## ABSTRACT

WORNOFF, JASON ROBERT. Examining Associations between Social Experiences and Heart Rate Variability among Undergraduate Students. (Under the direction of DeLeon L. Gray, John Neitfeld, and Jessica Decuir-Gunby).

Researchers commonly examine wellness on college campuses in terms of social support and the ability to manage stress. However, there is room for a greater understanding of the social factors that predict undergraduate wellness. Considering the needs to *stand out* and *fit in* as basic human needs, this study hypothesized the fulfillment of these needs to be positively associated with undergraduate wellness. Synthesizing across Optimal Distinctiveness Theory (ODT; Brewer, 1991) and a Stage-Environment Fit perspective (Eccles & Midgley, 1989), results supported this prediction. Hierarchical regression analyses demonstrate the need to fit in as a positive predictor of wellness. Moreover, analyses revealed the effect of standing out on wellness may be moderated by gender, such that this effect was stronger for males. The current study extends previous research by measuring wellness with a physiological bio-marker of overall physical and mental health, Heart Rate Variability (HRV). In doing so, this study simultaneously addresses a gap in our understanding for 1) the social factors (e.g. standing out, fitting in) which determine wellness, and 2) provides a physiological window for researchers and campus leaders to examine the social underpinnings of wellness.

# Examining Associations between Social Experiences and Heart Rate Variability among Undergraduate Students

by
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## DEDICATION

This document is dedicated to Mary Carmela Wornoff

Ma, you introduced me to the power of literature through my love for music. Thanks for bringing home that stack of Mark Twain, Rody Doyle, Nick Hornby, John Lennon, Bob Dylan, Kurt Cobain, and Tupac Shakur novels, biographies, and documentaries after I reluctantly joined the parish book-club. I may not have discovered my true passion, talent, and career as a life-long learner without your understanding and crafty accommodations. I hope this document channels the same creativity, discernment, and dedication you exerted in raising me from a physically ill-infant, to a stormy-teen, to the man I am today.

"and we all shine on".

Your son,

Jason

## BIOGRAPHY

Jason Wonoff resides in Raleigh, North Carolina. He received his B.S. in Human Development and Family Science in 2012 from The Ohio State University. Prior to graduate school, Jason has worked as a Health and Safety Administrator for the U.S. Department of Labor Occupational Safety and Health Administration (OSHA), as well as a Learning Specialist and Tutor to a diversity of students at The Ohio State University.

As an educational researcher, Jason has served as an Education Program Analyst at the U.S. Department of Defense Education Activity (DoDEA) in Washington D.C., during which time he worked with school leaders across the globe to improve program retention and identify modes of attrition. For his contributions and research efforts in these areas, Jason earned the prestigious Department of Defense Judith C. Gilliom Award.

Currently, Jason is a Masters student in the department of Curriculum and Instruction Counselor Education (CICE), with plans of continuing his research as a doctoral student in CICE. In addition to dedicating himself to his research and course work, Jason is a Graduate Assistant in the Media Education and Technology Resource Center (METRC), Research Assistant to faculty in CICE, and active member of the SMART collaborative research team at North Carolina State University.

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This document is a reflection of my growth as researcher in forming a clear and meaningful hypothesis, collecting data, critically analyzing data, and deeply considering how results may imply change in both theory and practice. Without the expert guidance and the challenging feedback of John Nietfeld and Jessica Decuir-Gunby the time pressures, organizational barriers, and conceptual constraints may not have been overcome to positively grow in the challenging experiences involved in completing this document.

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**Honorable Mention:**

Dad, it seems you have lost or been stripped of all but your persistence for making a better day for me and our family. I am taking your advice and continuing the passion and persistence you have inspired for this document towards earning my Ph.D., because “that’s an accomplishment nobody can take away from you”.

Lavell, Train, and Dale, from before I can remember you were always there to help me tackle my toughest opponents, and make the most out of my failed attempts. You have little to show for your tremendous will and self-sacrifice for others. One day you will, I promise.

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# CHAPTER 1
# INTRODUCTION

The term wellness is defined as the quality or state of being in good health (Wellness, 2011). When applied to educational settings, researchers have used this term in a broad sense by emphasizing variables measuring psychological, social, biological, and spiritual traits (Granello, 2009). Researchers have linked overall good health of undergraduate students to greater performance on exams (Andrews & Wilding, 2004; Howell, 2009), higher grade point averages (Trockel, Barnes, & Egget, 2000), positive emotional in-school experiences (Granello, 2009; Hearman & Hazler, 1999) and an overall positive outlook for college careers (Adams, Bezner, Drabbs, & Zambrano, 2000). Since the late 1980s, university leaders have become progressively interested in improving the wellness of students on their campuses (Opatz, 1984; Opatz, 1986; Sivik, & And O, 1992) by creating programs and course sections aiming to inform and improve students' sense of wellness in terms of interpersonal support, self-esteem, and stress management (McClary, Pyeritz, Bruce, & Henshaw, 1992).

Despite universities being increasingly interested in improving student wellness, studies reveal that undergraduates' self-reported psychological (e.g. anxiety, depression) and physiological stress levels increase over the course of a four-year degree (Bewick, Koutsopoulou, Miles, Slaa, & Barkham, 2010). In addition, researchers acknowledge that little empirical research has been conducted to determine psychological (Abood & Conway, 1992; Adams, Bezner, Drabbs, Zambarano & Steinhardt, 2000) and sociological factors

(Bronman, 1993; Oleckno & Blacconiere, 1990) affecting undergraduate wellness. Research exploring the effect of these factors on wellness is vitally needed to push university leaders' current thinking concerning wellness on their college campuses.

This study represents an effort to determine how the fulfillment of undergraduate students' social needs may contribute to wellness in university settings. Specifically, social psychological frameworks will be considered alongside a Stage-Environment Fit perspective to examine whether students' experiences with standing out from, and fitting in with, their peers predicts wellness—operationalized in terms of heart rate variability.

### 1.1. Stage-Environment Fit Theory

Students' wellness may be undermined when school environments are not attuned to their developmental needs. According to Stage–Environment Fit theory (Eccles & Midgley, 1989; Eccles Midgley, Wigfield, Buchanan, Reuman, & Flanagan, 1993), in order for the positive growth of an individual to occur there must be synchrony between an individual's developmental needs and the opportunities afforded by their social environment to meet these needs. Accordingly, Eccles (2004) posits that students in school environments, which are not adaptive or attuned with their needs, are more likely to produce declines in students' self-efficacy (Eccles et al., 1993) and mental health (Rosser, Eccles, & Freedman-Doan, 1999). Such environments are considered developmentally regressive; that is, the environment does not provide students with appropriate opportunities for continuous positive growth.

As the social needs between individuals at developmental stages may differ (Higgins & Eccles, 1983), consideration of a Stage-Environment Fit perspective is needed to fully

understand how university environments may affect wellness. Consider, for example, the social need of belongingness (Baumeister & Leary, 1995). Eccles and Midgley (1989) would suggest that in order for a students' need for belongingness to be met, a school environment must first be attuned to this need in terms of providing the opportunistic structures necessary for students to satisfy their need for belongingness. For the student in a college environment who has not been provided the opportunity to pursue a sense of belongingness, this student would be more likely at risk for the aforementioned decrements of self-esteem and mental health.

### 1.2. Identity Exploration: A Hallmark of Emerging Adulthood

Identity formation, in particular, has been cited as an integral feature of healthy adolescent development (Eccles, 1983; Eccles et al., 1993; Fraser & Eccles, 1994; Templeton & Eccles, 2006), motivation and academic achievement (Roeser & Nasir, 2006), as well as the healthy development of emerging adults (Arnett, 2000). As Eccles and Midgley (1989) explain, adolescence is a stage in which individuals place high value on identity exploration. Accordingly, adolescents devote a great deal of time and effort to assess what others think of them and more importantly how they think of themselves in relation to others. In doing so, Eccles and Midgley (1989) describe that adolescents experiment with an array of social behaviors through different social experiences. Although the identity formation processes may begin in adolescents (ages 10-18), Arnett (2000) suggests these processes remain active during emerging adulthood (ages 18-25). Research has supported this suggestion with findings that demonstrate how identity development often spans as far as the late twenties

(Valde, 1996; Whitbourne & Tesch, 1985). As noted by Arnett (2000), due to changes in educational requirements for employment in industrialized workforces, increasing numbers of adolescents enter college directly from high school (Arnett & Taber, 1994; Bianchi & Spain, 1996). Consequently, in many ways college has become a place of prolonged adolescence in which emerging adults may continue to explore their identities.

### 1.3. Social Identity

Considering identity formation as an important developmental feature of emerging adults, it may be useful to investigate the needs which drive undergraduate students to construct their own identities as predictors of wellness. Social psychologists suggest identity formation may occur through a process in which individuals are driven to form identities by the need to differentiate (stand out) and assimilate (fit in). *Optimal Distinctiveness Theory* (ODT; Brewer, 1991) is a framework that draws from social identity theory (Tajfel & Turner, 1986) and self-categorization theory (Turner, Hogg, Oakes, Reicher, & Wetheral, 1987) to explain how humans develop self-concepts or identities from their group memberships. ODT proposes the need to stand out and fit in from others as two important social identity needs. According to Brewer (1991), if a student perceives themselves as too similar to their group, this should activate a student's need to stand out from that group. In contrast, when an individual feels too dissimilar from their group, this should activate that student's need to fit in.

