relationship between health and wellness was established from both a subjective and objective standpoint. Confirming my hypothesis, the ANS was implicated as an objectively measured index of wellness. This is vital to my understanding of the effects that perceptions of every day phenomena have on individual health.

From a theoretical viewpoint, autonomic activity as assessed via heart rate variability did in fact yield a significant relationship with domains of wellness. This finding suggests that the ANS, and more specifically, heart rate variability, can be seen as an index of wellness. Greater variability is associated with better health (Acharya et al., 2006; Kleiger et al., 1987; Thayer, Hansen, Saus-Rose, & Johnsen, 2009; Thayer et al., 2012). The existing literature on heart rate variability has substantially shown that higher variability is indicative of a better health state. My findings corroborate the existing literature and show that indices of heart rate variability are significantly related to components of wellness. Moreover, my study provides support for the linkage of the subjective construct of wellness to the objective phenomenon of health as previously defined by WHO. Although previous models of wellness are effective in the way that they describe implicated effects of wellness on a variety of variables, it is not until objective measures are incorporated that a better understanding of the actual health effects can occur. My model can be used as a theoretical ground point for the establishment of more novel models of wellness incorporating specific objective measures.

From a practical standpoint, my results are important for physicians, clinicians, practitioners, counselors, and therapists for variety of reasons. Whether utilizing survey instrumentation or physiological measures of basic vital signs, this relationship appears to be beneficial and informative. The observed relationship between ANS function and wellness, as assessed via HRV, highlights the importance of perceptions as indicative of health. Survey instrumentation designed to assess perceptions of wellness proves useful for a general assessment of autonomic modulation. Furthermore, this can inform health professionals on target areas in order for health maintenance and promotion.

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APPENDIX

Table 1
Models of Wellness Reviewed

	Physical	Social	Emotional	Intellectual	Spiritual	Occupational	Environmental	Psychological	Mental	Vocational	Economic	Financial
Dunn (1961)	X	X					X				X	
Ardell (1977)	X	X	X		X							
Lafferty (1979)	X	X	X	X	X							
Hettler (1980)	X	X	X	X	X	X						
Greenberg (1985)	X	X	X		X				X			
Crose et al. (1992)	X	X	X	X	X					X		
Witmer & Sweeney (1992)	X	X	X	X	X	X	X	X			X	
Adams et al. (1997)	X	X	X	X	X			X				
Durlak (2000)	X	X		X								
Renger et al. (2000)	X	X	X	X	X		X					
Montague et al. (2002)	X	X	X	X	X					X		
Myers and Sweeney (2004)	X	X	X	X	X	X	X	X			X	
Travis and Ryan (2004)	X	X	X	X	X	X	X					
Anspaugh et al. (2006)	X	X	X	X	X	X	X					
Hales (2006)	X	X	X	X	X	X	X					
Botha & Brand (2009)	X	X	X	X	X	X						
Roscoe (2009)	X	X	X	X	X	X	X					
Brown & Applegate (2012)	X	X	X		X		X		X			X

Table 2*Means and Standard Deviations for all Psychological Health Study Variables*

Variables	<i>M</i>	<i>SD</i>
Age	20.716	3.256
Retention Score	6.942	1.727
Congruent Flanker	802.028	143.029
Incongruent Flanker	810.851	127.954
Flanker Effect	8.823	94.670
Perceived Wellness Score	27.149	3.011
Psychological Wellness Component	4.456	0.719
Physical Wellness Component	4.379	0.763
Emotional Wellness Component	4.235	0.832
Spiritual Wellness Component	4.759	0.713
Social Wellness Component	4.755	0.648
Intellectual Wellness Component	4.563	0.524
Health Score	36.149	4.864
Heart Rate	79.904	11.339
VLF%	22.328	9.836
LF%	42.453	10.486
HF%	34.777	12.992
LF/HF Ratio	1.527	1.103
SDNN	46.268	28.879
Skin Conductance	2.978	2.612
Alpha-Electroencephalography	9.099	0.328

Note. VLF% = Percentage of Very Low Frequency power domain between the limits of 0.003 Hz and 0.04 Hz. LF% = Percentage of Low Frequency power domain between the ranges of 0.04 Hz and 0.15 Hz. HF% = Percentage of High Frequency power in the range of 0.15 Hz and 0.40 Hz. LF/HF Ratio = The ratio between Low Frequency and High Frequency power domains of Heart Rate Variability. SDNN = The time-domain measure of the standard deviation of the normal-normal interval.

Table 3

Pearson Correlation Analysis between the Psychological Health Study Perceived Wellness Scale, Skin Conductance, Alpha-Electroencephalography, and components of Heart Rate Variability at Rest

Variables		HR	VLF%	LF%	HF%	LF/HF	SDNN	SC	aEEG
PWS	Pearson Correlation	-.103	.077	.153	-.151	.173*	-.004	.011	.075
	Sig. (2-tailed)	.228	.371	.072	.076	.043	.965	.898	.374
	N	139	139	139	139	138	138	141	141
HR	Pearson Correlation	1	.121	-.012	-.181*	.175*	-.485**	.196*	-.127
	Sig. (2-tailed)		.155	.891	.033	.040	.000	.021	.137
	N		139	139	139	138	138	139	139
VLF%	Pearson Correlation		1	-.197*	-.626**	.328**	-.241**	.243**	-.048
	Sig. (2-tailed)			.020	.000	.000	.004	.004	.572
	N			139	139	138	138	139	139
LF%	Pearson Correlation			1	-.540**	.422**	-.336**	.149	.122
	Sig. (2-tailed)				.000	.000	.000	.079	.152
	N				139	138	138	139	139
HF%	Pearson Correlation				1	-.762**	.507**	-.305**	-.039
	Sig. (2-tailed)					.000	.000	.000	.650
	N					138	138	139	139
LF/HF	Pearson Correlation					1	-.428**	-.080	-.019
	Sig. (2-tailed)						.000	.349	.823
	N						138	139	139
SDNN	Pearson Correlation						1	-.173*	-.022
	Sig. (2-tailed)							.042	.796
	N							139	139
SC	Pearson Correlation							1	.041
	Sig. (2-tailed)								.629
	N								141

Note. PWS = Perceived Wellness Scale. HR = Heart Rate. VLF% = Percentage of Very Low Frequency power domain between the limits of 0.003 Hz and 0.04 Hz. LF% = Percentage of Low Frequency power domain between the ranges of 0.04 Hz and 0.15 Hz. HF% = Percentage of High Frequency power in the range of 0.15 Hz and 0.40 Hz. LF/HF = The ratio between Low Frequency and High Frequency power domains of Heart Rate Variability. SDNN = The time-domain measure of the standard deviation of the normal-normal interval. SC = Skin Conductance. aEEG = Alpha-Electroencephalography

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4

Pearson Correlation Analysis between the Psychological Health Study Perceived Wellness Components, Skin Conductance, Alpha-Electroencephalography, and components of Heart Rate Variability at Rest

Variables		2	3	4	5	6	7	8	9	10	11	12	13	14
1	Pearson													
	Correlation	0.281**	0.584**	0.602**	0.459**	0.391**	-0.066	0.000	0.030	-0.026	0.084	0.082	-0.025	0.016
	Sig. (2-tailed)	0.001	0.000	0.000	0.000	0.000	0.443	1.000	0.726	0.764	0.327	0.340	0.765	0.846
2	N	141	141	141	141	141	139	139	139	139	138	138	141	141
	Pearson													
	Correlation	1	0.277**	0.340**	0.284**	0.258**	-0.238**	-0.020	0.101	-0.057	0.092	0.135	0.156	-0.015
3	Sig. (2-tailed)		0.001	0.000	0.001	0.002	0.005	0.818	0.235	0.506	0.281	0.115	0.065	0.860
	N		141	141	141	141	139	139	139	139	138	138	141	141
	Pearson													
4	Correlation		1	0.612**	0.347**	0.420**	-0.056	0.022	0.177*	-0.114	0.122	-0.016	0.053	0.043
	Sig. (2-tailed)			0.000	0.000	0.000	0.509	0.796	0.037	0.183	0.156	0.852	0.535	0.615
	N			141	141	141	139	139	139	139	138	138	141	141
5	Pearson													
	Correlation			1	0.606**	0.412**	0.004	0.094	0.108	-0.144	0.161	-0.011	-0.004	0.012
	Sig. (2-tailed)				0.000	0.000	0.960	0.273	0.204	0.090	0.060	0.897	0.963	0.886
6	N				141	141	139	139	139	139	138	138	141	141
	Pearson													
	Correlation				1	0.260**	-0.037	0.192*	0.041	-0.137	0.112	-0.016	0.060	0.024
7	Sig. (2-tailed)					0.002	0.664	0.024	0.634	0.108	0.190	0.848	0.481	0.781
	N					141	139	139	139	139	138	138	141	141
	Pearson													
8	Correlation					1	-0.016	0.058	0.198*	-0.188*	0.185*	-0.265**	0.090	0.051
	Sig. (2-tailed)						0.854	0.495	0.020	0.026	0.030	0.002	0.289	0.546
	N						139	139	139	139	138	138	141	141
9	Pearson													
	Correlation						1	0.121	-0.012	-0.181*	0.175*	-0.485**	-0.127	0.196*
	Sig. (2-tailed)							0.155	0.891	0.033	0.040	0.000	0.137	0.021
10	N							139	139	139	138	138	139	139
	Pearson													
	Correlation													

Table 4 Continued

Variables	2	3	4	5	6	7	8	9	10	11	12	13	14
8 Pearson													
Correlation							1	-0.197*	-0.626**	0.328**	-0.241**	-0.048	0.243**
Sig. (2-tailed)								0.020	0.000	0.000	0.004	0.572	0.004
N								139	139	138	138	139	139
9 Pearson													
Correlation								1	-0.540**	0.422**	-0.336**	0.122	0.149
Sig. (2-tailed)									0.000	0.000	0.000	0.152	0.079
N									139	138	138	139	139
10 Pearson													
Correlation									1	-0.762**	0.507**	-0.039	-0.305**
Sig. (2-tailed)										0.000	0.000	0.650	0.000
N										138	138	139	139
11 Pearson													
Correlation										1	-0.428	0.060	0.163
Sig. (2-tailed)											0.000	0.488	0.057
N											138	138	138
12 Pearson													
Correlation											1	-0.025	-0.186
Sig. (2-tailed)												0.770	0.029
N												138	138
13 Pearson													
Correlation												1	0.041
Sig. (2-tailed)													0.629
N													141

Note. 1 = Psychological wellness. 2 = Physical wellness. 3 = Emotional wellness. 4 = Spiritual wellness. 5 = Social wellness. 6 = Intellectual wellness. 7 = Heart Rate. 8 = Very Low Frequency%. 9 = Low Frequency%. 10 = High Frequency%. 12 = Low Frequency, High Frequency Ratio. 12 = Normalized R-R ratio. 13 = Alpha Electroencephalography. 14 = Skin Conductance.

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Table 5*Means and Standard Deviations for all Relational Health Study Variables*

Variables	<i>M</i>	<i>SD</i>
Age	18.63	1.172
Number of Significant Relationships	12.87	9.142
Perceived Stress Scale	24.640	7.644
Social Provisions Scale	81.730	9.622
Perceived Wellness Scale Composite	147.372	23.622
Psychological Wellness Component	24.562	4.422
Emotional Wellness Component	23.008	5.220
Social Wellness Component	27.377	4.083
Physical Wellness Component	24.815	4.820
Spiritual Wellness Component	26.108	4.850
Intellectual Wellness Component	24.431	2.309
Health Score	36.149	4.864
Heart Rate - pre	77.585	12.127
VLF% - pre	19.588	10.156
LF% - pre	41.340	13.138
HF% - pre	39.057	15.410
LF/HF Ratio - pre	1.559	1.545
SDNN - pre	52.506	33.928
Skin Conductance - pre	2.797	2.609
Alpha Encephalogram - pre	10.317	9.329
Heart Rate - post	76.772	12.923
VLF% - post	19.170	13.564
LF% - post	37.217	16.202
HF% - post	43.633	19.293
LF/HF Ratio - post	1.481	1.666
SDNN - post	22.094	15.740
Skin Conductance - post	4.730	4.685
Alpha Encephalogram - post	9.369	0.679

Note. VLF% = Percentage of Very Low Frequency power domain between the limits of 0.003 Hz and 0.04 Hz. LF% = Percentage of Low Frequency power domain between the ranges of 0.04 Hz and 0.15 Hz. HF% = Percentage of High Frequency power in the range of 0.15 Hz and 0.40 Hz. LF/HF Ratio = The ratio between Low Frequency and High Frequency power domains of Heart Rate Variability. SDNN = The time-domain measure of the standard deviation of the normal-normal interval. – pre = before the visualization task (at baseline). – post = taken simultaneously during the visualization task.