Considering identity formation from an ODT perspective, when a student's need to fit in or stand out from a group is activated in response to themselves as too similar or

dissimilar from their group, this may imply a change in the way an individual identifies themselves (Brewer, 1991; Brewer & Gardner, 1996). Synthesizing across ODT and Stage-Environment Fit theory, one would posit an undergraduate's identity formation to most flourish when their needs to stand out and fit in from their peers are satiated.

### 1.4. Standing Out and Fitting In as Basic Human Needs.

Considering the needs to stand out and fit in as important drives to forming social identity, these needs are also regarded at their most rudimentary level as basic human needs, which may drive wellness. When these needs are thwarted, negative consequences on social identity formation and ultimately wellness may result. Brewer's (1991) suggestion of fitting in as a basic human need may be clearly understood when considering its theoretical grounding. Baumeister and Leary (1995) describe the need for belongingness (fitting in) as a basic human need. Specifically, belongingness theory (Baumeister & Leary, 1995) suggests that human beings persistently strive to develop and uphold positive, interpersonal connections through relationships with others. Preceding belongingness theory, frameworks such as that proposed by Maslow (1968) have implied the importance of belongingness. Drawing from Maslow (1968), Baumeister and Leary (1995) posit that a deprivation in feelings of fitting in may lead to a variety of negative mental and physical health outcomes. Such that, for an individual who feels that their need to fit in is thwarted in their environment, this individual should be more likely to experience negative outcomes such as physical illness (Kietcolt-Glaser 1984), cognitive impairments (Baumeister, Twenge, &

Nuss, 2002), and higher incidences of psychopathology (Bhatti, Derezotes, Kim, & Specht, 1989) or anxiety (Baumeister & Tice, 1990).

Consider, for example, a first semester undergraduate student navigating the social terrain of their campus for the first time. Baumeister and Leary (1995) would posit he or she will likely possess a need to establish deep interpersonal connection in order to achieve a sense of belongingness. Whether it is through the community environment on the floor of their residency hall, or rooting on their collegiate team at a large sporting event, this student may actively pursue to fit in on their campus. For the student in this environment who perceives their need to fit in as thwarted, the decrements to wellness presented by Baumeister and Leary (1995) may be more likely to occur.

As ODT suggests, the need to stand out as a basic human need has also been supported by empirically tested theoretical constructs. Uniqueness theory (Snyder & Fromkin, 1980) posits that individuals pursue, form, and conserve a sense of distinctiveness because perceptions of extreme similarity to others are experienced as unpleasant. According to this theory, an individual should experience greater positive emotion when perceiving that they are unique (standing out) to others as opposed to similar (fitting in). Fromkin (1972) investigated students' emotional responses to appraisals about fitting in with others. As predicted, students who perceived themselves as standing out from their peers reported more positive emotion than did students who perceived themselves as fitting in. Considering the implications of ODT (Brewer, 1991) in addition to belongingness theory (Baumeister & Leary, 1995), a university undergraduate navigating the social terrain of their campus for the

first time would also pursue opportunities for differentiation, which would allow him or her to stand out in relation to others. For the student who feels their need to stand out is thwarted in their school environment, this student would be likely to experience more negative emotion (Snyder & Fromkin, 1980) than would the student who perceives their need to stand out as satiated.

### 1.5. HRV

From the aforementioned theoretical implications and the findings which support them, it is plausible that the satiation of undergraduate students' need to stand out or fit in may have implications for undergraduate wellness. Moreover, the effects of standing out and fitting in on wellness may be observed through bio-markers of mental and physical health. One such bio-marker, Heart Rate Variability (HRV), has been widely cited as a reliable index of overall health and wellbeing (Carney, Blumenthal, Stein, Watkins, Catellier, Berkman, & Freedland, 2001; Kleiger, 1987; Tsuji, Larson, Venditti, Manders, Evans, Feldman & Levy, 1996).

HRV is recognized by the Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (1996) as a measure of time between each oscillation of the heart. On an electrocardiogram, HRV is represented as the distance in milliseconds from one R-spike (one heart beat) to the next or the R-R intervals. Higher variability in R-R intervals are reflective of a well-balanced autonomic nervous system (ANS), whereas lower variability in R-R intervals are reflective of an imbalance in this system (Appelhans & Luecken, 2006). The ANS, which is widely regarded as the

primary regulatory system of an organism's physiological adaption to their environment, is composed of two subdivisions; an excitatory (increases heart rate) division known as the sympathetic nervous system (SNS), and an inhibitory (decreases heart rate) subdivision known as the parasympathetic nervous system (PNS) (Appelhans & Luecken, 2006). More functionally, HRV is widely recognized as a measure of the continuous interplay taking place between these subdivisions of the ANS (Appelhans &Luecken, 2006). By these two subsystems (SNS, PNS) working together in an antagonistic nature, an organism may appropriately adjust its physiological functioning to the changes in its environment (Hollenstein, McNeely, Eastabrook, Mackey, & Flynn, 2012).

### 1.6. HRV as an Indicator of Wellness

Researchers have linked changes in HRV to a host of outcomes directly associated to physical and mental wellness. As studies suggest, physiological stress may elicit sympathetic activity, in turn, resulting in changes in cardiovascular response (Verkuil, Brosschot, de Beurs, & Thayer, 2009). From this understanding, various studies have inversely linked high levels of HRV to adaptive behaviors in response to psychological stress (Mezzacappa, Kelsey, Katkin, & Sloan, 2001; Visnovcova, Calkovska, & Tonhajzerova, 2013). In contrast, studies have revealed low levels of HRV (ANS imbalance) to be related to poor overall physical health (Mezzacappa et al., 2001; Visnovcova et al., 2013) as well as a host of emotion-related problems such as aggression (Gordis, Feres, Olezeski, Rabkin, & Trickett, 2010; Hinnant & El-Sheik, 2009), anxiety (Kawachi, Sparrow, Vokonas, & Weiss, 1995; Watkins, Grossman, Krishnan, & Sherwood, 1998), and depression (Carney et al., 2009;

Krittayaphong et al., 1997; Licht et al., 2008). From these findings, it is evident that changes in students' cardiovascular responses may serve as a window to view and interpret wellness: low levels of resting HRV indicating poor health and well-being and high levels of resting HRV indicating good health and well-being.

As the aforementioned studies demonstrate the relationship between standing out and fitting in and outcomes related to students wellness, none have interpreted this relationship by any measure other than self-report or through observation. To better understand the relationships described by previous literature and to push our thinking when considering reliable measurement methods of undergraduate wellness, it would seem plausible to employ a more direct, unfiltered index of wellness. In this regard, HRV indices could provide utility for researchers to extend beyond the reach of traditional measures of self-report and observation in hopes of revealing the most critical markers of undergraduate wellness.

### 1.7. Gender Differences

Gender may moderate undergraduate students' cardiovascular responding to perceptions of standing out and fitting in. As illustrated by previous literature, the satiation of an individual's need for belongingness or uniqueness could lead to unpleasant feelings, or emotional stress (Baumeister & Leary, 1995; Snyder & Fromkin, 1980). Moreover, the relevance of these needs to undergraduate wellness may differentiate by gender. In fact, previous research has revealed that emotional responding to social stressors may often differentiate due to gender socialization factors, which aim females to place higher importance on interpersonal relationships (Hyde, Mezulis, & Abramson, 2008).

Verkuil and colleagues (2009) have linked different patterns of emotional responding to different patterns of HRV. Considering the gender differences in emotional responding revealed by Hyde et al. (2008), it is plausible that these differences may be reflected by students' HRV. Considering the sense of belongingness to be construed based upon one's interpersonal and emotional connections to others (Baumeister & Leary, 1995), it is plausible to expect that female students' need for belonging may be more salient to wellness than their male peers. In turn, this study predicts that gender should moderate the relationship between fitting in and wellness, such that the increases in female undergraduate students' need to fit in should have a stronger effect than increases in males need to fit in on increasing HRV. In contrast, considering uniqueness to be less reliant upon the sharing of interpersonal connections, it is plausible to expect the satiation of the need to stand out to have a weaker effect on increasing HRV for females than males.