Table 6

Pearson Correlation Analysis between the Relational Health Study Perceived Stress Scale, Perceived Wellness Scale, Social Provisions Scale, and Number of reported significant relationships

Variables	Relationships	PSS	PWS	SPS
Relationships	Pearson Correlation	1		
	Sig. (2-tailed)	0.001	0.184**	0.035
	N	0.989	0.039	0.697
PSS	Pearson Correlation	1		
	Sig. (2-tailed)	0.001	0.184**	0.035
	N	126	126	124
PWS	Pearson Correlation		1	
	Sig. (2-tailed)		0.000	0.010
	N		98	98
SPS	Pearson Correlation			1
	Sig. (2-tailed)			0.446**
	N			0.000

Note. PSS = Perceived Stress Scale. PWS = Perceived Wellness Scale. SPS = Social Provisions Scale.

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7

Pearson Correlation Analysis between the Relational Health Study Perceived Wellness Scale, Skin Conductance, Alpha-Electroencephalography, and components of Heart Rate Variability at Rest

Variables		HR	VLF	LF	HF	LF/HF	SDNN	aEEG	SC
PWS	Pearson								
	Correlation	-0.263**	0.001	-0.105	0.080	-0.017	0.130	0.017	0.104
	Sig. (2-tailed)	0.003	0.988	0.235	0.369	0.852	0.143	0.846	0.239
	N	129	129	129	129	129	129	129	129
HR	Pearson								
	Correlation	1	0.007	0.049	-0.059	0.028	-0.383**	0.054	0.056
	Sig. (2-tailed)		0.933	0.538	0.458	0.723	0.000	0.496	0.485
	N		160	160	160	160	160	160	160
VLF	Pearson								
	Correlation		1	-0.148	-0.551**	0.123**	-0.397**	0.069	0.086
	Sig. (2-tailed)			0.062	0.000	0.007	0.000	0.383	0.282
	N			160	160	160	160	160	160
LF	Pearson								
	Correlation			1	-0.702**	0.688**	-0.304**	0.061	0.112
	Sig. (2-tailed)				0.000	0.000	0.000	0.441	0.159
	N				160	160	160	160	160
HF	Pearson								
	Correlation				1	-0.763**	0.546**	-0.097	-0.177*
	Sig. (2-tailed)					0.000	0.000	0.223	0.026
	N					160	160	160	160
LF/ HF	Pearson								
	Correlation					1	-0.360**	0.013	0.103
	Sig. (2-tailed)						0.000	0.870	0.195
	N						160	160	160
SDNN	Pearson								
	Correlation						1	-0.030	-0.015
	Sig. (2-tailed)							0.707	0.848
	N							160	160
aEEG	Pearson								
	Correlation							1	0.121
	Sig. (2-tailed)								0.129
	N								160
SC	Pearson								
	Correlation								1
	Sig. (2-tailed)								
	N								

Table 7 Continued

Note. PWS = Perceived Wellness Scale. HR = Heart Rate. VLF% = Percentage of Very Low Frequency power domain between the limits of 0.003 Hz and 0.04 Hz. LF% = Percentage of Low Frequency power domain between the ranges of 0.04 Hz and 0.15 Hz. HF% = Percentage of High Frequency power in the range of 0.15 Hz and 0.40 Hz. LF/HF = The ratio between Low Frequency and High Frequency power domains of Heart Rate Variability. SDNN = The time-domain measure of the standard deviation of the normal-normal interval. aEEG = Alpha-Electroencephalography. SC = Skin Conductance.

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 8

Pearson Correlation Analysis between the Relational Health Study Perceived Wellness Components, Skin Conductance, Alpha-Electroencephalography, and components of Heart Rate Variability at Rest

Variables		2	3	4	5	6	7	8	9	10	11	12	13	14
1	Pearson													
	Correlation	0.297**	0.593**	0.442**	0.717**	0.350**	-0.154	-0.095	0.032	0.032	-0.046	0.016	0.133	0.008
	Sig. (2-tailed)	0.001	0.000	0.000	0.000	0.000	0.079	0.280	0.714	0.719	0.600	0.858	0.130	0.924
	N	130	130	130	130	130	130	130	130	130	130	130	130	130
2	Pearson													
	Correlation	1	0.425**	0.307**	0.371**	0.206**	-0.112	-0.066	-0.111	0.140	-0.095	0.153	0.055	0.042
	Sig. (2-tailed)		0.000	0.000	0.000	0.019	0.205	0.456	0.209	0.111	0.280	0.082	0.531	0.637
	N		130	130	130	130	130	130	130	130	130	130	130	130
3	Pearson													
	Correlation		1	0.361**	0.653**	0.408**	-0.099	0.110	0.024	-0.097	0.038	-0.051	0.122	0.090
	Sig. (2-tailed)			0.000	0.000	0.000	0.261	0.214	0.786	0.272	0.664	0.565	0.167	0.307
	N			130	130	130	130	130	130	130	130	130	130	130
4	Pearson													
	Correlation			1	0.484**	0.178*	0.058	-0.054	-0.017	0.054	-0.081	-0.049	0.042	-0.044
	Sig. (2-tailed)				0.000	0.043	0.514	0.539	0.844	0.540	0.359	0.578	0.637	0.616
	N				130	130	130	130	130	130	130	130	130	130
5	Pearson													
	Correlation				1	0.510**	-0.200*	-0.026	-0.037	0.048	-0.059	0.105	0.106	0.002
	Sig. (2-tailed)					0.000	0.022	0.773	0.674	0.585	0.506	0.232	0.231	0.983
	N					130	130	130	130	130	130	130	130	130
6	Pearson													
	Correlation					1	-0.267**	0.028	-0.034	0.013	0.049	0.176*	-0.055	0.045
	Sig. (2-tailed)						0.002	0.748	0.705	0.881	0.549	0.046	0.533	0.609
	N						130	130	130	130	130	130	130	130
7	Pearson													
	Correlation						1	0.007	0.049	-0.059	0.028	-0.383**	0.054	0.056
	Sig. (2-tailed)							0.933	0.538	0.458	0.723	0.000	0.496	0.485
	N							160	160	160	160	160	160	160

Table 8 Continued

Variables	2	3	4	5	6	7	8	9	10	11	12	13	14
8 Pearson													
Correlation						1	-0.148	-0.551**	0.213**	-0.397**	0.069	0.086	
Sig. (2-tailed)							0.062	0.000	0.007	0.000	0.383	0.282	
N							160	160	160	160	160	160	
9 Pearson													
Correlation							1	-0.702**	0.688**	-0.304**	0.061	0.112	
Sig. (2-tailed)								0.000	0.000	0.000	0.441	0.159	
N								160	160	160	160	160	
10 Pearson													
Correlation								1	-0.763**	0.546**	-0.097	-0.177*	
Sig. (2-tailed)									0.000	0.000	0.223	0.026	
N									160	160	160	160	
11 Pearson													
Correlation									1	-0.360**	0.013	0.103	
Sig. (2-tailed)										0.000	0.870	0.195	
N										160	160	160	
12 Pearson													
Correlation										1	-0.030	-0.015	
Sig. (2-tailed)											0.707	0.848	
N											160	160	
13 Pearson													
Correlation												1	0.121
Sig. (2-tailed)													0.129
N													160

Note. 1 = Psychological wellness. 2 = Physical wellness. 3 = Emotional wellness. 4 = Spiritual wellness. 5 = Social wellness. 6 = Intellectual wellness. 7 = Heart Rate. 8 = Very Low Frequency%. 9 = Low Frequency%. 10 = High Frequency%. 12 = Low Frequency, High Frequency Ratio. 12 = Normalized R-R ratio. 13 = Alpha Electroencephalography. 14 = Skin Conductance.

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Table 9*Paired Samples T-Test for Psychological Health Study ANS modalities*

	Mean	Std. Dev.	Std. Error	95% Confidence Interval		t	df	Sig. (2-tailed)
				Mean	Lower	Upper		
HRpre-post	.950	6.825	.541	-.119	2.019	1.755	158	.081
VLFpre-post	.302	15.073	1.195	-2.059	2.663	.253	158	.801
LFpre-post	4.144	16.510	1.309	1.558	6.730	3.165	158	.002*
HFpre-post	-4.480	18.190	1.443	-7.329	-1.631	-3.105	158	.002*
LFHFpre-post	.0770	1.706	.135	-.190	.344	.569	158	.570
NNpre-post	30.377	25.304	2.007	26.414	34.341	15.138	158	.000*
aEEGpre-post	.949	9.379	.741	-.516	2.413	1.279	159	.203
SCpre-post	-1.933	3.456	.273	-2.472	-1.393	-7.074	159	.000**

Note. Pre-post = paired samples test examining difference between baseline and post-manipulation means. HR = Heart Rate. VLF = Percentage of Very Low Frequency power domain between the limits of 0.003 Hz and 0.04 Hz. LF = Percentage of Low Frequency power domain between the ranges of 0.04 Hz and 0.15 Hz. HF = Percentage of High Frequency power in the range of 0.15 Hz and 0.40 Hz. LFHF = The ratio between Low Frequency and High Frequency power domains of Heart Rate Variability. NN = The time-domain measure of the standard deviation of the normal-normal interval. aEEG = Alpha-Electroencephalography. SC = Skin Conductance.

**. Correlation is significant at the 0.01 level (2-tailed).

Table 10

Pearson Correlation Analysis between the Relational Health Study Components of Perceived Wellness and number of reported significant relationships

Variables		Psychological	Emotional	Social	Physical	Spiritual	Intellectual
Relationships	Pearson						
	Correlation	0.064	-0.023	0.188*	0.028	0.140	0.201*
	Sig. (2-tailed)	0.480	0.801	0.036	0.756	0.119	0.024
	N	125	125	125	125	125	125
Psychological	Pearson						
	Correlation	1	0.593**	0.442**	0.297**	0.717**	0.350**
	Sig. (2-tailed)		0.000	0.000	0.001	0.000	0.000
	N		130	130	130	130	130
Emotional	Pearson						
	Correlation		1	0.361**	0.425**	0.653**	0.408**
	Sig. (2-tailed)			0.000	0.000	0.000	0.000
	N			130	130	130	130
Social	Pearson						
	Correlation			1	0.307**	0.484**	0.178**
	Sig. (2-tailed)				0.000	0.000	0.043
	N				130	130	130
Physical	Pearson						
	Correlation				1	0.371**	0.206**
	Sig. (2-tailed)					0.000	0.019
	N					130	130
Spiritual	Pearson						
	Correlation					1	0.510**
	Sig. (2-tailed)						0.000
	N						130
Intellectual	Pearson						
	Correlation						1
	Sig. (2-tailed)						
	N						

Note. *. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 11*Means and Standard Deviations for all Physical Health Study Variables*

Variables	<i>M</i>	<i>SD</i>
Age	21.45	6.363
Body Mass Index	23.631	3.536
Perceived Stress Scale	22.72	8.740
Perceived Wellness Scale Composite	170.48	22.068
Psychological Wellness Component	27.81	4.707
Physical Wellness Component	26.43	5.123
Emotional Wellness Component	26.79	5.177
Spiritual Wellness Component	29.96	3.682
Social Wellness Component	30.24	4.083
Intellectual Wellness Component	29.25	3.682
Social Provisions Scale	84.58	8.655
Heart Rate	74.999	11.628
VLF%	18.472	9.246
LF%	39.482	13.949
HF%	41.919	17.187
LF/HF Ratio	1.510	1.646
SDNN	48.242	34.021
Skin Conductance	1.196	0.880
Alpha-Electroencephalography	9.464	0.476

Note. VLF% = Percentage of Very Low Frequency power domain between the limits of 0.003 Hz and 0.04 Hz. LF% = Percentage of Low Frequency power domain between the ranges of 0.04 Hz and 0.15 Hz. HF% = Percentage of High Frequency power in the range of 0.15 Hz and 0.40 Hz. LF/HF Ratio = The ratio between Low Frequency and High Frequency power domains of Heart Rate Variability. SDNN = The time-domain measure of the standard deviation of the normal-normal interval.

Table 12*Means and Standard Deviations for the Physical Fitness Indicators by Sex*

Variables	Male		Female	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Muscular Fitness	37.62	17.815	29.39	10.947
Flexibility	29.42	9.056	36.51	8.981
Cardiorespiratory Fitness	28.194	5.620	26.571	5.432
Body Composition	16.481	7.494	23.706	4.051

Note. Muscular Fitness was measured in the number of Push-ups completed within 1-minute. Flexibility was assessed in centimeters using a Sit-and-Reach box. Cardiorespiratory Fitness was estimated using the Bruce Submaximal exercise treadmill protocol (mL/min/kg). Body Composition (in millimeters) was assessed using skin calipers measuring skinfold thickness of lean body mass.