### 1.8. Considering Wellness from a Stage Environment-Fit Theory Perspective

As previous studies have provided descriptions of the relationship between social needs and wellness (Baumeister & Leary, 1995; Baumeister & Tice, 1990; Kietcolt-Glaser 1984; Snyder and Fromkin, 1980), these studies rarely consider the nature of this relationship in a developmental context. Therefore, it may be useful for Stage-Environment Fit perspective to be considered for the following line of reason: As previously noted, to first understand how to improve wellness in the university context, Stage-Environment Fit perspective would assert practitioners and university leaders must first be attuned to the specific needs unique to the developmental stage of university students (emerging adulthood)

which may affect wellness. Accordingly, as identity formation is cited as a developmental hallmark of emerging adulthood (Arnett, 2000), and the need to stand out and fit in have been considered by social psychologists as basic human needs instrumental in forming social identities (Brewer, 1991) and maintaining wellness (Baumeister & Leary, 1995; Fromkin, 1972), findings from this study may provide useful knowledge for understanding the social factors effecting wellness on university campuses.

### 1.9. Current Study

When considering the needs to stand out and fit in as basic human needs necessary to forming social identities and maintaining wellness, the present study predicts that the fulfillment of an undergraduate's needs to stand out and fit in will be positively associated to measures of wellness. In this particular study, students' needs for standing out and fitting in will be investigated as predictors of students' HRV. Fitting in is defined as the degree of perceived overlap between an individual's own characteristics and those of others. Standing out is defined as the degree of perceived contrast between an individual's own characteristics and those of others (Gray, 2014).

To address individual differences in standing out and fitting in, this study will control for students' perceptions of the need for uniqueness, and the need to belong. As the perceptions of standing out and fitting in between two individuals differ, this may result from individual differences in the need to belong and the need for uniqueness (Brewer & Roccas, 2002). Specifically, two students may hold two different standards for how much uniqueness

or belongingness they must feel in order to perceive themselves in terms of standing out or fitting in.

Because researchers suggests positive and negative emotional affect to influence health (e.g. depression, anxiety) outcomes associated to our dependent variable (HRV) (Hughes & Kendall, 2009; Laurent, Joiner & Cantanzaro, 2011) this study will control for different emotional states by employing the Positive and Negative Affect schedule – Expanded Form (PANAS-X Watson & Clarke, 1994). By employing this particular scale, this study may carefully consider how students' social experiences effect HRV, while honoring the value of the negative or positive affect experienced at or around the time of this study. The specific aims of this study are as follows:

**Specific Aim I** – Explore whether patterns in undergraduates' cardiovascular responses can be explained by students' perceptions of social needs being fulfilled in the context of their university setting.

*A)* Determine if increases in undergraduate students' perceptions of standing out and fitting in are positively associated with HRV. ***Expected Findings*:** Students who perceive their needs to stand out from their university peers as satisfied will demonstrate higher HRV. Likewise, students who perceive their needs to fit in with their university peers as satisfied will demonstrate lower HRV.

*B)* Investigate gender differences in the associations between standing out, fitting in, and HRV. ***Expected Findings:*** Female students who perceive their need to fit in as satisfied will demonstrate higher HRV than males who perceive their need to

fit in as satisfied. In contrast, female students who perceive their need to stand out as satiated will demonstrate lower HRV than males who perceive their need to stand out as satiated.

# CHAPTER 2

# METHOD

## 2.1. Data Source, Design, and Sample

This study measured students' perceptions and attitudes towards standing out from, and fitting in with their peers at their own university. These data were collected from the spring of 2014 during which time approximately 43 undergraduates were recruited from Introductory Educational Psychology courses at a large public university in the southern region of the United States. In terms of gender, this sample was approximately 70% female and 30% male. The majority of participants in this sample were Education majors taking Educational Psychology as a requirement for their major.

## 2.2. Participants and Procedures

Undergraduates in Educational Psychology courses were invited to participate in a two-part study. Following an in-class announcement regarding the study, students voluntarily provided their university email and a preferred time to participate in the study. Participation was voluntary or students received extra credit. As a result of accepting the invitation to participate, students completed an online pre-survey taking approximately 10-15 minutes. Data collection was conducted via Qualtrics (an online research tool approved by the university). Students were allowed to complete this pre-survey from any location. Students provided electronic consent for this study via the Qualtrics welcome screen. Failure to complete this pre-survey prohibited students from participating in the in-person portion of this study. After completion of the pre-survey, students received an email asking them to

confirm their availability for the in-person portion of the study. The in-person portion of the study was held in a silent and controlled room within the university's College of Education. This specific room was selected as it allowed for little outside noise to be heard while inside, and provided participants privacy from any outside stimuli.

The in-person portion of the study was conducted via one-on-one meetings with the researcher during which time the participant was fitted with a sport watch (Polar RS800CX) which collected participants' cardiovascular responses. Prior to the interview, students were asked to put on the coordinating chest band to the Polar RS800CX. This particular watch was chosen to measure HRV because its elastic chest band allowed for heart beats to be directly detected by the wrist watch and provided software which synthesized these heart beats into interpretable R-R intervals. Students were asked to sit comfortably alone in a silent room for 5 minutes while the Polar watch collected R-R intervals which were used to interpret baseline Heart Rate Variability. As R-R intervals represent the distance between two heartbeats, these data points (R-R spikes) were used to compute various HRV indexes. The preferred HRV measures for this particular study will be discussed further in the proceeding section. This portion of our study provided a controlled time and space for the Polar RS800CX fitness monitor to capture how the diversity of students' social experiences in their university envirnment are linked with a pure measure of their cardiovascular activity (heart rate variability).When the duration of 5 minutes was reached, all recording was ended. This concluded participation in the study.

## 2.3. Variables and Measures

Within this two-part study, the online-survey included measures of Standing Out, Fitting In, Need for Uniqueness and Need to Belong. All scales were adapted from previously used measures. Moreover, all measures included in this study have been previously demonstrated as acceptable psychometric properties, including a Cronbach's alpha over .70. In addition, Cronbach's alpha were computed for all measures used in the proposed study.

***2.3.1. Standing Out and Fitting In.*** To measure students' perceived satisfaction in terms of standing out from and fitting in with their peers, measures from Gray (2014) were adapted to measure students' social needs satisfaction at the university level. For example "in my math class" will be adapted to "at my university" for use with the sample of this study. These scales consisted of three items assessing students' perceptions of standing out among their university peers (e.g., "I am okay with how different I am", "I am satisfied with how unique I am from other students", and "I stand out enough from my peers") and three items measuring students' perceptions of fitting in (e.g., "I am okay with how similar I feel to other students," "I blend in enough with other students," and "The amount of similarity I feel to other students meets my standards"). This response format consisted of a 7-point Likert scale ranging from 1 (*not at all true*) to 7 (*very true*). This measure was scored such that higher scores indicated higher perceptions of standing out or fitting in.

***2.3.2. Need for Uniqueness.*** The need for uniqueness was assessed using items directly from Lynn and Snyder's (2002) need for uniqueness scale. This scale consists of four

items assessing students' *need for uniqueness* in the context of their university: "I prefer being _____ different from other people" (1=*not at all*, 5=*extremely*); "Being distinctive is _____ important to me" (1=*not at all*, 5=*extremely*); "I _____ intentionally do things that make myself different from those around me" (1=*never*, 5=*always)*; "I have a _____ need for uniqueness" (1=*weak*, 5=*very strong)*. This measure was scored such that higher values were indicative of a higher *need for uniqueness*.

***2.3.3. Need to Belong.*** Perceptions of students' *need to belong* within the context of their university were measured using items from Leary, Kelly, Cottrell and Schreindorfer's (2013) need to belong scale, which consists of 10 items measuring students' perceptions of their *need to belong* at their university: "If other people don't seem to accept me, I don't let it bother me (reverse coded)", "I try hard not to do things that will make other people avoid or reject me", "I seldom worry about whether other people care about me (reverse coded)", "I need to feel that there are people I can turn to in times of need", "I want other people to accept me", "I do not like being alone", "Being apart from my friends for long periods of time does not bother me (reverse coded)", "I have a strong need to belong", "It bothers me a great deal when I am not included in other people's plans", and "My feelings are easily hurt when I feel that others do not accept me." This response format consisted of a 5-point Likert scale ranging from 1 (*not at all true*) to 7 (*very true*), with higher scores indicating stronger *need to belong.*

***2.3.4. HRV.*** Interpretations of the activity of the ANS can be derived from different indexes of HRV. Accordingly, it is prudent to explicate the basis of the measures chosen for this study. In this particular study, patterns of participants' cardiovascular responses were investigated exclusively using time domain measures (explains HRV as a function of time in milliseconds) which are deconstructed below:

***2.3.4.1. sdRR.*** The distance between a single heartbeat and the next is known as an R-R interval. Within a distribution of R-R intervals, *sdRR* represents the average distance of a single R-R interval from a person's mean R-R interval. Essentially, this measure represents the standard deviation of participants' R-R intervals within a particular time frame.