Table 13

Pearson Correlation Analysis between the Physical Health Study Perceived Wellness Scale, Components, and Physical Fitness Indicators

Variables	2	3	4	5	6	7	8	9	10	11
1 Pearson Correlation	0.248*	0.255*	-0.263*	0.281*	0.388**	0.241*	0.369**	0.328**	0.258*	0.401**
Sig. (2-tailed)	0.043	0.037	0.034	0.021	0.001	0.050	0.002	0.007	0.035	0.001
N	67	67	65	67	67	67	67	67	67	67
2 Pearson Correlation	1	-0.075	0.025	0.228	0.202	0.115	0.216	0.148	0.179	0.232
Sig. (2-tailed)		0.547	0.843	0.063	0.101	0.353	0.079	0.233	0.148	0.059
N		67	65	67	67	67	67	67	67	67
3 Pearson Correlation		1	-0.189	0.217	0.202	0.203	0.097	0.253*	0.066	0.224
Sig. (2-tailed)			0.133	0.078	0.101	0.099	0.437	0.039	0.598	0.069
N			65	67	67	67	67	67	67	67
4 Pearson Correlation			1	-0.019	0.002	0.201	-0.174	0.007	0.122	0.016
Sig. (2-tailed)				0.883	0.985	0.108	0.167	0.958	0.333	0.902
N				65	65	65	65	65	65	65
5 Pearson Correlation				1	0.736**	0.541**	0.547**	0.771**	0.424**	0.865**
Sig. (2-tailed)					0.000	0.000	0.000	0.000	0.000	0.000
N					67	67	67	67	67	67
6 Pearson Correlation					1	0.506**	0.536**	0.721**	0.531**	0.867**
Sig. (2-tailed)						0.000	0.000	0.000	0.000	0.000
N						67	67	67	67	67
7 Pearson Correlation						1	0.336**	0.622**	0.360**	0.703**
Sig. (2-tailed)							0.005	0.000	0.003	0.000
N							67	67	67	67
8 Pearson Correlation							1	0.479**	0.467**	0.727**
Sig. (2-tailed)								0.000	0.000	0.000
N								67	67	67
9 Pearson Correlation								1	0.441**	0.868**
Sig. (2-tailed)									0.000	0.000
N									67	67
10 Pearson Correlation									1	0.660**
Sig. (2-tailed)										0.000
N										67

Table 13 Continued

Note. 1 = Muscular Fitness. 2 = Flexibility. 3 = Cardiorespiratory Fitness. 4 = Body Composition. 5 = Psychological wellness. 6 = Emotional wellness. 7 = Social wellness. 8 = Physical wellness. 9 = Spiritual wellness. 10 = Intellectual wellness. 11 = Overall Wellness.

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 14*Model Fit Summary for Physical Fitness as a Predictor of Overall Perceived Wellness*

Variable	R	R ²	Adj. R ²	Std. Error	F	Sig	Unstd. B	Std. Error
Physical Fitness	0.213	0.045	0.030	20.974	2.996	0.088	1.740	1.005

Note. Physical Fitness was a composite score taken by adding the physical fitness components (muscular fitness, cardiorespiratory fitness, body composition, and flexibility). Higher physical fitness score is indicative of a better physical fitness state. Physical fitness is the independent predictor variable used to predict overall wellness perceptions.

Table 15

*Pearson Correlation Analysis between the Physical Health Study Perceived Wellness Components, Skin Conductance, Alpha-
Electroencephalography, and components of Heart Rate Variability at Rest*

Variables		2	3	4	5	6	7	8	9	10	11	12	13	14
1	Pearson													
	Correlation	0.547**	0.736**	0.771**	0.541**	0.424**	-0.092	0.113	-0.137	0.039	-0.084	0.005	0.165	0.004
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.464	0.365	0.271	0.758	0.501	0.970	0.182	0.975
	N	67	67	67	67	67	66	66	66	66	66	66	67	67
2	Pearson													
	Correlation	1	0.536**	0.479**	0.336**	0.467**	-0.149	-0.127	0.125	-0.041	0.066	0.060	0.146	0.092
	Sig. (2-tailed)		0.000	0.000	0.005	0.000	0.234	0.309	0.316	0.741	0.598	0.631	0.238	0.461
	N		67	67	67	67	66	66	66	66	66	66	67	67
3	Pearson													
	Correlation		1	0.721**	0.506**	0.531**	-0.084	-0.065	-0.087	0.098	-0.062	-0.022	0.113	0.034
	Sig. (2-tailed)			0.000	0.000	0.000	0.503	0.606	0.487	0.432	0.624	0.859	0.361	0.782
	N			67	67	67	66	66	66	66	66	66	67	67
4	Pearson													
	Correlation			1	0.622**	0.441*	-0.116	-0.009	-0.051	0.038	-0.103	0.034	0.056	0.101
	Sig. (2-tailed)				0.000	0.000	0.353	0.945	0.684	0.760	0.409	0.788	0.652	0.414
	N				67	67	66	66	66	66	66	66	67	67
5	Pearson													
	Correlation				1	0.360**	-0.197	-0.070	-0.073	0.088	-0.090	0.128	0.125	0.024
	Sig. (2-tailed)					0.003	0.113	0.575	0.558	0.484	0.470	0.306	0.315	0.845
	N					67	66	66	66	66	66	66	67	67
6	Pearson													
	Correlation					1	-0.138	-0.150	-0.043	0.114	-0.079	0.066	0.209	0.052
	Sig. (2-tailed)						0.269	0.229	0.730	0.363	0.528	0.597	0.099	0.675
	N						66	66	66	66	66	66	67	67
7	Pearson													
	Correlation						1	-0.193	-0.021	0.130	-0.072	-0.434**	-0.053	0.171
	Sig. (2-tailed)							0.120	0.867	0.300	0.566	0.000	0.670	0.169
	N							66	66	66	66	66	66	66

Table 15 Continued

Variables	2	3	4	5	6	7	8	9	10	11	12	13	14
8 Pearson													
Correlation							1	0.037	-0.580**	0.187	-0.323**	0.067	-0.178
Sig. (2-tailed)								0.769	0.000	0.133	0.008	0.595	0.152
N								66	66	66	66	66	66
9 Pearson													
Correlation								1	-0.832**	0.807**	-0.425**	-0.021	0.014
Sig. (2-tailed)									0.000	0.000	0.000	0.866	0.909
N									66	66	66	66	66
10 Pearson													
Correlation									1	-0.762**	0.525**	-0.039	0.078
Sig. (2-tailed)										0.000	0.000	0.759	0.531
N										66	66	66	66
11 Pearson													
Correlation										1	-0.361**	-0.019	-0.070
Sig. (2-tailed)											0.003	0.879	0.575
N											66	66	66
12 Pearson													
Correlation											1	0.013	-0.083
Sig. (2-tailed)												0.918	0.507
N												66	66
13 Pearson													
Correlation												1	0.107
Sig. (2-tailed)													0.387
N													67

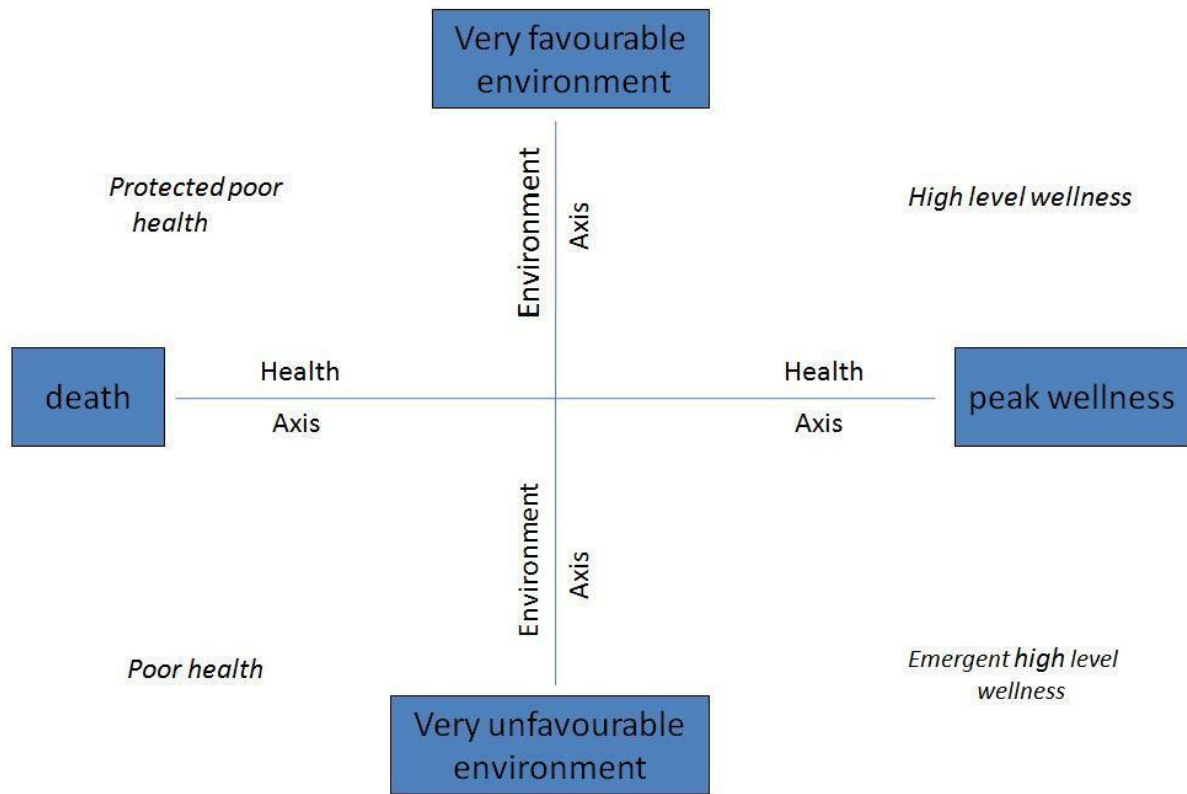
Note. 1 = Psychological wellness. 2 = Physical wellness. 3 = Emotional wellness. 4 = Spiritual wellness. 5 = Social wellness. 6 = Intellectual wellness. 7 = Heart Rate. 8 = Very Low Frequency%. 9 = Low Frequency%. 10 = High Frequency%. 12 = Low Frequency, High Frequency Ratio. 12 = Normalized R-R ratio. 13 = Alpha Electroencephalography. 14 = Skin Conductance.

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Table 16*Means and Standard Deviations for Collapsed across studies*

Variables	<i>M</i>	SD
Age	20.04	4.71
Perceived Wellness Scale Composite	163.52	21.40
Psychological Wellness Component	26.72	4.71
Physical Wellness Component	26.25	5.00
Emotional Wellness Component	25.42	5.33
Spiritual Wellness Component	28.57	4.99
Social Wellness Component	28.79	4.08
Intellectual Wellness Component	27.77	3.69
Heart Rate	78.00	11.84
SDRR	112.60	69.44
VLF%	20.43	9.97
LF%	41.43	12.37
HF%	37.94	15.09
LF/HF Ratio	1.54	1.41
SDNN	49.24	32.22
Skin Conductance	2.57	2.47
Alpha-Electroencephalography	9.70	6.17

Note. SDRR = The time-domain measure of the standard deviation of the R-R interval. VLF% = Percentage of Very Low Frequency power domain between the limits of 0.003 Hz and 0.04 Hz. LF% = Percentage of Low Frequency power domain between the ranges of 0.04 Hz and 0.15 Hz. HF% = Percentage of High Frequency power in the range of 0.15 Hz and 0.40 Hz. LF/HF Ratio = The ratio between Low Frequency and High Frequency power domains of Heart Rate Variability. SDNN = The time-domain measure of the standard deviation of the normal-normal interval.