***2.3.4.2. Root Mean Square Successive Differences (RMSSD).*** A more critical interpretation of HRV may be construed from the statistical indices, Root Mean Squared Successive Differences (RMSSD). As noted by the European Cardiology Task Force (1996), 5-minute intervals are widely expressed as the "golden standard" for HRV analysis. Researchers explain that 5-minute time intervals are highly correlated to HRV measures recorded over extended periods of time (e.g. 24-hours) (Sinnreich, Kark, Friedlander, Sapoznikov, & Luria, 1998). In simple terms, the supporters of the "golden standard" suggests a participants over all ANS activity to be most accurately expressed by HRV measures when recorded over short time spans of precisely 5-minutes. Accordingly, this study has applied RMSSD to measure the HRV of participants within a 5-minute time frame. This parameter can best be interpreted as the ratio of the standard deviation of the R-R interval (SD) over the root mean squared of the successive differences (Salahuddin, Cho,

Jeong, & Kim, 2007). In other words, this measure may be interpreted as the average distance between "normal" R-R intervals.

Moreover, as various HRV parameters have been cited as valuable and meaningful measures of a balanced ANS, many only provide a meaningful index of HRV over an extended period of time. Supporting the "gold standard", researchers have revealed RMSSD as one of the few statistically significant measures that can be collected over short periods of time by correlating participants' ultrashort (60 second or less) RMSSD values to participants' average RMSSD values of whole 5-minute intervals (Nussinovitch, Elishkevitz, Katz, Nussinovitch, Segev, Volovitz & Nussinovitch, 2011; Thong, Li, McNames, Aboy & Goldstein, 2003).

# CHAPTER 3

## RESULTS

Means, standard deviations and correlations of all variables are presented in Table 1. This study predicted that the satisfaction of students' social needs would be positively associated with students' HRV. Moreover, this study predicted that the relationship between students' social needs and HRV would be moderated by gender. Each of these hypotheses were tested in two different models (Model A; Model B) using RMSSD and sdRR as dependent variables. Prior to analyses, these data were screened for violation of assumptions (e.g., normality, homogeneity of variance) and missing data values. Moreover, violations of the assumptions of nonlinearity, heteroscedasticity, and non-normality were tested in all hierarchal regression models.

Table 1

*Means, standard deviations, and correlations*

| Variable | Mean | SD | 1. | 2. | 3. | 4. | 5. | 6. | 7. |
|---|---|---|---|---|---|---|---|---|---|
| 1. sdRR | 51.78 | 22.94 | -- | -- | -- | -- | -- | -- | -- |
| 2. RMSSD | 47.16 | 27.80 | 0.93*** | -- | -- | -- | -- | -- | -- |
| 3. Standing Out | 5.30 | 1.26 | 0.24 | 0.27* | -- | -- | -- | -- | -- |
| 4. Fitting In | 4.83 | 1.11 | 0.16 | 0.22 | 0.28* | -- | -- | -- | -- |
| 5. Need to Belong | 3.25 | 0.64 | -0.03 | 0.05 | -0.16 | -0.06 | -- | -- | -- |
| 6. Negative Affect | 1.38 | 0.35 | -0.02 | -0.12 | -0.09 | -0.02 | -0.03 | -- | -- |
| 7. Male | 0.30 | 0.46 | 0.00 | -0.03 | 0.20 | -0.26* | -0.24 | 0.03 | -- |

*$p < .05$:**; $p < .01$:***; $p < .001$

### 3.1. sdRR Results

To examine the relationship between social needs and HRV, a hierarchal regression analysis was conducted to systematically explain the effect of independent, control, and moderator variables in predicting HRV, as measured by sdRR. All variables included in this model were entered in specific blocks so that residual variance could be explained at each subsequent step of our model. All continuous variables *(*Fitting In, Standing Out, Need to Belong) were converted to standardized z-scores. All categorical variables (Gender) were dummy coded (e.g. 0=female, 1=male). sdRR was entered as the dependent variable in this model. In Step 1 of this model, control variables (Negative Affect, Need to Belong) were included simultaneously with our independent variables (Standing Out, Fitting In). In Step 2 of this model, the interaction terms (Standing Out X Gender, Fitting In X Gender) were included simultaneously to our regression model.

**3.1.1. Model A.** The results of this analysis are presented in Table 2. In Step 1, students' perception of standing out, fitting in, negative affect, need to belong, and gender accounted for 15% of variance in sdRR. However, this model was not statistically significant, $R^2 = .15$, $F\ (5, 29) = 1.08$, $p = .39$. Holding all other variables constant, results did not support the prediction that increases in students' perceptions of fitting in would positively predict HRV, $b = 7.44$, $p > .05$. Likewise, results did not support the prediction that increases in students' perceptions of standing out would positively predict HRV, $b = 1.66$, $p > .05$.

**3.1.2. Model B.** The results of this analysis are presented in Table 2. The final step of our model revealed the interaction terms (Standing Out X Gender, Fitting In X Gender) to

account for an additional 35% of variance in sdRR. Likewise, this model was also not statistically significant, $R^2 = .35$, $F$ (7, 27) = 2.16, $p = .07$. One of the two coefficients for our interaction terms reached statistical significance. Results revealed that gender does not moderate the effect of fitting in on HRV, $b = 5.61$, $p > .05$. However, results did support the prediction that gender would moderate the effect of standing out on HRV, $b = 22.4$, $p < .05$. Such that for two students of opposite gender, both equal at the mean score of standing out, the male student would demonstrate an sdRR score 22.4 ms (milliseconds) higher than the female student

As demonstrated in Figure 2, gender does not predict sdRR at low (-2 standard deviation below the mean) perceptions of standing out $b = -45.4$, $p > .05$ (-1 standard deviation) $b = -23.0$, $p > .05$. Gender also did not predict sdRR at average (0 standard deviations above or below) perceptions of standing out, $b = -.52$, $p > .05$. In contrast, at high (+1 standard deviation above the mean) perceptions of standing out gender does predict sdRR, $b = 21.9$, $p < .05$. For two students of opposite gender who are both one standard deviation above the mean score of standing out, the male student will have an estimated sdRR score 21.9 ms higher than the female student. Among male students, standing out significantly predicted sdRR, $b = 20.7$, $p < .05$. For two male students, the student who is one standard deviation above the other in standing out will have an estimated sdRR score 20.7 ms higher than their peer. Among female students, there was no significant effect of standing out, $b = -1.72$, $p > .05$.

### 3.2. RMSSD Results

To examine the relationship between social needs and HRV, a hierarchal regression analysis was conducted to systematically explain the effect of independent, control, and moderator variables in predicting HRV, as measured by RMSSD. All variables included in this model were entered in specific blocks so that residual variance could be explained at each subsequent step of our model. All continuous variables *(*Fitting In, Standing Out, and Need to Belong) were converted to standardized z-scores. All categorical variables (Gender) were dummy coded (e.g. 0=female, 1=male). RMSSD was entered as the dependent variable in this model. In Step 1 of this model, control variables (Negative Affect, Need to Belong) were included simultaneously with our independent variables (Standing Out, Fitting In). In Step 2 of this model, the interaction terms (Standing Out X Gender, Fitting In X Gender) were included simultaneously to our regression model.

**3.2.1. Model A.** The results of this analysis are presented in Table 3. In Step 1, students' perceptions of standing out, fitting in, negative affect, need to belong, and gender accounted for 22% of variance in RMSSD. However, this model did not reach statistical significance, $R^2$ =.22, $F$ (5, 29) = 1.72, $p$ = .16. Holding all other variables constant, results supported the prediction that increases in students' satisfaction for fitting in would positively predict HRV, $b$ = 9.42, $p$<.05. Consistent with predictions, RMSSD increases by 9.42 ms with every one unit increase in fitting in. In contrast, standing out did not significantly predict RMSSD, $b$ = 2.17, $p$>.05.

**3.2.2. Model B.** The results of this analysis are presented in Table 3. The final step of our model revealed the interaction terms (Standing Out X Gender, Fitting In X Gender) to account for an additional 46% of variance in RMSSD, $R^2 = .46$, $F$ (7, 27) = 3.31, $p < .05$. The results of this analysis are presented in Table 2. One of the two coefficients of our interaction terms reached statistical significance. Gender moderates the effect of standing out on RMSSD, $b = 23.1$, $p < .05$. The slope for standing out on RMSSD is 23.1 ms higher for males. Results did not support the prediction that gender would moderate the effect of fitting in on RMSSD, $b = 14.4$, $p > .05$.

It was also important to probe the nature of the significant Standing Out X Gender interaction. As demonstrated in Figure 1, the x axis demonstrates a range of scores representing students' highest and lowest rating for perceptions of standing out. Gender does not predict RMSSD at low (-2 standard deviations) perceptions of standing out $b = -43.6$, $p > .05$; (-1 standard deviation) $b = -20.4$, $p > .05$. Gender also did not predict RMSSD at the average (0 standard deviations above or below) perceptions of standing out, $b = 2.71$, $p > .05$. In contrast, at high (+1 standard deviation) perceptions of standing out gender does predict RMSSD, $b = 25.8$, $p < .05$. For two students of opposite gender who are both one standard deviation above the mean score of standing out, the male student is estimated to have an RMSSD score 25.8 ms higher than their female peer. Among male students, standing out significantly predicted RMSSD, $b = 21.9$, $p < .05$. Such that for two male students, the student who is one standard deviation higher in standing out is estimated to have an HRV

score 21.9 ms higher than their peer. Among female students, there was no significant effect of standing out, $b$ = -1.21, $p$ > .05.