Dunn's Wellness Grid

3

Figure 1. Dunn's High Level Wellness Health Grid



Figure 2. Hettler's Holistic Wellness Model

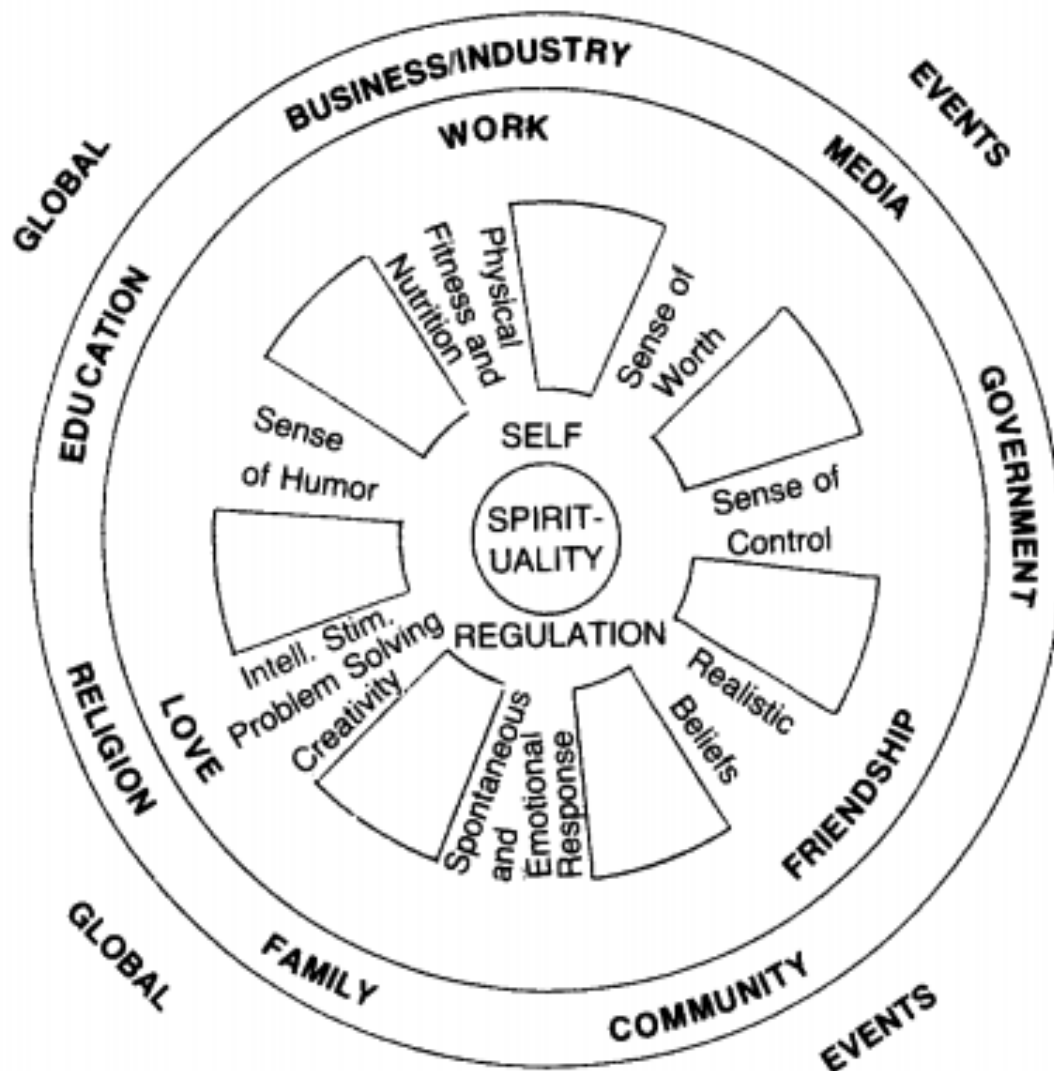


FIGURE 1
Wheel of Wellness and Prevention

Note. Copyright 1990, J. Melvin Witmer and Thomas J. Sweeney, Ohio University. From "Beyond Social Interest: Striving Toward Optimal Health and Wellness" by J. Melvin Witmer and T. J. Sweeney, 1991, *Individual Psychology*, 40. Copyright 1991 by J. Melvin Witmer and T. J. Sweeney. Reprinted by permission.

Figure 3. Witmer and Sweeney's Wheel of Wellness and Prevention Model

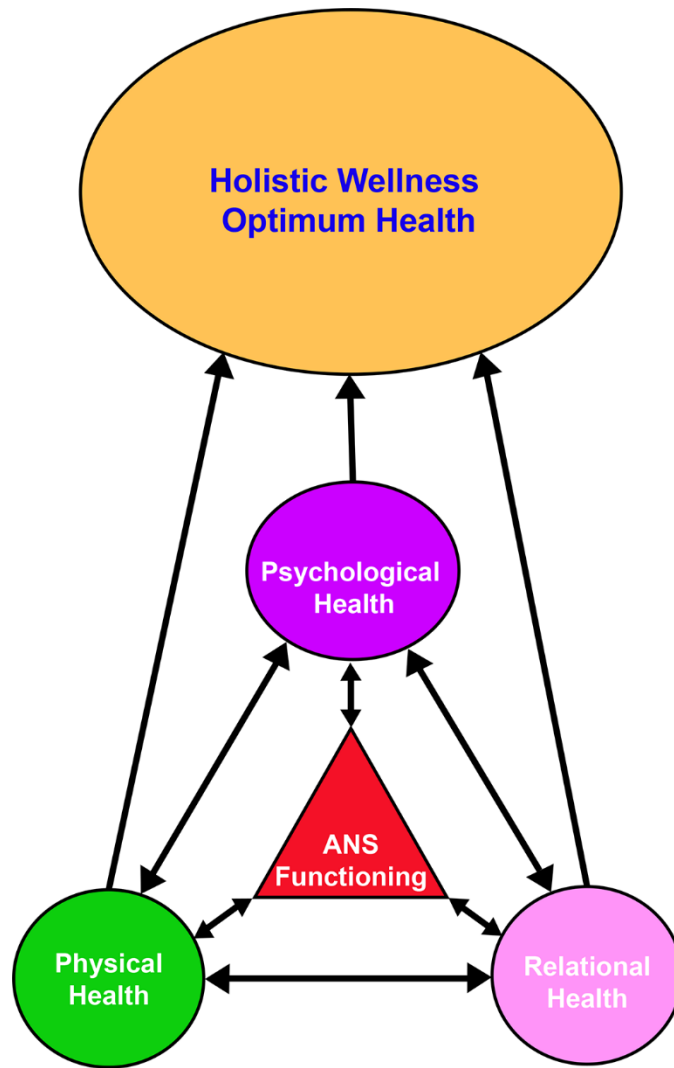


Figure 4. Oliver Health Factor Wellness Model

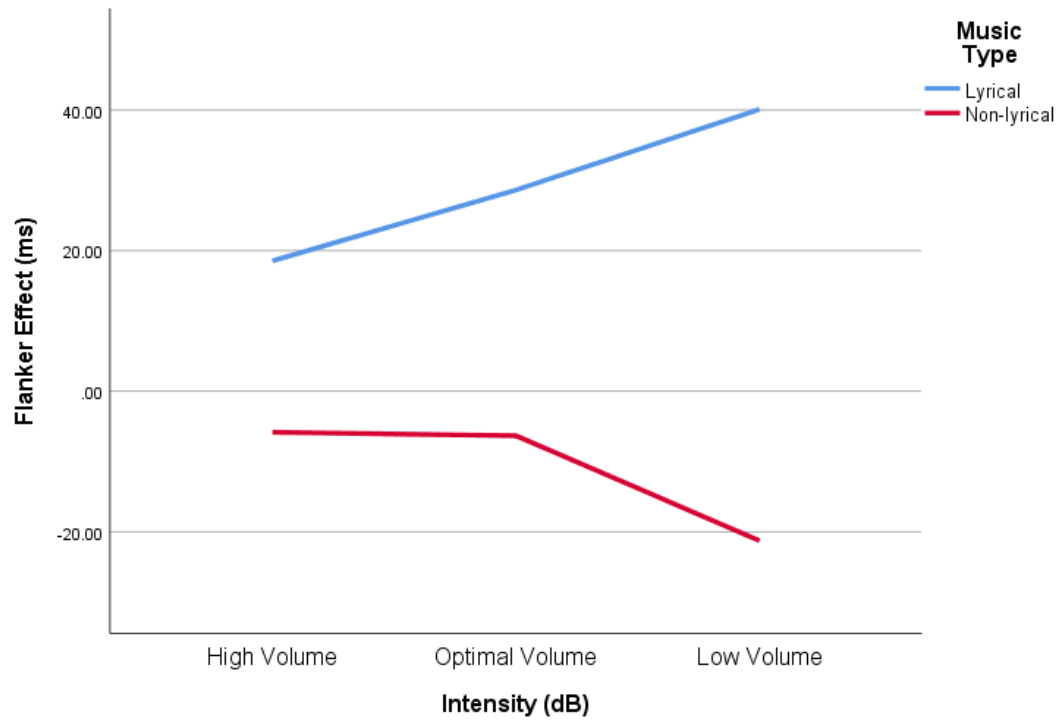


Figure 5. Interaction between Intensity and Music Type on the Flanker Task.

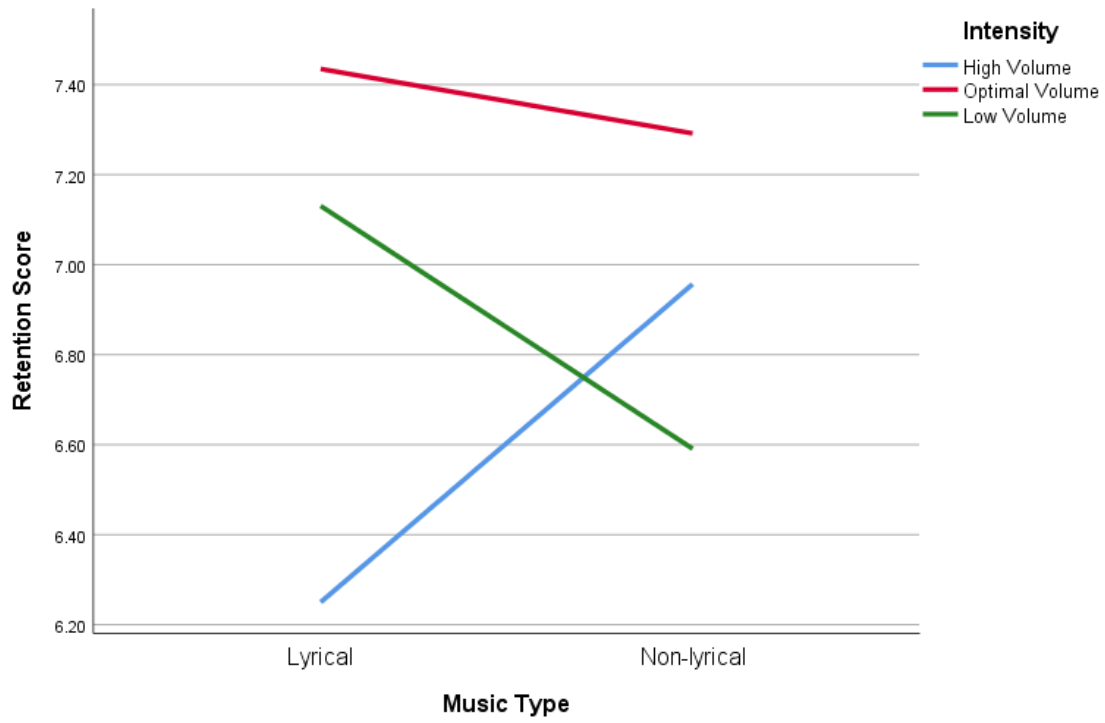


Figure 6. Interaction between Music Type and Intensity on the Retention Task.

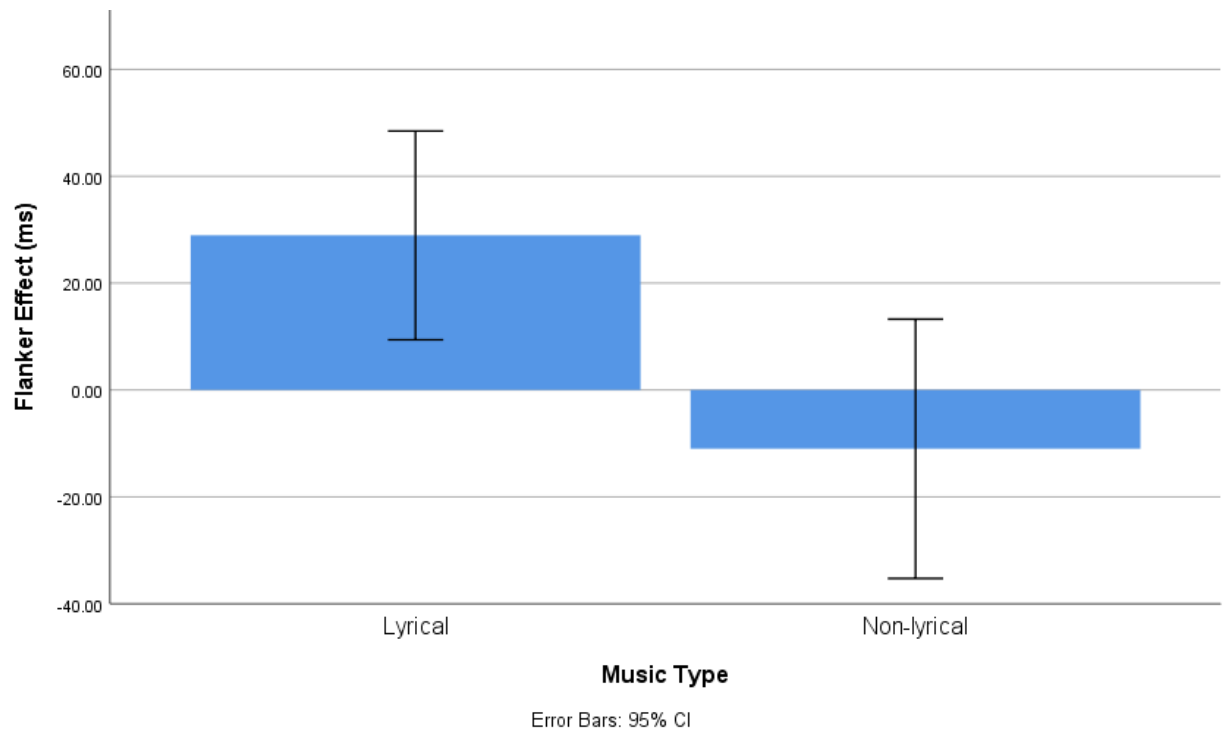


Figure 7. Results of the comparison between Music Type (Lyrical vs Non-Lyrical) on the Flanker Task on performance in milliseconds.