Table 2

*Unstandardized Regression Coefficients in a Time Domain Analyses of Heart Rate Variability using an sdRR indices*

| Variable | *b* step 1 | *SE* | *b* step 2 | *SE* |
|---|---|---|---|---|
| Intercept | 5.55 | 32.96 | 29.98 | 31.06 |
| Fitting In[b] | 6.70 | 3.62 | 5.14 | 3.72 |
| Standing Out[b] | 1.31 | 2.82 | -1.36 | 2.78 |
| Need to Belong[b] | 2.85 | 5.76 | 3.82 | 5.28 |
| Negative Affect[b] | -4.76 | 9.47 | -9.80 | 8.74 |
| Gender[a] | 7.06 | 8.55 | -118.90 | 46.53 |
| Fitting In X Gender[c] | | | 5.05 | 8.00 |
| Standing Out X Gender[c] | | | 17.81* | 7.07 |
| $R^2$ ($R^2$ adj) | 0.15 ( 0.01) | | 0.35 ( 0.19) | |
| $\Delta R^2$ | 0.02 | | 0.04 | |
| Root mse | 19.747 | | 17.84 | |

* $p$<.05:**;$p$<.01:***;$p$<.001

[a]Gender: female=0; male=1

[b]Standardized continuous variables

[c]Interaction terms

Table 3

*Unstandardized Regression Coefficients in a Time Domain Analysis of Heart Rate Variability using an RMSSD indices*

| Variable | *b* step 1 | *SE* | *b* step 2 | *SE* |
|---|---|---|---|---|
| Intercept | -22.79 | 36.53 | 9.04 | 32.97 |
| Fitting In[b] | 8.48* | 4.01 | 5.10 | 3.95 |
| Standing Out[b] | 1.72 | 3.31 | -.95 | 2.95 |
| Need to Belong[b] | 9.25 | 6.38 | 11.15 | 5.60 |
| Negative Affect[b] | -10.15 | 10.50 | -16.46 | 3.31 |
| Gender[a] | 9.47 | 9.48 | -156.32 | 49.39 |
| Standing Out X Gender[c] | | | 18.36* | 7.50 |
| Fitting In X Gender[c] | | | 13.02 | 8.49 |
| $R^2$ ($R^2$ adj) | 0.22 ( 0.09) | | 0.46 ( 0.32) | |
| $\Delta R^2$ | 0.02 | | 0.04 | |
| Root mse | 21.88 | | 18.97 | |

* $p$<.05:**;$p$<.01:***;$p$<.001

[a]Gender: female=0; male=1

[b]Standardized continuous variables

[c]Interaction terms

# CHAPTER 4

# DISCUSSION

Research concerning social needs as predictors of wellness has taken place without the consideration of the developmental needs most salient to the wellness of specific age groups. The present study was designed to address this lack of developmental concern by considering the relationship between the social needs salient to undergraduate students (emerging adults) and wellness. In doing so, predictions from multiple theoretical frameworks informed the prediction that undergraduate students' need to stand out from and fit in with their peers would predict wellness. As expected, results suggest that undergraduate wellness may be understood in terms of students' satisfaction as standing out and fitting in.

## 4.1. Theoretical Implications

The assumptions of ODT emphasize both standing out and fitting in as equally salient needs to wellness. This study supported the implications of ODT, revealing that the need to stand out and fit in both contributed to increasing HRV. However results supported this implication only for male undergraduates. Specifically the need to stand out had no significant effect on predicting the wellness of female undergraduates. The proceeding paragraphs will discuss the relevance of ODT when considering wellness by revisiting the discrete frameworks supporting ODT.

As predicted, results demonstrated that when perceptions of fitting in increase, HRV also increases. Undergraduates are driven to fit in as a response to their human desire to belong. As suggested by Baumeister and Leary (1995), all human beings have a need for

belongingness, in which individuals seek to establish a sense of interpersonal connection with others. In the ODT framework, Brewer (1991) explains that students may satiate this need for belongingness through opportunities to assimilate with others. Future work regarding opportunities of assimilation may better explain the positive association between fitting in and HRV.

This study supports fitting in as a basic human need and primary driver of wellness by revealing the satiation of fitting in to increase HRV. As noted by physiologists, for healthy cognitive and physical functioning to occur, an individual must first physiologically adapt to the stressors of their environment (Hollenstein et al., 2012; Mezzacappa et al., 2001). Most importantly, in order for this adaption to occur, an individual's most basic needs must be met (Maslow, 1968). On campus, it may be requisite for a student to gain social acceptance into their pledged fraternity, or establish deep interpersonal connections with their specific interest group in order to then contribute to their campus community. Specifically, the results of this study support the aforementioned theoretical implications, by revealing the satiation of a student's need to fit in to increase HRV – implying greater flexibility in the ability to adapt to environmental stressors, as well as greater cognitive and physical functioning.

The implications of uniqueness theory were not fully supported by this study, as the hypothesized unconditional link between standing out and HRV was not significant. However, when conditional upon gender, the need to stand out was a significant predictor of HRV. Specifically, this study revealed when male students perceive themselves at high levels

of standing out, they experience increases in HRV. Seeing that the effect of standing out was conditional upon gender, these results suggest that the implications of ODT theory concerning undergraduate students may depend on an undergraduate's gender.

### 4.2. Implications for HRV

By examining the pure bio-marker of HRV to determine the healthy function of undergraduate students, this study bypasses the psychometric barriers of self-report methods-providing a window to directly examine the true drivers of wellness. If this study were to employ self-report as the measure of our dependent variable, the physiological changes that often prelude students' scholastic behavior would have gone undetected. In this study's departure from self-report, HRV has enhanced our understanding of wellness by allowing us to view these physiological changes in response to students' social experiences.

In doing so, the basic human need to fit in has been emphasized by HRV measures as a social underpinning to the physiological changes occurring in undergraduates, and as a biological driver of undergraduate wellness. Specifically, HRV has explained the satiation of students' need to fit in as a proximal predictor of physiological functions concurrent to healthy cognitions, and positive affect in the university context.

In contrast, HRV has not supported line of reasoning which suggest standing out as an equally salient need to increasing wellness. It could be concurred from the HRV measures used in this study that standing out, particularly at the stage of emerging adulthood (university students), may be emphasized as an unimportant factor in predicting wellness, as

results showed no significant relationship between standing out and wellness by any measure of HRV. However, future work should consider measuring the effect of standing out on undergraduate wellness with different measures of HRV. It could be possible that there are in fact changes in students' cardiovascular responding to the perceptions of standing out that are undetected by the modes of measurement used in the present study. As the present study applied only time domain indices of HRV, future research should explore the value of power-spectral analysis in capturing R-R waves, and synthesizing R-R wave frequency.

### 4.3. Practical Considerations for Wellness on University Campuses

Findings from this study support the practical relevance of university student life and wellness organizations. Specifically, findings from this study suggest that university interest and funding should be directed towards student life and wellness organizations which explicitly provide university structures and opportunities for students to pursue their desires to\ stand out and fit in.

The physiological results of this study may extend beyond wellness – to the class room. Specifically, this study may have practical relevance for university leaders who value academic achievement. Considering wellness as a robust predictor of academic achievement (Andrews & Wilding, 2004; Howell, 2009), and standing out and fitting in as predictors of wellness, university leaders may be able to maximize the academic performance of their students by structuring university environments and wellness intervention in ways the explicitly serve the needs to stand out and fit in.

### 4.4. Limitations and Future Research

Several limitations of the present study should be considered. Firstly, the generalizability of this sample across undergraduate students was limited, as the selected sample drew only from a small target population of undergraduate education majors. It is plausible that these results may not be an accurate reflection of the particular university's population, as the experiences of an undergraduate education major may not be generalizable to the experiences of students in other college majors, such as engineering. More campus wide recruitment efforts could have been designed to recruit a more diverse sample in terms of college majors.

To theoretically increase the generalizability of these results, this study could have benefited from questions probing for ethnic differences in cardiovascular responding. This also may have been limited due to a small sample size, as these data are primarily limited in the distribution of ethnicity – inhibiting analysis between ethnic groups. A stronger link between the primary investigator and the desired sample population could have increased the sample population of this study, in turn creating a wider range of variables to analyze when considering ethnic differences.

Moreover, there were several limitations in the design and methods section of this study which may have affected the results. Firstly, this study measured standing out and fitting in with the assumption that the satiation of these needs are experienced as positive. In doing so, our results may have been interpreted while ignoring deeper psychological processes associated to standing out and fitting in. For example, there could be gender

differences in the attitudes held towards standing out and fitting in. Specifically, seminal work in line with this inquiry propose that males ascribe different connotations to the notion of standing out and fitting in, such that African American males viewed fitting in as a negative trait in certain social domains (Gray, Leach, Zimmerman, Wornoff, Johnson & Baker, in press). Indeed, future research should explore these differences through cross comparisons of gender and race. However, without considering how the meaning of standing out and fitting in may qualitatively change between genders, future quantitative evidence may not accurately inform our understanding of social needs and wellness.