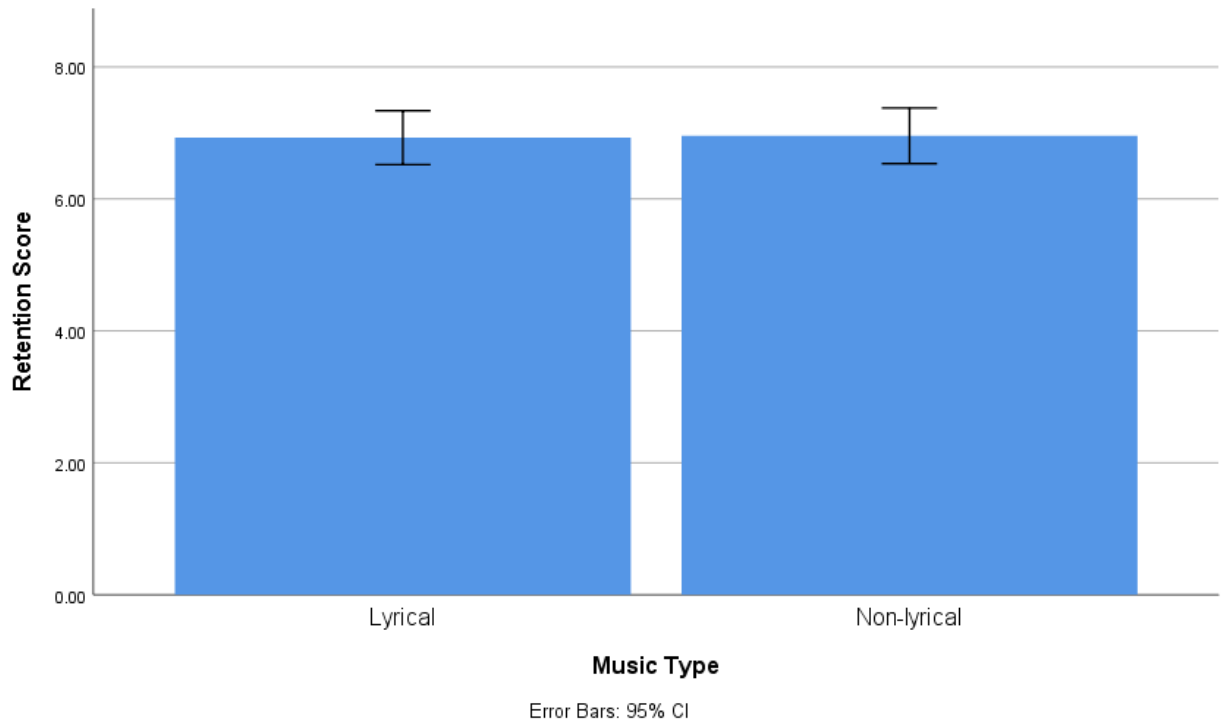


Figure 8. Results of the comparison between Music Type (Lyrical vs Non-Lyrical) on performance on the retention task.

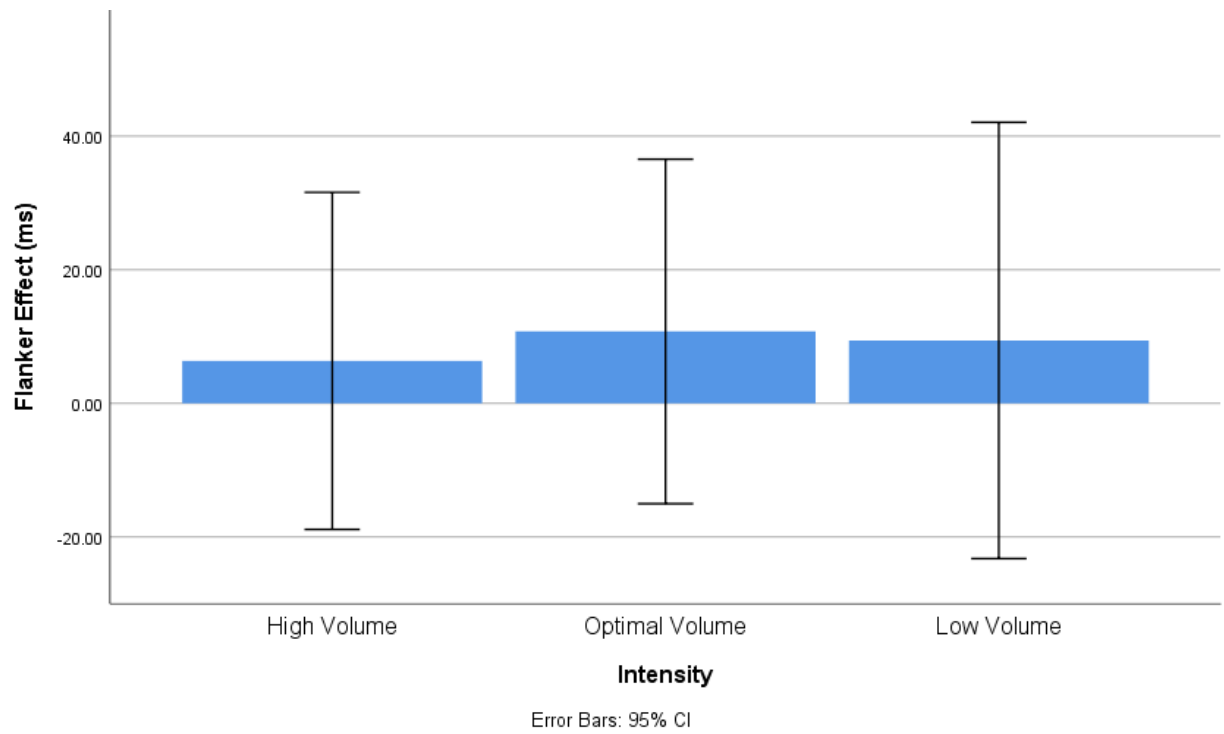


Figure 9. Results of the comparison between Intensity (High vs Optimal vs Low) on the Flanker Task on performance in milliseconds.

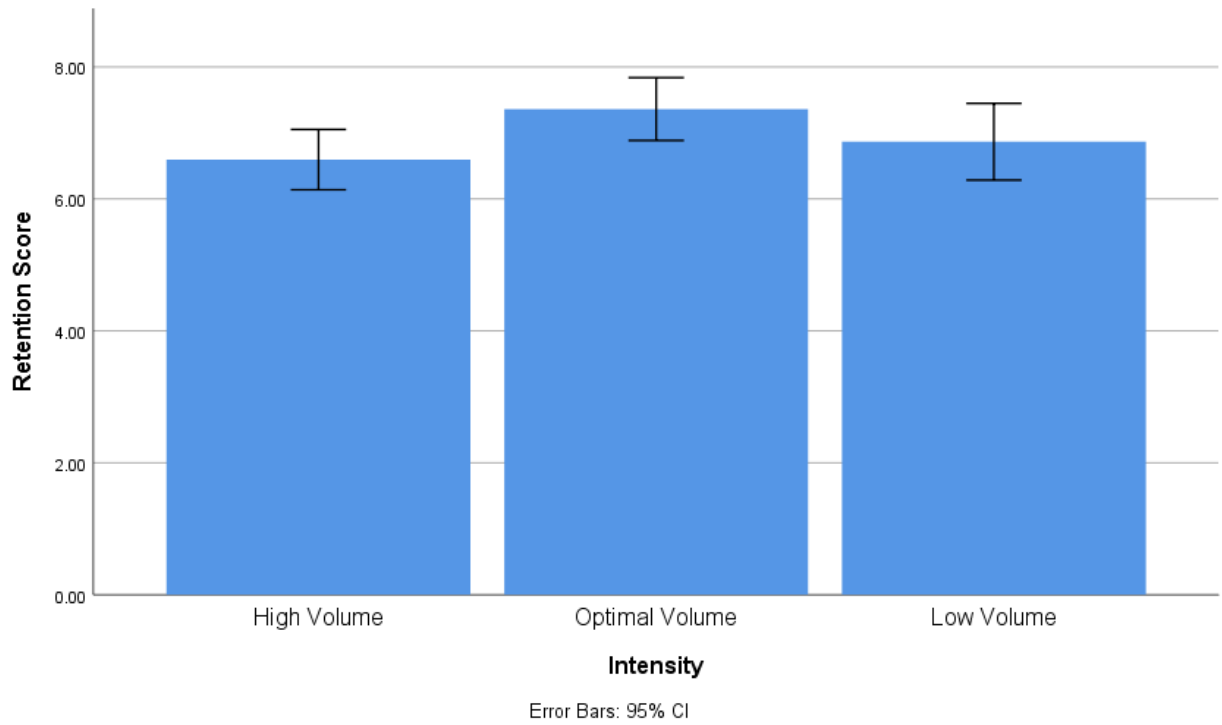


Figure 10. Results of the comparison between Intensity (High vs Optimal vs Low) on performance on the retention task.

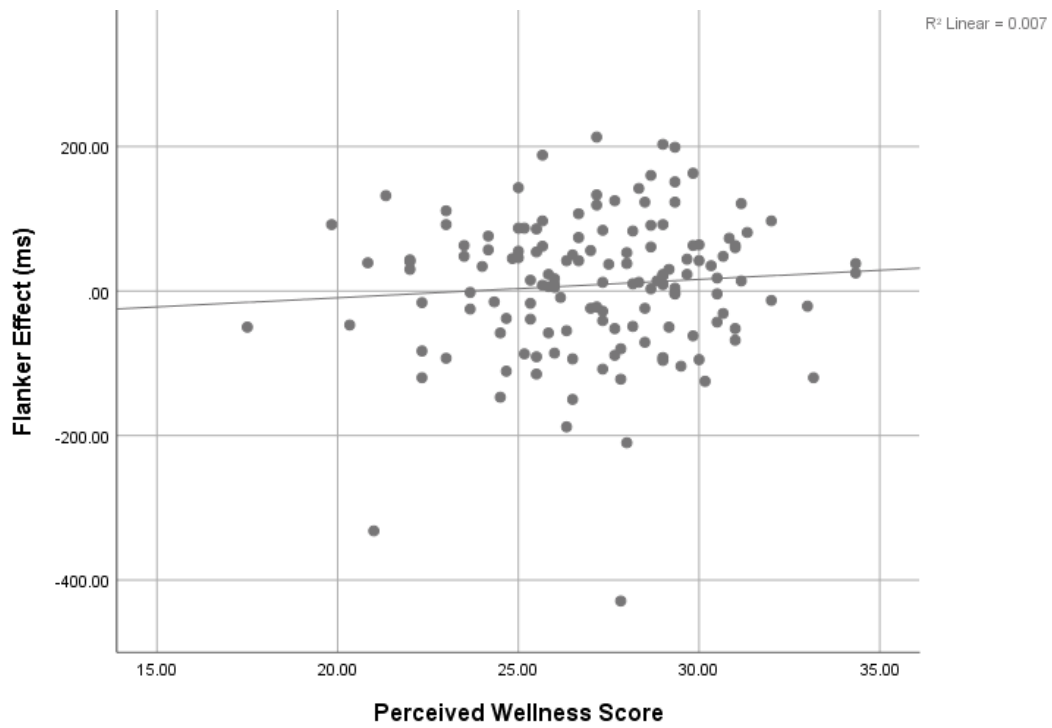


Figure 11. Correlation between Perceived Wellness Score and Flanker Effect in milliseconds.

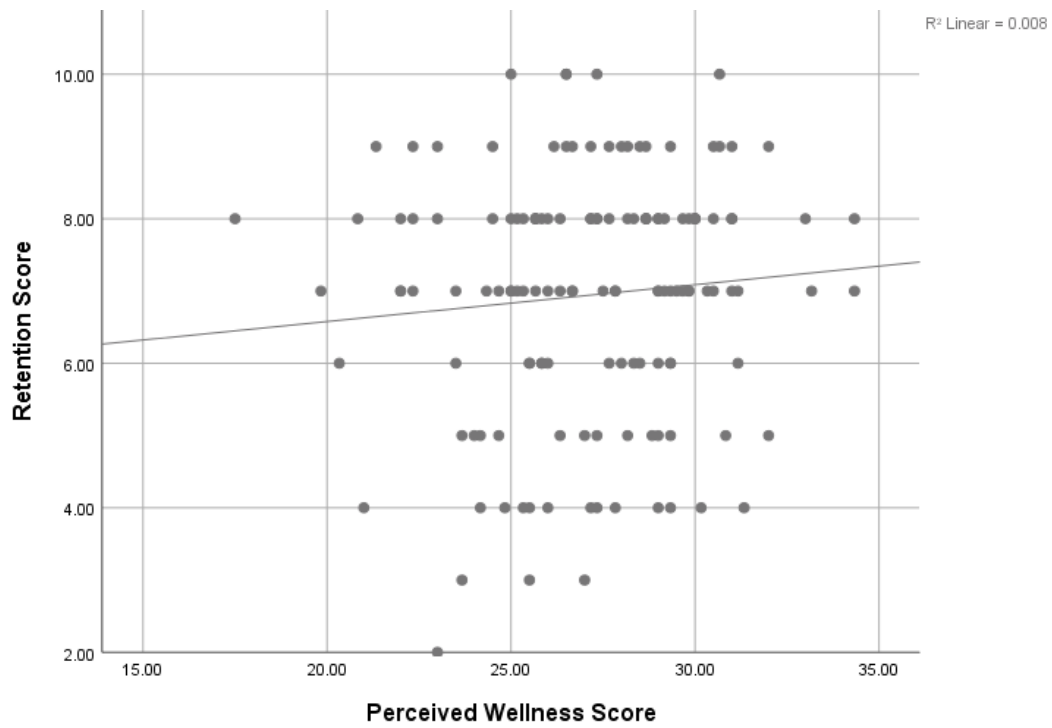


Figure 12. Correlation between Perceived Wellness Score and Score on the Retention task.

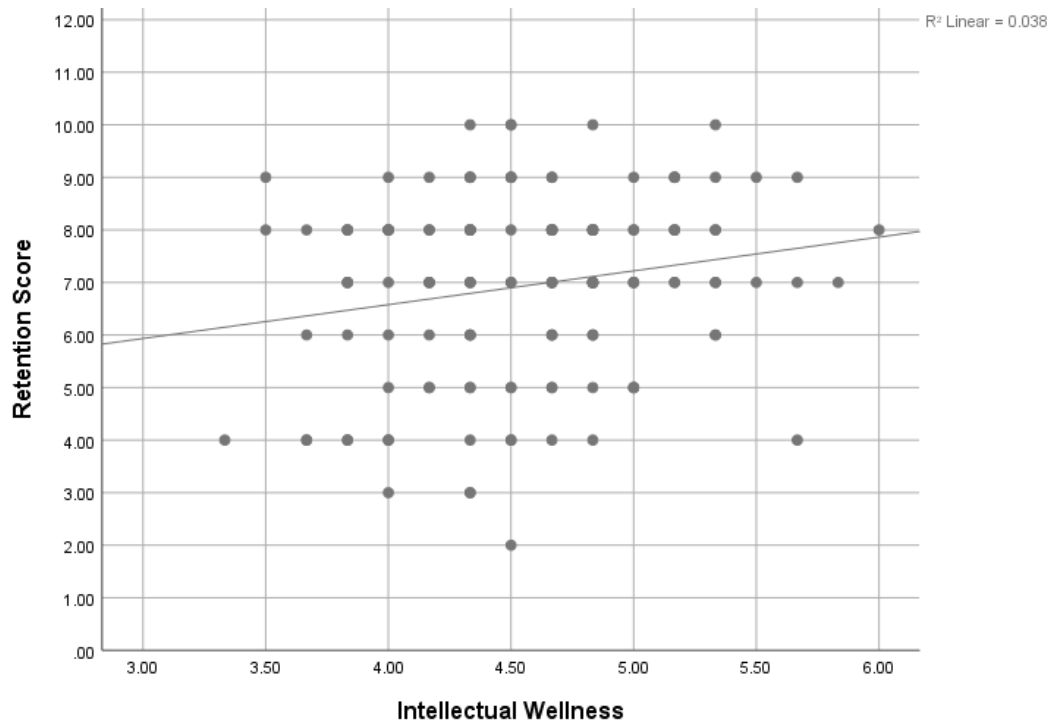


Figure 13. Correlation between Intellectual Wellness Score and Score on the Retention task.

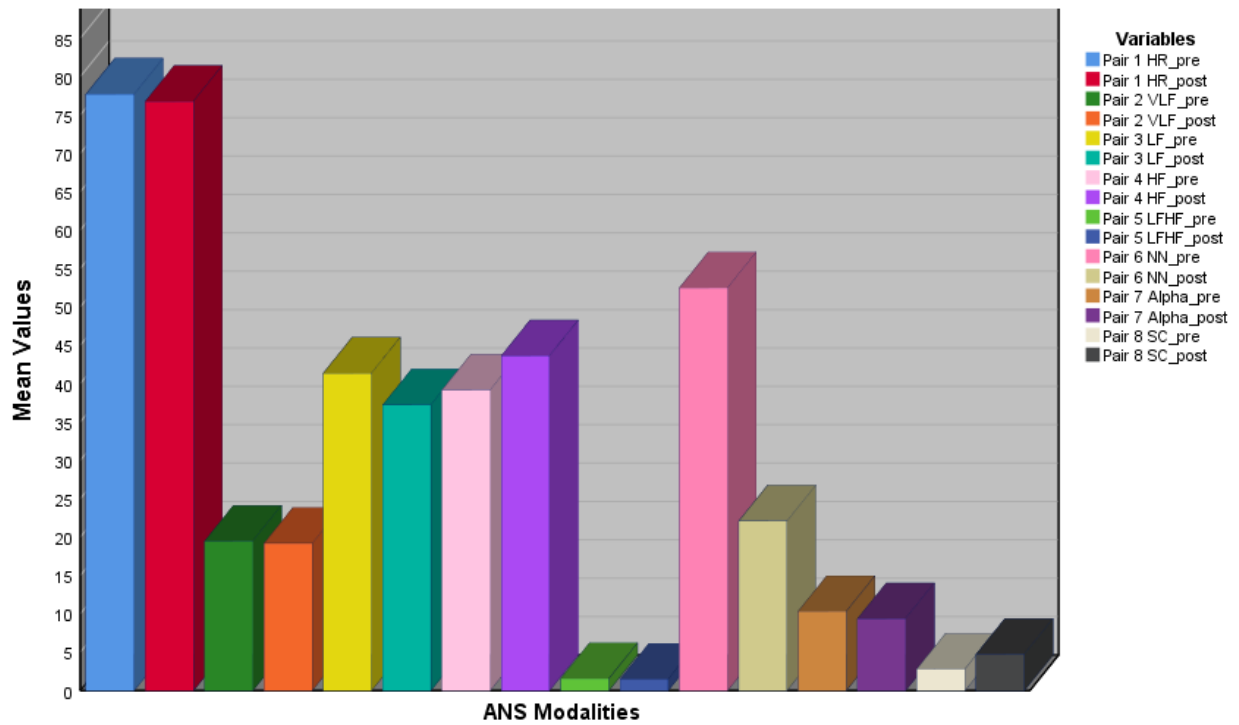


Figure 14. Mean Comparison of the ANS modalities at baseline and post-manipulation using the Paired Samples T-Test.

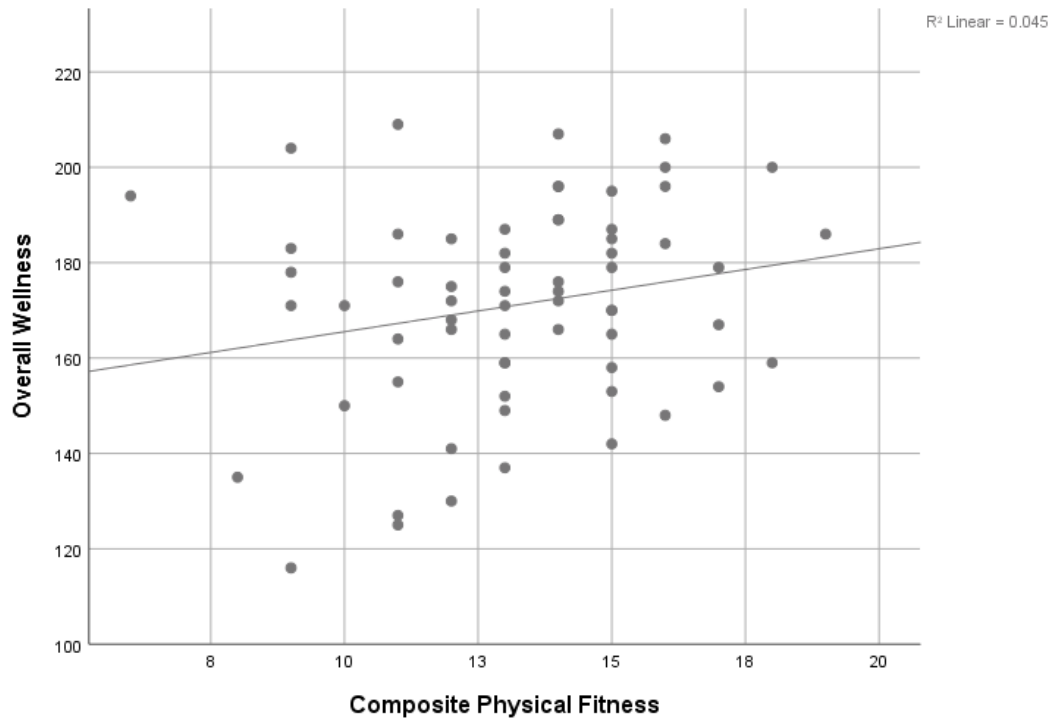


Figure 15. Correlation between composite physical fitness and composite wellness perceptions.

Informed Consent Form

Title of Project: The Effects of Music Intensity on Cognitive Performance: An Examination of Wellness

Principal Investigator: Michael D. Oliver II, M.A.

Purpose: This study is designed to examine whether or not the volume intensity of music plays a role in cognitive performance. Various studies have shown that music can be beneficial in increasing cognitive performance. However, none to our knowledge have examined if volume level has negative effects on cognitive ability. In addition, this study will examine aspects of wellness as it relates to cognitive performance. Wellness is a very important concept that has been linked to health and vitality.

This study is a two-day examination to be completed in consecutive fashion. On Day 1, you will be asked to complete a few surveys (wellness, health, stress, sleep), sit quietly while physiological measures are taken (heart rate, EEG, skin conductance, and saliva for alpha amylase concentration) using a small physio-graph with sensors attached the wrists, forearms, and fingers, as well as the ears and scalp (both of which will have conductive paste used in their application), listen to music while completing a laboratory cognitive task, and read a short article and answer subsequent questions about the information in the article. On Day 2, you will be administered another survey measuring aspects of retention. We aim to learn more about the relationship between volume intensity, cognitive performance, and aspects of wellness in a college student population. Saliva samples will be collected through a non-invasive technique that is painless, and they will be destroyed after analysis. Participation is strictly voluntary, and only the PI and faculty advisors will have access to the data. The total time to complete this experiment is approximately 1 hour over 2 days (45 minutes on day 1, 15 minutes on day 2).

Risks and Benefits: Risks to participate in this study are minimal, although breach of confidentiality is possible. If you become disturbed or upset during the data collection period, you will be given instruction regarding psychological services on campus. It is possible that discomfort due to electrode placement may occur. Participation in this study will provide no long-term benefits to you. However, the information obtained during data collection may provide you insights about aspects of wellness. Moreover, your performance on the cognitive task may provide additional insights regarding listening to music while studying.

Compensation: You will be awarded two SONA credits for complete participation in this study. No compensation will be given for incomplete participation in this study.

Confidentiality: The information you provide is strictly confidential. No names or other identifying items will be present on any of the surveys or data analyses. Participant's data will be coded, and all identifiers will be removed. All data will be kept in a secure password protected computer file, and all data will be discarded after the required minimum of 3 years. Only the PI (Michael D. Oliver II) and faculty advisors (Drs. Baldwin and Datta) will have access to this data. No reference will be made in oral or written reports which could link you to this study.

Informed Consent Form Continued

Participation: You can withdraw from the study at any time without penalty and your participation is completely voluntary. Refusal to participate or withdrawal will involve no loss of benefits to which you are otherwise entitled. Upon completion of this study, the PI will provide you with an opportunity to ask questions during the de-briefing session.