Initially, future research should be led by two potential concerns 1) the wavering meaning of standing out and fitting in, 2) the behaviors associated to perceptions of standing out and fitting in, and 3) opportunity structures for standing out and fitting in. Firstly, forming an enriched definition of standing out and fitting in may allow researchers to better understand the relationship between social needs and wellness. This enriched definition may be obtained by facilitating focus groups of undergraduate students, in which researchers could lead discussions probing for what it means to stand out and fit in as an undergraduate student who is male or female, or of different ethnic groups. By facilitating focus groups with similar aims, researchers can evaluate students' positive and negative attitudes towards standing out and fitting in, which could identify implications for future research design, and intervention.

Secondly, future research should consider not only the perceptions of standing out and fitting in as predictors of wellness, but also the health behaviors which are activated by

perceptions of standing out and fitting in and their relationship to wellness. As suggested by ODT, the behaviors activated in response to one's perception as standing out or fitting in often take place during the processes of assimilation and differentiation. It may benefit future research to investigate the traditional modes of socialization on campus, such as being active in a Greek organization, collegiate sport, or intramural organization as modes of assimilation and differentiation. Moreover, it is possible that there is specific health behaviors characteristic of a students' differentiating and assimilating from in groups (e.g. fraternity) or out groups (e.g. larger Greek community) that may have significant bearing on wellness. The health behaviors exhibited in these groups may be operationalized as moderators of the effect of standing out and fitting in on wellness. Perhaps the more proximal predictors of wellness hinge on the extent to which students go to fit in or stand out on campus. Do these accelerated efforts to stand out and fit in entail risky behavior and negative consequences for wellness? Such information may be beneficial in designing formal intervention efforts which are fine-tuned to addressing the social factors which influence undergraduate wellness.

In addition to health behaviors, the in-school behaviors relating to scholastic achievement should also be considered. Future work should consider how standing out and fitting in may predict cognitive processes and self-regulated behaviors in the classroom through the mediation of HRV. As increases in HRV have been linked to efficient cognitive strategy use (De, 2007; Hansen, Johnsen, Thornton, Waage, & Thayer, 2007), and higher levels of self-regulation (Thayer & Brosschot, 2005; Thayer, Newman, & McClain, 1994), it is plausible that HRV may mediate the relationship between students' social needs and the

scholastic behaviors relating to cognitive function and self-regulated learning – effective strategy shifting, metacognition.

Thirdly, more work is needed in identifying the social structures common on college campuses which speak to the unique social needs of undergraduate students. More importantly, researchers should investigate how undergraduates themselves perceive and value these structures in relation to standing out and fitting in. As revealed by previous research, in effort to satiate the need to stand out and fit in, students pursue opportunities for assimilation and differentiation (Brewer, 1991). It may be possible that social structures on campus, which in theory, provide opportunities to assimilate and differentiate may not actually be perceived as such in real-time by students. Relating to Arnett (2000), students may have different desires for who and what they strive to identify as. With different agendas for their own identity exploration, it is possible that undergraduate students may have certain groups for which they desire to stand out from, or fit in with, in order to achieve their sense of social identity. Gray (2014) describes these groups in terms of social targets (desired group to stand out from, or fit in with). On this note, future work may benefit by examining how undergraduates' different social targets may determine how they value or perceive opportunity structures as modes of assimilation or differentiation.

Future research should consider probing at different dimensions of fitting in though examining these specific indicators of fitting in. With an understanding of how these specific feelings differentially effect one's perception of fitting in, such data points may have informed the understanding of why increases in fitting in positively predict HRV scores.

Such work may reveal findings that can pin point facets of the undergraduate social experience which may have direct ramifications on students' social identities and wellness.

## Conclusion

Literature suggests current university wellness programs and intervention methods do not reach the needs of all students. College being a time of heightened stress (Bewick et al., 2010), university leaders push to implement stress management courses (Sivik et al., 1992), but know little of the basic components needed for undergraduates to effectively respond to the stressors of their developmental stage (Bezner et al., 2000; Blacconiere, 1990). Moreover, universities advocate for creating social support structures on campus, but know little of the unique social factors supporting undergraduate wellness. This study revealed these social factors in terms of standing out and fitting in, such that students' healthy cardiovascular responding was predicted by increases in the satiation of these basic human needs. As a college degree continues to grow in societal and economic demand, it is vital that we consider ways in which students can live healthier social lives that are conducive to meeting this demand. By and large, the success or failure of students in meeting this demand may hinge on the satiation of the needs to stand out and fit in.

## References

Abood, D. A., & Conway, T. L. (1992). Health Value and Self-Esteem as Predictors of Wellness Behavior. *Health Values: The Journal of Health Behavior, Education & Promotion*, *16*(3), 20-26.

Adams, T., Bezner, J., Drabbs, M., Zambarano, R., & Steinhardt, M. (2000). Conceptualization and measurement of the spiritual and psychological dimensions of wellness in a college population. *Journal of American College Health*, *48*(4), 165-173.

Andrews, B., & Wilding, J. M. (2004). The relation of depression and anxiety to life-stress and achievement in students. *British Journal of Psychology*, *95*(4), 509–521.

Appelhans, B. M., & Luecken, L.J. (2006). Heart rate variability as an index of regulated emotional responding. *Review of General Psychology, 10,* 229-240.

Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist*, *55*(5), 469-480.

Baumeister, R. F., & Tice, D. M. (1990). Anxiety and social exclusion. *Journal of Social and Clinical Psychology* 9*,* 165-195.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*(3), 497-529.

Baumeister, R., Twenge, J., M., & Nuss, C. (2002). Effects of social exclusion on cognitive processes: Anticipated aloneness reduces intelligent thought. *Journal of Personality and Social Psychology*, *83*(4), 817-827.

Bewick, B., Koutsopoulou, G., Miles, J., Slaa, E., & Barkham, M. (2010). Changes in Undergraduate Students' Psychological Well-Being as They Progress through University. *Studies in Higher Education*, *35*(6), 633-645.

Bhatti, B., Derezotes, D., Kim, S., & Specht, H. (1989). The association between child maltreatment and self-esteem. In A. M. Mecca, N. J. Smelser, & J. Vasconcellos (Eds.), *The social importance of self-esteem* (pp. 24-71). Berkley: University of California Press.

Brewer, M. B., & Roccas, S. (2002). Individual values, social identity, and optimal distinctiveness. In C. Sedikides & M. B. Brewer (Eds), *Individual self, relational self, collective self* (pp. 219–237). New York: Psychology Press.

Brewer, M. B. (1991). The social self - on being the same and different at the same time. *Personality and Social Psychology Bulletin, 17*(5), 475-482.

Brewer, M. B., & Gardner, W. (1996). Who is this "we"? Levels of collective identity and self-representation. *Journal of Personality and Social Psychology, 71*, 83-93.

Bronman, C. L. (1993). Social relationships and health related behavior. *Journal of Behavioral Medicine, 16*(4). 335-351.

Carney, R., Blumenthal, J., Stein, P., Watkins, L., Catellier, D., Berkman, L., Freedland, K. (2001). Depression, Heart Rate Variability, and Acute Myocardial Infarction. *Circulation, 104*(17), 2024-2028.

Carney, R. M., & Freedland, K. E. (2009). Depression and heart rate variability in patients with coronary heart disease. *Cleveland Clinic Journal of Medicine*, *76*(2), S13–S17.

De, J.P. (2007). Differential association of cognitive and somatic depressive symptoms with heart rate variability in patients with stable coronary heart disease: findings from the Heart and Soul Study. *Psychosomatic medicine (0033-3174),* 69 (8), p. 735.

Eccles, J.S. (2004). Schools, Academic Motivation, and Stage-Environment fit. In R.M. Lerner & L. Steinberg (Eds). *Handbook of adolescent psychology* (pp. 125-153), 2nd Edition. Hoboken, NJ: Wiley.

Eccles, J., Midgley, C., Wigfield, A., Buchanan, C.M., Reuman, D., Flanagan, C., & Maclever, D. (1993). Development during adolescence: The impact of stage-environment fit on adolescents' experiences in schools and families. *American Psychologist 48*(2), 90-101.

Eccles, J. & Midgley, C. (1989). Stage/environment fit: Developmentally appropriate classrooms for young adolescents. In R. Ames & C. Ames (Eds.), Research on motivation and education: goals and cognitions (vol. 3. pp. 139-186). New York: NY, Academic Press.

Erikson, E. H. (1950). *Childhood and Society*. New York: Norton.

Erikson, E. H. (1968). *Identity: Youth and Crisis*. New York: Norton.

Eveland-Sayers, B. M. (2009). Physical Fitness and Academic Achievement in Elementary School Children. *Journal of physical activity & health 6*(1) 1543-3080.

Fraser, K., & Eccles, J.S. (1994, February). Ethnic differences in adolescents' possible selves: The role of ethnic identity in shaping self-concept. Poster session at the biennial meeting of the Society for Research on Adolescence, San Diego, CA.