Contact Information: Michael D. Oliver II can be contacted at moliver8@utk.edu or 974-5694. Dr. Debora Baldwin's contact information is dbaldwin@utk.edu or 974-3357. Dr. Subimal Datta can be contacted at sdatta1@utk.edu. In addition, if you have any questions about your rights as a participant, you may contact the University of Tennessee IRB Compliance Officer at utkirb@utk.edu or (865) 974-7697.

Permission: I hereby grant Michael D. Oliver II permission to use and archive this data obtained from my participation in this study as necessary. I understand that no personal information will be disclosed. My signature below grants this permission.

Statement of Consent: I certify that I have read and fully understand the procedures contained within this form and agree to participate in the research described therein. My participation is given voluntarily and without coercion or undue influence.

Signature of Participant

Printed Name

Date

Informed Consent Form

Title of Project: The Effects of Relationships: An Examination of Wellness

Principal Investigator: Michael D. Oliver II, M.A.

Purpose: This study is designed to better understand the relationship between wellness of an individual and aspects of relational health. In order to do so, relationship qualities and characteristics should be examined. Relationship maintenance and construal play important roles in individual, and ultimately, societal health. Although much is known about the positive and negative effects of multiple forms of relationships on the individual, research is lacking regarding its connection between indices of health (ANS) and domains of wellness. Given that wellness is a very important concept that has been linked to health and vitality, it is important to examine the effects that relationships play on wellness.

Upon participation in this study, you will be asked to complete a few surveys (wellness, health, stress, sleep, social relationships), sit quietly while physiological measures are taken (heart rate, EEG, and skin conductance) using a small physio-graph with sensors attached the wrists, forearms, and fingers, as well as the ears and scalp (both of which will have conductive paste used in their application), and complete a laboratory social assessment task. Participation is strictly voluntary, and only the PI and faculty advisors will have access to the data. The total time to complete this experiment is approximately 45 minutes.

Risks and Benefits: Risks to participate in this study are minimal, although breach of confidentiality is possible. If you become disturbed or upset during the data collection period, you will be given instruction regarding psychological services on campus. It is possible that discomfort due to electrode placement may occur. Participation in this study will provide no long-term benefits to you. However, the information obtained during data collection may provide you insights about aspects of wellness.

Compensation: You will be awarded one SONA credit for complete participation in this study. No compensation will be given for incomplete participation in this study.

Confidentiality: The information you provide is strictly confidential. No names or other identifying items will be present on any of the surveys or data analyses. Participant's data will be coded, and all identifiers will be removed. All data will be kept in a secure password protected computer file, and all data will be discarded after the required minimum of 3 years. Only the PI (Michael D. Oliver II) and faculty advisors (Drs. Baldwin and Datta) will have access to this data. No reference will be made in oral or written reports which could link you to this study.

Participation: You can withdraw from the study at any time without penalty and your participation is completely voluntary. Refusal to participate or withdrawal will involve no loss of benefits to which you are otherwise entitled. Upon completion of this study, the PI will provide you with an opportunity to ask questions during the de-briefing session.

Informed Consent Form Continued

Contact Information: Michael D. Oliver II can be contacted at moliver8@utk.edu or 974-5694. Dr. Debora Baldwin's contact information is dbaldwin@utk.edu or 974-3357. Dr. Subimal Datta can be contacted at sdatta1@utk.edu. In addition, if you have any questions about your rights as a participant, you may contact the University of Tennessee IRB Compliance Officer at utkirb@utk.edu or (865) 974-7697.

Permission: I hereby grant Michael D. Oliver II permission to use and archive this data obtained from my participation in this study as necessary. I understand that no personal information will be disclosed. My signature below grants this permission.

Statement of Consent: I certify that I have read and fully understand the procedures contained within this form and agree to participate in the research described therein. My participation is given voluntarily and without coercion or undue influence.

Signature of Participant

Printed Name

Date

Informed Consent Form

The Relationship between Physical Wellness and Physical Fitness Components: An Examination into Autonomic Health

Introduction: You are invited to participate in a research study designed to examine the relationship between perceptions of physical wellness and indicators of health.

Participants' Involvement in the Study: You will be asked to complete 5 computerized questionnaires (demographics, wellness, health, stress, sleep). Once you complete the questionnaires, we will ask you to sit quietly while measures are taken examining your heart rate, brain activity, and levels of stress and arousal.

Next, you will be asked to walk at varying speeds and level of incline on the treadmill, complete as many push-ups as you can in one minute, and complete a flexibility task on the sit-and-reach box. We will also assess your body fat composition using calipers on your skin. Your entire participation will take approximately 1 hour and you may stop at any time.

Benefits: There is no direct benefit for your participation. However, this information will help us understand the relationship between components of physical health and perceived wellness. At the end of this session, we can provide you with some guidance on how your physical fitness compares with your age group if desired.

Risks: There is minimal risk associated with this study. Most research involves some risk to breach of confidentiality and it is possible that someone could either find out you were in this study or see your study information. Although this risk is possible, the investigators will make every effort to minimize these risks and to protect participants.

During participation in this study, you may experience some level of muscle soreness/cramping, dizziness, nausea, or vomiting as a result of the maximal exercise test and/or the exercise experimental conditions. We may stop the test at any time because of signs of fatigue or changes in your heart rate, electrocardiogram, blood pressure, or symptoms you may experience. It is important for you to realize that you may stop when you wish because of feelings of fatigue or any discomfort. Please let the study investigators immediately so that you can be assisted with your recovery appropriately, or further action can be taken.

All exercise sessions will be supervised by a trained investigator and may be terminated early based on the aforementioned guidelines outlined by the American College of Sports Medicine, or in the event that the participant requests that the session be stopped. An Automated External Defibrillator (AED) will be readily available in the experimental room for resuscitation in the unlikely event that you will need it. A trained AED operator will be present during every participant's data collection process.

Informed Consent Form Continued

Participation: Your participation is strictly voluntary and you may decline to participate without penalty. Additionally, you can stop and/or withdraw from this study at any time. If you withdraw from the study before data collection is complete, your data will be destroyed and eliminated from analyses.

Compensation: You will receive 2 SONA credits upon full participation. Any form of partial participation (i.e. stopping the submaximal testing) will result in 1 SONA credit for completion.

Confidentiality: The information you provide is strictly confidential. No names or other identifying items will be present on any of the surveys or data analyses. Your data will be used solely for this study. Only the Principal Investigator (Michael D. Oliver II) and faculty advisors (Drs. Debora R. Baldwin, David R. Bassett Jr., and Subimal Datta) will have access to this data. All data will be kept on a password protected computer and stored in a locked file cabinet in Walter Life Sciences A308. No reference will be made in oral or written reports which could link you to this study.

Emergency medical treatment: The University of Tennessee does not automatically reimburse participants for medical claims or other compensation. If physical injury is suffered in the course of research, or for more information, please immediately notify the investigator in charge: Michael D. Oliver II at moliver8@utk.edu or (865) 974-5694.

Contact Information: Michael D. Oliver II can be contacted at moliver8@utk.edu or (865) 974-5694. Dr. Debora R. Baldwin's contact information is dbaldwin@utk.edu or (865) 974-3357. Dr. Subimal Datta can be contacted at sdatta1@utk.edu. Dr. David R. Bassett Jr. can be contacted at dbassett@utk.edu. In addition, if you have any questions about your rights as a participant, you may contact the University of Tennessee IRB Compliance Officer at utkirb@utk.edu or (865) 974-7697.

CONSENT

I have read the above information. I have received a copy of this form. I agree to participate in this study.

Participant's Name (printed) _____

Participant's Signature _____ Date _____

Demographic Information

The following information is needed so that we can describe the group that participated in this study. Please circle or make a check by the item that best describes you.

Age: _____

Race: _____

Height: _____ feet _____ inches

Weight (lbs): _____

Gender: Male Female Transgender

Classification: Graduate Senior Junior Sophomore Freshman

Overall GPA: _____

Employment: None Part-time Full-time

Relationship status: Single In a relationship Engaged/Married

Favorite Genre of Music: _____

Average amount of sleep per night (in hours)? _____

Religious affiliation (if none, write NONE): _____

Demographic Information

The following information is needed so that we can describe the group that participated in this study. Please circle or make a check by the item that best describes you.

Age: _____

Race: _____

Height: _____ feet _____ inches

Weight (lbs): _____

Gender: Male Female Transgender

Classification: Graduate Senior Junior Sophomore Freshman

Employment: None Part-time Full-time

Relationship status: Single In a relationship Engaged/Married

Average amount of sleep per night (in hours)? _____

Religious affiliation (if none, write NONE): _____

Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?	Yes	No
--	-----	----

Do you feel pain in your chest when you do physical activity?	Yes	No
---	-----	----

In the past month, have you had chest pain when you were not doing physical activity?	Yes	No
---	-----	----

Do you lose your balance because of dizziness or do you ever lose consciousness?	Yes	No
--	-----	----

Do you have a bone or joint problem that could be made worse by a change in your physical activity?	Yes	No
---	-----	----

Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?	Yes	No
---	-----	----

Do you know of any other reason why you should not do physical activity?	Yes	No
--	-----	----

HS

Circle the answer that most accurately describes your health habits.

4 = DAILY = 5 or more times per week

3 = FREQUENTLY = two or three times per week

2 = OCCASIONALLY = a few times each month

1 = NEVER = almost never

How often do you:

1. Eat Fruits, Vegetables, and Fiber?	1	2	3	4
2. Drink 5 or more cups of coffee/day	1	2	3	4
3. Drink 5 or more soft drinks?	1	2	3	4
4. Eat candies, sugars, pastries?	1	2	3	4
5. Eat between meals?	1	2	3	4
6. Skip breakfast?	1	2	3	4
7. Take diet pills?	1	2	3	4
8. Swim	1	2	3	4
9. Walk at least 1 mile/day	1	2	3	4
10. Ride a bike	1	2	3	4
11. Calisthenics	1	2	3	4
12. Participate in Team Sports	1	2	3	4
13. Run at least 2 miles/day	1	2	3	4
14. Other Physical Exercise	1	2	3	4

Perceived Wellness Survey

The following statements are designed to provide information about your wellness perceptions. Please carefully and thoughtfully consider each statement, then select the one response option with which you most agree.

	Very Strongly Disagree	Very Strongly Agree
1. I am always optimistic about my future.	1 2 3 4 5 6	
2. There have been times when I felt inferior to most of the people I knew.	1 2 3 4 5 6	
3. Members of my family come to me for support.	1 2 3 4 5 6	
4. My physical health has restricted me in the past.	1 2 3 4 5 6	
5. I believe there is a real purpose for my life.	1 2 3 4 5 6	
6. I will always seek out activities that challenge me to think and reason.	1 2 3 4 5 6	
7. I rarely count on good things happening to me.	1 2 3 4 5 6	
8. In general, I feel confident about my abilities.	1 2 3 4 5 6	
9. Sometimes I wonder if my family will really be there for me when I am in need.	1 2 3 4 5 6	
10. My body seems to resist physical illness very well.	1 2 3 4 5 6	
11. Life does not hold much future promise for me.	1 2 3 4 5 6	
12. I avoid activities which require me to concentrate.	1 2 3 4 5 6	
13. I always look on the bright side of things.	1 2 3 4 5 6	
14. I sometimes think I am a worthless individual.	1 2 3 4 5 6	
15. My friends know they can always confide in me and ask me for advice.	1 2 3 4 5 6	
16. My physical health is excellent.	1 2 3 4 5 6	
17. Sometimes I don't understand what life is all about.	1 2 3 4 5 6	
18. Generally, I feel pleased with the amount of intellectual stimulation I receive in my daily life.	1 2 3 4 5 6	
19. In the past, I have expected the best.	1 2 3 4 5 6	
20. I am uncertain about my ability to do things well in the future.	1 2 3 4 5 6	
21. My family has been available to support me in the past.	1 2 3 4 5 6	
22. Compared to people I know, my past physical health has been excellent.	1 2 3 4 5 6	
23. I feel a sense of mission about my future.	1 2 3 4 5 6	
24. The amount of information that I process in a typical day is just about right for me (i.e., not too much and not too little).	1 2 3 4 5 6	
25. In the past, I hardly ever expected things to go my way.	1 2 3 4 5 6	
26. I will always be secure with who I am.	1 2 3 4 5 6	
27. In the past, I have not always had friends with whom I could share my joys and sorrows.	1 2 3 4 5 6	
28. I expect to always be physically healthy.	1 2 3 4 5 6	
29. I have felt in the past that my life was meaningless.	1 2 3 4 5 6	
30. In the past, I have generally found intellectual challenges to be vital to my overall well-being.	1 2 3 4 5 6	
31. Things will not work out the way I want them to in the future.	1 2 3 4 5 6	

The Perceived Wellness Survey Continued

- | | |
|---|-------------|
| 32. In the past, I have felt sure of myself among strangers. | 1 2 3 4 5 6 |
| 33. My friends will be there for me when I need help. | 1 2 3 4 5 6 |
| 34. I expect my physical health to get worse. | 1 2 3 4 5 6 |
| 35. It seems that my life has always had purpose. | 1 2 3 4 5 6 |
| 36. My life has often seemed void of positive mental stimulation. | 1 2 3 4 5 6 |

The Pittsburgh Sleep Quality Index (PSQI)

Instructions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions. During the past month,

1. When have you usually gone to bed? ____
2. How long (in minutes) has it taken you to fall asleep each night? ____
3. When have you usually gotten up in the morning? ____
4. How many hours of actual sleep do you get at night? (This may be different than the number of hours you spend in bed)

5. During the past month, how often have you had trouble sleeping because you...	Not during the past month (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times week (3)
a. Cannot get to sleep within 30 minutes				
b. Wake up in the middle of the night or early morning				
c. Have to get up to use the bathroom				
d. Cannot breathe comfortably				
e. Cough or snore loudly				
f. Feel too cold				
g. Feel too hot				
h. Have bad dreams				
i. Have pain				
j. Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s):				
6. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?				

The Pittsburgh Sleep Quality Index (PSQI) Continued

7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				
	Very good (0)	Fairly good (1)	Fairly bad (2)	Very bad (3)
9. During the past month, how would you rate your sleep quality overall?				

Perceived Stress Scale

INSTRUCTIONS:

The questions in this scale ask you about your feelings and thoughts during **THE LAST MONTH**. In each case, you will be asked to indicate your response by placing an “X” over the circle representing **HOW OFTEN** you felt or thought a certain way. Although some of the questions are similar, there are 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 number of times you felt a particular way, but rather indicate the alternative that seems like a reasonable estimate.

	Almost Never	Fairly <u>Never</u>	Sometimes	Very Often	<u>Often</u>
	0	1	2	3	4
1. In the last month, how often have you been upset because of something that happened unexpectedly?	☐	☐	☐	☐	☐
2. In the last month, how often have you felt that you were unable to control the important things in your life?	☐	☐	☐	☐	☐
3. In the last month, how often have you felt nervous and “stressed”?	☐	☐	☐	☐	☐
4. In the last month, how often have you dealt successfully with day to day problems and annoyances?	☐	☐	☐	☐	☐
5. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?	☐	☐	☐	☐	☐
6. In the last month, how often have you felt confident about your ability to handle your personal problems?	☐	☐	☐	☐	☐

Perceived Stress Scale Continued

- | | | | | | |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 7. In the last month, how often have you felt that things were going your way? | ☐ | ☐ | ☐ | ☐ | ☐ |
| 8. In the last month, how often have you found that you could not cope with all the things that you had to do? | ☐ | ☐ | ☐ | ☐ | ☐ |
| 9. In the last month, how often have you been able to control irritations in your life? | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10. In the last month, how often have you felt that you were on top of things? | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11. In the last month, how often have you been angered because of things that happened that were outside of your control? | ☐ | ☐ | ☐ | ☐ | ☐ |
| 12. In the last month, how often have you found yourself thinking about things that you have to accomplish? | ☐ | ☐ | ☐ | ☐ | ☐ |
| 13. In the last month, how often have you been able to control the way you spend your time? | ☐ | ☐ | ☐ | ☐ | ☐ |
| 14. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? | ☐ | ☐ | ☐ | ☐ | ☐ |

History of Music

Pre-Renaissance Music: The Evolution of Instruments and Theory

Prehistoric Music

The earliest forms of music were probably drum-based, percussion instruments being the most readily available at the time (i.e. rocks, sticks). These simplest of simple instruments are thought to have been used in religious ceremonies as representations of animals. There was no notation or writing of this kind of "music" and its sounds can only be extrapolated from the music of (South) American Indians and African natives who still adhere to some of the ancient religious practices.

As for the more advanced instruments, their evolution was slow and steady. It is known that by 4000 BCE the Egyptians had created harps and flutes, and by 3500 BCE lyres and double-reeded clarinets had been developed.

In Denmark, by 2500 BCE an early form of the trumpet had been developed. This trumpet is what is now known as a "natural trumpet." It is valveless, and depends completely on manipulation of the lips to change pitch.

One of the most popular instruments today was created in 1500 BCE by the Hittites. I am talking about the guitar. This was a great step; the use of frets to change the pitch of a vibrating string would lead to later instruments such as the violin and harpsichord.

In 800 BCE the first recovered piece of recorded music was found. It was written in cuneiform and was a religious hymn. It should be noted that cuneiform is not a type of musical notation.

By 700 BCE there are records of songs that include vocals with instrumentals. This added a whole new dimension to music: accompaniment.

Music in Ancient Rome and Greece

Greece was the root of all Classical art, so it's no coincidence that Classical music is rooted in Grecian innovations. In 600 BCE, famed mathematician Pythagorus dissected music as a science and developed the keystone of modern music: the octave scale. The importance of this event is obvious. Music was a passion of the Greeks. With their surplus of leisure time (thanks to slave labor) they were able to cultivate great artistic skills. Trumpet competitions were common spectator events in Greece by 400 BCE. It was in Greece that the first bricks in music theory's foundation were laid. Aristotle wrote on music theory scientifically, and brought about a method of notation in 350 BCE. The work of that genius is still studied today.

History of Music Continued

The next significant step in music's evolution was by Boethius. In 521 CE he brought the Greek system of notation to Western Europe, allowing the musicians there to scribe accurately the folk songs of their lands. Incidentally, it was Boethius who first wrote on the idea of the opera.

Music in the Middle Ages

Most of the music created after Rome fell was commissioned by the church. The Catholic religion has a long history of involvement (for better or worse) with the musical arts. In 600 CE Pope Gregory had the Schola Cantorum built. This was the first music school in Europe.

Meanwhile in China, music was progressing also: it was reported that in 612 CE there were orchestras with hundreds of musicians performing for the assorted dynasties. Although the specific music from this period in China is unknown, the distinct style supposed to have developed there is reflected even in recent orchestral Asiatic pieces.

In 650 CE a new system of writing music was developed using "neumes" as a notation for groups of notes in music.

144 years after the Schola Cantorum was built, a singing school opened in the Monastery of Fuda, fueling the interest in musical vocation. And by 790 CE, there were splinters of the Schola Cantorum in Paris, Cologne and Metz. In 800 CE the great unifier Charlemagne had poems and psalms set to music. In 850 CE Catholic musicians had a breakthrough by inventing the church "modes." These modes would later metamorphose into today's major and minor scales. In 855 CE, the first polyphonic (2 unrelated melodies/voices at once) piece was recorded, and by 1056 this polyphonic style replaced Gregorian chants as the music of choice (even after the Church made polyphonic music "illegal"; this ban was later lifted). In 980 CE, the great tome Antiphonarium Codex Montpellier was scribed.

In 1000 CE Guido D'Arezzo made many improvements in music theory. He first improved and reworked standard notation to be more user-friendly by adding time signatures. Then he invented solfege. This is the vocal note scale: do, re, mi, fa, so, la, ti, do. This innovation has affected almost every modern vocalist.

In 1100 CE, a new secular movement began. This separation of Church from music was a straddling one, and soon this new "folk" music was looked down upon as pagan and borderline blasphemous.

History of Music Continued

The Renaissance

On the dawn of the Renaissance in 1465 the printing press was first used to print music. By using a press, a composer could organize his pieces and profit from them with great ease. In 1490 Boethius's writings on opera were republished in Italian.

With the onset of the Renaissance, the rules of music were about to change drastically. This was the beginning of a new enlightened age that would showcase some of the greatest musical minds ever produced.

The history of music at this point is best told by the styles that emerged and the composers who lived after the Renaissance.

Citation:

Hollis, B. (n.d.) History of Music. Retrieved August 1, 2017, from: <https://method-behind-the-music.com/history/history/>

Retention Questionnaire

You will be asked questions over the reading from yesterday. Please fill out to the best of your ability the following brief questionnaire. Once complete, let the researcher know and we thank you for your cooperation.

1. Who was credited for creation of the harps and flutes?
a. Hittites b. Egyptians c. Americans d. Europeans
2. The Hittites created which instrument in 1500 BCE?
a. Flute b. Drums c. Saxophone d. Guitar
3. What type of music was the first recovered piece of music?
a. Religious Hymn b. Classical c. Jazz d. Rock
4. Where does Classical music derive its roots?
a. Africa b. Greece c. Paris d. Egypt
5. The octave scale was developed by whom?
a. Boethius b. Hittites c. Egyptians d. Pythagorus
6. What style of music did Boethius bring from Greece to Western Europe?
a. Opera b. Rock c. Jazz d. Folk
7. What is the Schola Cantarum?
a. First music school in Europe b. Type of Music c. Musical Notes d. Instrument
8. What did “modes” evolve into in today’s music?
a. Lyrics b. Musical Instruments c. Major and Minor scales d. Music Genres
9. What important invention did Guido D’Arezzo contribute to music that is still utilized today?
a. Piano b. The vocal note scale c. Folk Music d. Radio
10. What did the Renaissance era bring about that helped Revolutionize music?
a. Radio b. Electronic music c. Printing press d. Country music

Relationship Assessment Questionnaire:

List all of the important relationships currently in your life:

Indicate the significance/roles of the aforementioned relationship(s)

Circle your most important relationship and explain why below:

Glossary

Definitions of Wellness Dimensions

Physical Wellness

Physical wellness is the normal functioning of biological and physiological processes in the body affecting normal development and functioning. It is the active and continual effort at both maintaining and improving the four primary physical fitness indicators in oneself. It is the knowledge about proper exercise habits and diet and nutrition in order to make healthy lifestyle choices by encouraging good exercise habits and healthy eating behaviors, and discouraging bad ones. Finally, it is having high physical resilience, thus having the positive perception and expectation of good physical health.

Social Wellness

Social wellness encompasses the quality and extent of interactions with others and the interdependence between the individual, others, the community, and nature (Roscoe, 2009). It is the ability to develop and maintain meaningful relationships, to contribute to the community in an effective and productive way, and to balance the various life interactions between the individual, society, environment, nature, and work. Finally, social wellness is actively seeking ways along the course of life to balance and integrate the interactions between oneself and the natural environment in order to enhance relationships and foster the establishment of a better living atmosphere and community suitable for all.

Emotional Wellness

Emotional wellness is the ability to both recognize and manage emotions and subsequent behaviors in a positive and healthy manner, while maintaining an optimistic approach to life and to be emotionally aware of and accept the various feelings about oneself, others, and life.

Intellectual Wellness

Intellectual wellness is the active and continual process of pursuing and retaining knowledge via stimulating intellectual activity. It involves problem solving, creativity, learning new skills and information, and a commitment to both sharing with and learning knowledge from others. One who is intellectually well will utilize such information to identify problems and/or critical issues, make sound judgments, propose potential solutions, and act in a way that promotes personal growth and the betterment of society.

Spiritual Wellness

Spiritual wellness is the continual process of seeking and finding a positive sense of meaning and purpose in life, while appreciating the intricacies of life itself. It is understanding that the world and universe are both very complex and that everything was created for a reason and has a specific purpose in life. It is developing a personal belief system and a system of faith in something that is beyond oneself (i.e. higher power) and living by those systems to govern everyday actions.

Occupational/Vocational Wellness

Occupational or vocational wellness is dependent on one's feelings about work and whether or not one feels work is meaningful and enriching and is a safe and positive environment contributing to personal growth. It is also related to the ability to balance occupational and other responsibilities, express personal values openly, have financial stability, and provide skills beneficial for enhancing the workplace atmosphere.

Environmental Wellness

Environmental wellness is actively striving toward improving one's local community and natural and physical environment via an individual's relationship with one's home, work, community, and nature. It is taking a responsibility in creating and maintaining sustainable living communities that can positively impact the global environment and reduce negative environmental hazards.

Psychological/Mental

Psychological wellness is wellness of the mind and it includes feelings and behaviors that are reflective of a stable mental and emotional state. It includes having an element of control over one's life and the ability to cope with the demands and stressors of life in a positive and constructive manner.

VITA

Michael Darnell Oliver was born in Virginia, but moved to Tennessee at an early age by way of his military family. He was raised by his parents Kendall and Shannon Kitchen and is the eldest of two boys. Michael was educated through the Clarksville Montgomery County School System from elementary through high school. Upon graduation, he decided to attend the University of Tennessee – Knoxville. In May 2013, Michael graduated with a Bachelor of Arts degree in Psychology with a minor in Business Administration. He then accepted a graduate teaching assistantship in August 2013 at the University of Tennessee – Knoxville in Experimental Psychology with a Biological program focus under the supervision of Dr. Debora Baldwin. Upon completion of his Master of Arts in Experimental Psychology, Michael decided to further his education by pursuing a Ph.D. at UTK. He worked under the supervision of both Drs. Debora Baldwin and Subimal Datta while pursuing his doctorate degree. Under their guidance, his research took a psychophysiological approach to the phenomenon of wellness.