Fromkin, H. L., (1972). Feelings of interpersonal undistinctiveness: An unpleasant affective state. *Journal of Experimental Research in Personality,* 6, 178-182.

Granello, P. F. (1999). College Students' Wellness as a Function of Social Support and Empathic Ability. *Journal of College Counseling*, *2*(2), 110-20.

Gray, D. L. (2014). Understanding STEM-focused high school students' perceptions of task importance: The role of "standing out" and "fitting in" in mathematics class. *Contemporary Educational Psychology*, *39,* 29-41.

Gray, D. L., Leach, N., Zimmerman, S., Wornoff, J., Johnson, D., & Baker, Q. (In Press). "This is me, all day!" A standing out and fitting in (SOFI) perspective on black males' sense of school belonging in high school. Manuscript to appear in T. L. Strayhorn (Ed.), *Interrogating Black Masculinity in Higher Education: A Collection of Critical Race Analyses*.

Gray, D. L., & Rios, K. (2012). Achievement motivation as a function of assimilation and differentiation needs. *Zeitschrift für Psychologie-Journal of Psychology*, *220*(3), 157–163.

Gordis, E. B., Feres, N., Olezeski, C. L., Rabkin, A. N., & Trickett, P. K. (2010). Skin Conductance Reactivity and Respiratory Sinus Arrhythmia among Maltreated and Comparison Youth: Relation with Aggressive Behavior. *Journal of Pediatric Psychology, 35*(5), 547-558.

Hansen, A.L., Johnsen, B.H., Thornton, D, Waage, L., Thayer J.F. (2007). Facets on Psychopathy Checklist—Revised Predicts Heart Rate Variability and Cognitive Function. *Journal of Personality Disorders*. *21*, 565– 579.

Henri, T., & Turner, J. (1986). The Social Identity Theory of Intergroup Behavior. In *Psychology of Intergroup Relations* (pp. 7-24). Chicago, Illinois: Nelson Hall.

Hermon, D. A., & Hazler, R. J. (1999). Adherence to a wellness model and perceptions of psychological well-being. *Journal of Counseling & Development, 77,* 339-343.

Higgins, E. T., & Eccles[Parsons], J. S. (1983). Social cognition and the social life of the child: Stages as subcultures. In E. T. Higgins , D. W. Ruble, & W. W. Hartup (Eds.), *Social cognition and social behavior: Developmental issues* (pp. 15-62). Cambridge, England: Cambridge University Press.

Hinnant, J.B., & El-Sheikh, M. (2009). Children's externalizing and internalizing symptoms over time: The role of individual differences in patterns of RSA responding. *Journal of Abnormal Child Psychology, 37*, 1049-1061.

Hollenstein, T., McNeely, A., Eastabrook, J., Mackey, A., & Flynn, J.J. (2012). Sympathetic and parasympathetic responses to social stress across adolescence. *Developmental Psychobiology, 54*, 207-214.

Howell, A.J. (2009). Flourishing: Achievement related correlates of students' well-being. *Journal of Positive Psychology, 4*, 1–13.

Hughes, A. A., & Kendall, P. C. (2009). Psychometric Properties of the Positive and Negative Affect Scale for Children (PANAS-C) in Children with Anxiety Disorders. *Child Psychiatry And Human Development*, *40*(3), 343-352.

Hyde, J. S., Mezulis, A. H., & Abramson, L. Y. (2008). The ABCs of depression: Integrating affective, biological, and cognitive models to explain the emergence of the gender difference in depression. *Psychological Review, 115*(2), 291-313.

Kawachi, I., Sparrow, D., Vokonas, P.S., Weiss, S.T. (1995) Decreased heart rate variability in men with phobic anxiety (data from the Normative Aging Study). *American Journal of Cardiology, 14*, 882–885.

Kleiger, R. E. (1987). Heart rate variability and its association with increased mortality after acute myocardial infarction. *The American journal of cardiology, 59*(4), 0002-9149.

Kiecolt-Glaser, J.K., Garner, W., Speicher, C., Penn, G. M., Holiday, J., & Glaser, R. (1984). Psychosocial modifiers of immunocompentence in medical students. *Psychosomatic Medicine, 46*, 7-14.

Krittayaphong, R., Cascio, W.E., Light, K.C. (1997) Heart rate variability in patients with coronary artery disease: differences in patients with higher and lower depression scores. *Psychosomatic Medicine, 59*, 231–235.

Laurent, J., Joiner, T. J., & Catanzaro, S. J. (2011). Positive Affect, Negative Affect, and Physiological Hyperarousal among Referred and Nonreferred Youths. *Psychological Assessment, 23*(4), 945-957

Leary, M. R., Kelly, K. M., Cottrell, C. A., & Schreindorfer, L. S. (2013). Individual differences in the need to belong: Mapping the nomological network. *Journal of Personality Assessment, 95*, 610-624.

Licht, C. M.M., deGeus, E. J. C., Zitman, F. G., Hoogendijk, W. J. G., VanDyck, R., & Penninx, B. W. J. H. (2008). Association between major depressive disorder and heart rate variability in the Netherlands Study of Depression and Anxiety (NESDA). *Archives of General Psychiatry*, *65*, 1358–1367.

Lynn, M., & Snyder, C. R. (2002). Uniqueness seeking. In C. R. Snyder & S. J. Lopez (Eds.), *Handbook of positive psychology* (pp. 395–410). Oxford: Oxford University Press.

Maslow, A.H. (1968). Toward a psychology of being (2nd edn). New York: VanNostrand. (Original work published 1962)

McClary, C., Pyeritz. E., Bruce, W., & Henshaw, E. (1992). A Liberal arts health promotion course. *College Heath*. *41*. 71-73.

Meeres, S. L. & Grant, P. R. (1999). Enhancing collective and personal self-esteem through differentiation: Further exploration of Hinkle & Brown's taxonomy. *British Journal of Social Psychology, 38*, 21-34.

Mezzacappa, E. S., Kelsey, R. M., Katkin, E. S., & Sloan, R. P. (2001). Vagal Rebound and Recovery from psychological stress. *Psychosomatic Medicine, 63*, 650-657.

Montemayor, R., Brown, B., & Adams, G. (1985). *Changes in identity status and psychological adjustment after leaving home and entering college*. Paper presented at the biennial meeting of the Society for Research on Child Development, Toronto, Ontario, Canada.

Nussinovitch, U., Elishkevitz, K.P., Katz, K., Nussinovitch, M., Segev, S., Volovitz, B., & Nussinovitch, N. (2011). Reliability of ultra-short ECG indices for heart rate variability. *Ann Noninvasive Electrocardiol 16*(2), 117-122

Opatz, J. P. (1984). Wellness promotion strategies: Selected proceedings of the eight annual national wellness conference. Dubuque, IA: Kendall

Opatz, J. P. (1986). Stevens Point: A longstanding program for students at a Midwestern university. *American Journal of Health Promotion, 1*, 60–67.

Oleckno, W. A., & Blacconiere, M. J. (1987). A Study of County Environmental Health Practitioners in Illinois. *Journal of Environmental Health, 50*(2), 66-72.

Roeser, R., Eccles, J.S., & Freedman-Doan, C. (1999). Academic functioning and mental health in adolescence: Patterns, progressions, and routes from childhood. *Journal of Adolescent Research, 14*(2), 135-174.

Roeser, R.W., Peck, S.C., & Nasir, N.S. (2006). Self and identity processes in school motivation, learning, and achievement. In P.A. Alexander & P.H. Winne (Eds.*), Handbook of educational psychology* (pp.391-424). Mahwah, NJ: Lawrence Erlbaum Associates.

Salahuddin, L., Cho, J., Jeong, M. G., & Kim, D. (2007). Ultra short term analysis of heart rate variability for monitoring mental stress in mobile settings. Proceedings of the annual international conference of the IEEE Engineering in Medicine and Biology Society (Vol. 2007, pp. 4656–4659). Lyon, France: IEEE.

Sinnreich, R., Kark, J.D., Friedlander, Y., Sapoznikov, D., & Luria, M.H. (1998). Five minute recordings of heart rate variability for population studies: repeatability and age–sex characteristics. *Heart* 80, 156-62.

Sivik, S. J., & And, O. (1992). College and University Wellness Programs: An Assessment of Current Trends. *NASPA Journal*, *29* (2), 136-42.

Sollers, J. S., Buchanan, T.W., Mowrer, S. M., Hill, L.K., & Thayer, J. (2007). Comparison of the ratio of the standard deviation of the R-R interval and the root mean squared successive differences to the low frequency-to-high frequency ratio in a patient population and normal healthy controls. *Biomed Sci Instrum, 43,* 158-163.

Snyder, C. R., & Fromkin, H. L. (1980). *Uniqueness: The human pursuit of difference.* New York: Plenum Press.

Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (1996). Heart rate variability. Standards of measurement, physiologic interpretation, and clinical use. 93:1043-1065

Taylor, E.D., & Wong, C.A. (1996). *Gender differences in the impact of peer influences and peer orientation on African-American adolescents' school value and academic*

*achievement.* Poster session at the sixth biennial meeting of the Society for Research on Adolescence, Boston, MA.

Templeton, J.L., & Eccles, J.S. (2006). The relation between spiritual development and identity processes. In E.C. Roehlkepartain, P.E. King, L. Wagener, & P.L. Benson (Eds.), *The Handbook of spiritual development in childhood and adolescence* (pp. 252-265). Thousand Oaks, CA: Sage Publications, Inc.

Thayer, J.F., Brosschot, J.F. (2005). Psychosomatics and psychopathology: Looking up and down from the brain. *Psychoneuroendocrinology*. *30* 1050–1058.

Thayer, R. E., Newman, J. R., & McClain, T. M. (1994). Self-regulation of mood: Strategies for changing a bad mood, raising energy, and reducing tension. *Journal Of Personality And Social Psychology*, *67*(5), 910-925.

Thong, T., Li, K., McNames, J., Aboy, M., Goldstein, B. (2003) Accuracy of ultra-short heart rate variability measures. *Conf Proc IEEE Eng Med Biol Soc 3*, 2424-2427

Trockel, M., Barnes, M., & Egget, D. (2000). Health-related variables and academic performance among first-year college students: implications for sleep and other behaviors. *Journal of American College Health*, *49*(3), 125-131.

Tsuji, H., Larson, M., Venditti, F.J., Manders, E., Evans, J., Feldman, C., & Levy, D. (1996) Impact of reduced heart rate variability on risk for cardiac events. The Framingham heart study. *Circulation 94*, 2850–2855

Valde, G. A. (1996). Identity closure: A fifth identity status. *Journal of Genetic Psychology*, *157*, 245-254.

Verkuil, B., Brosschot, J. F., De Beurs, D. P., & Thayer, J. F. (2009). Effects of explicit and implicit perseverative cognition on cardiac recovery after cognitive stress. *International Journal of Psychophysiology*, *74*(3), 220-228.

Visnovcova, Z., Calkovska, A., & Tonhajzerova, I. (2013). Heart rate variability and electrodermal activity as a noninvasive indices of sympathovagal balance in response to stress. *Acta Medica Martiniana*, *13*(1), 5-13.

Walerman, A. L. (1982). Identity development from adolescence to adulthood: An extension of theory and a review of research. *Developmental Psychology, 18,* 341-358.

Waterman, A. L. (1982). Identity development from adolescence to adulthood: An extension of theory and review of research. *Developmental Psychology, 18,* 341-358.

Watkins, L., Grossman, P., Krishnan, R., & Sherwood, A. (1998). Anxiety and vagal control of heart rate. *Psychosomatic Medicine, 60,* 498–502.

Watson, D., & Clark, L. A. (1994). *The PANAS-X: Manual for the Positive and Negative Affect Schedule-Expanded Form.* Ames: The University of Iowa.

Wellness. (2011). In *Merriam-Webster.com*. Retrieved December 13, 2014, from http://www.merriam-webster.com/dictionary/wellness

Whitbourne, S. K., & Tesch, S. A. (1985). A comparison of identity and intimacy statuses in college students and alumni. *Developmental Psychology. 2l,* 1039-1044.

Wigfield, A., Eccles, J., Harold-Goldsmith, R., Blumenfeld, P., Yoon, K., & Freedman-Doan, C. (1989, April). *Gender and age differences in children's achievement self-*

*perceptions during elementary school.* Paper presented at the biennial meeting of the Society for Research in Child Development, Kansas City, KA.

# APPENDICES

Appendix A

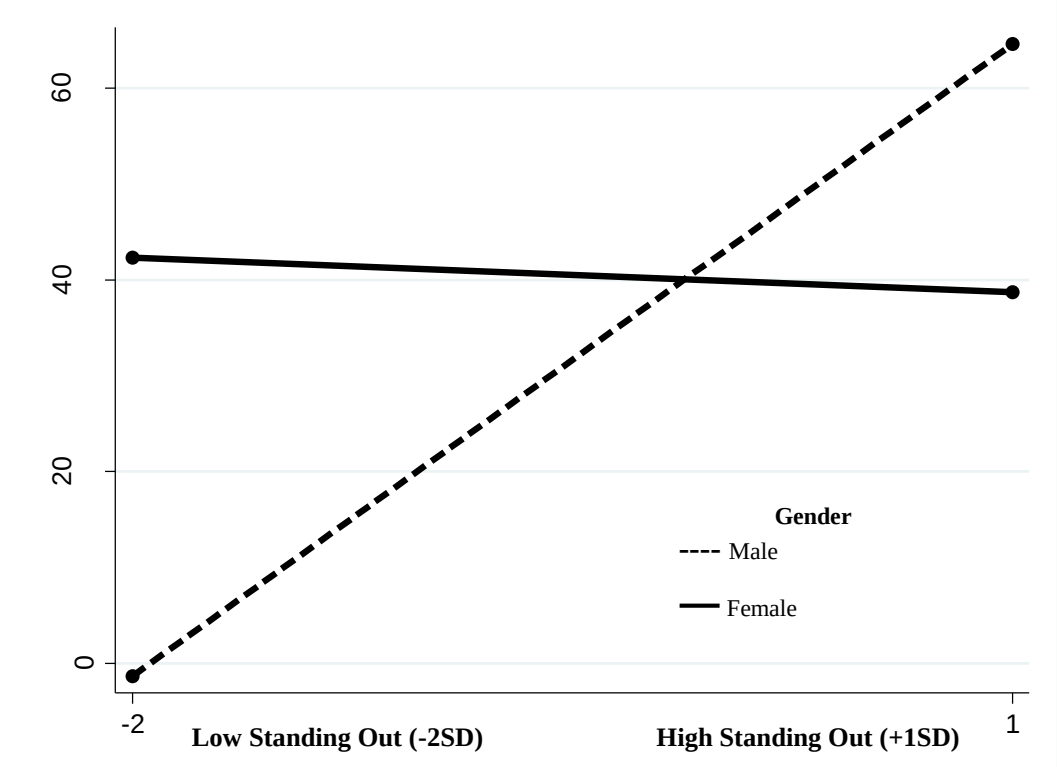


**Fig. 1.** Slope for standing out predicting RMSSD by Gender

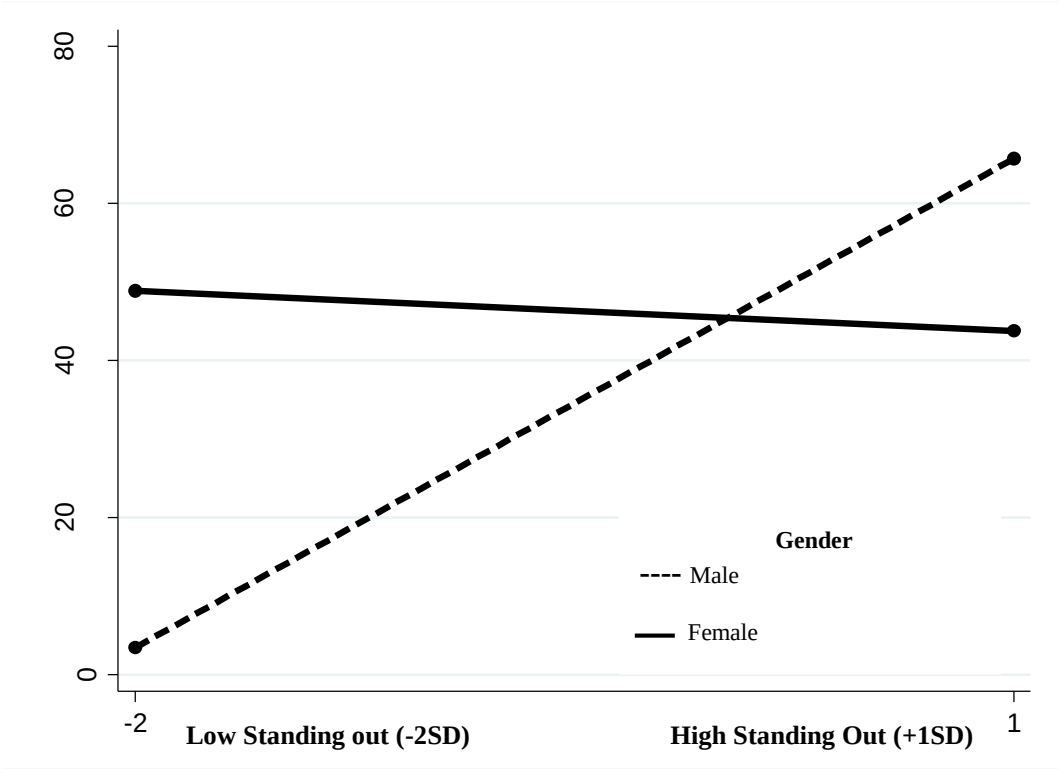


**Fig. 2.** Slope for standing out predicting sdRR by Gender.