IN GOOD TIMES AND BAD: ASSOCIATIONS OF PARTNERS' POSITIVE AFFECT WITH WIVES' PHYSICAL ACTIVITY – A POPULATION AVERAGE MODEL

by

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True education is a kind of never-ending story – a matter of continual beginnings, of habitual fresh starts, of persistent newness.

J. R. R. Tolkien

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ABSTRACT

Lack of physical activity is considered a public health crisis, with only 21% of women meeting current physical activity guidelines. Inactivity places individuals at higher risk for heart disease, type 2 diabetes, depression, cancer, and premature death. Affect, or one's mood and emotions, is often related to both health outcomes and health behaviors. Positive affect is associated with a lower risk of mortality, healthy eating habits, and decreased alcohol consumption, while negative affect is associated with premature mortality, lower medication adherence, and riskier sexual behaviors. Fredrickson's broaden and build theory of positive emotions (BABT) supports the relationship of how positive emotions can lead to enhanced health. This theory also incorporates social support as a key component to enhanced health, which is important since romantic partners often promote positive health behaviors. This dissertation aims to examine the relationship between positive affect of married women, positive affect of their husbands and wives' physical activity, guided by the BABT.

The three hypotheses for this investigation are: A) on days when wives have indicated higher positive affect, they will have higher levels of same day moderate to vigorous physical activity (MVPA), B) on days when wives have higher positive affect, they will have higher levels of next day MVPA, and C) husbands' positive affect will be associated with wives' same day MVPA beyond the impact of wives' own daily positive affect. To examine these relationships, a secondary data analysis of the Health and Relationships Project (HARP) data set using population average models was done. The HARP is a 10 day, online, daily diary study (including a baseline questionnaire) of couples that aimed to examine how individuals in long-term relationships manage situations/contexts that impact their health.

Independent variables assessing daily positive affect of calm and happy (1=not at all; 5= extremely) were used. The dependent variable of daily moderate-to-vigorous physical activity (MVPA) was created as a sum of minutes of reported moderate and vigorous activity over the last 24 hours. Covariates in the model included age, baseline moderate activity frequency, baseline vigorous activity frequency, education level, marital quality, and race/ethnicity. This analysis included 115 heterosexual couples (mean age females = 45.04 years; mean age males = 46.48 years; mean years married = 13.48 years).

There is partial support for the hypotheses. Results for hypothesis A showed only happiness ($\beta = 0.15$; $p < 0.01$) to be associated with same day MVPA. For hypothesis B neither happiness ($\beta = 0.11$; $p = 0.06$) nor calmness ($\beta = 0.01$; $p = 0.90$) were significantly associated with wives' next day MVPA. Findings for the two-partner model (hypothesis C) showed husbands' affect did not significantly contribute to wives' MVPA, while wives' positive affect remained significantly associated with their own same day MVPA (happy $\beta = 0.15$; $p < 0.01$).

Wives' positive affect being significantly associated with same day MVPA supports the tenets of Fredrickson's BABT and previous work surrounding affect and health behaviors, which states positive emotions (e.g., happiness) can lead to enhanced health. Past research shows partners to be influential on partner MVPA via their emotional contributions to marital satisfaction and their partner's overall happiness. While husbands' positive affect was not significant in this analysis, husbands could be contributing to their wives' MVPA in other ways such as increasing her overall happiness level or increasing her marital satisfaction. Additionally, other indicators of social support (e.g., close friends or other family members) could be impacting wives' MVPA behaviors and should be considered in future studies.

Limitations of this study include the use of a shortened form of the Positive and Negative Affect Schedule, response bias of reported MVPA minutes, and using secondary data (e.g., masked variables and desire for additional variables). Future studies could examine the associations of one partner's positive affect with the physical activity of the other in same-sex couples, different geographical locations, and utilize other MVPA outcomes such as leisure time activity. Additional research is needed to further define the relationship between positive affect and MVPA.

CHAPTER 1. INTRODUCTION

1.1 Introduction

Physical inactivity has remained a pervasive public health issue for decades (Guthold et al., 2018; Yang et al., 2019) with 23% of the U.S. population categorized as inactive (United Health Foundation, 2020b) and 22% of adults reporting no physical activity other than their regular job in 2019 (United Health Foundation, 2020a). From a young age, even as early as preschool, women start to fall behind in daily minutes of physical activity when compared to men (Edwards & Sackett, 2016). Into adulthood, men meet the physical activity guidelines more often than women (Keadle et al., 2016) and inactivity becomes more common among women (United Health Foundation, 2020a). Only 21% of women met the physical activity guidelines in the 2019 versus 25% of men (United Health Foundation, 2021b). In Indiana specifically, 29% of women completed no physical activity in 2019, compared to 24% of men (United Health Foundation, 2020a). Overall, women may perform less physical activity than their male counterparts because of their social roles (e.g., being a parent, lack of time, and other family obligations) (Scharff et al., 1999). Failing to meet physical activity guidelines places both men and women at increased risk for early death, heart disease, stroke, type 2 diabetes, depression, and various cancers (Centers for Disease Control and Prevention [CDC], 2014). For women specifically, physical activity decreases risk of bone fractures (Kujala et al., 2000; Warburton et al., 2006), improves bone density (Liu-Ambrose et al., 2004), and decreases the risk of breast, endometrial, and ovarian cancers (Edwards & Sackett, 2016).

For reference, physical activity is defined broadly as “bodily movements produced by skeletal muscles that result in energy expenditure” (Caspersen et al., 1985). Underneath the physical activity umbrella is exercise, which is defined as “physical activity that is planned, structured, and repetitive and has a final or intermediate objective [of] improvement or maintenance of physical fitness" (Caspersen et al., 1985). While there are many well-known determinants of physical activity (Chastin et al., 2015; O'Donoghue et al., 2018), they are often understudied in women (Kosma et al., 2004; Scharff et al., 1999). Knowing that physical activity participation is lower among women, it is imperative that future research focus on further understanding of influences of physical activity behavior among women specifically.

One potential influence on women's health behaviors is affect. Affect is a range of feelings that encompasses both emotions and mood (Liao et al., 2015; Rottenberg et al., 2005). Positive affect is associated with better health outcomes such as a lower risk of mortality and increased resistance to colds and the flu (Pressman et al., 2019). On the other hand, negative affect can lead to premature mortality, an increased risk of coronary heart disease, and type 2 diabetes (Steptoe et al., 2005). What is less well known is how affect can contribute to physical activity behaviors (Forster et al., 2021).

Another way to influence women's physical activity behaviors may be through individual social networks, specifically romantic partners (Martire & Helgeson, 2017). While current research has focused more on management of individual chronic illness, partners may also play a role in promoting overall healthy behaviors such as physical activity (Martire & Helgeson, 2017). Social networks have been shown to be beneficial to health by increasing life expectancy, decreasing age-associated cognitive decline, increasing resistance to infectious disease, and contributing to better chronic illness prognosis (Cohen & Janicki-Deverts, 2009). Partners influence each other through thoughts, feelings, and actions, which can in turn alter health outcomes (Cheng et al., 2018). Partner influences to increase physical activity among adults is an area for future research.

1.2 Problem Statement

Women are underrepresented in research on physical activity (Physical Activity Guidelines Advisory Committee [PAGAC], 2018; Kosma et al., 2004). Some research has been completed on the determinants of physical activity among women which showed marital status, having children, living in a rural area, age, employment, education, and belonging to a minority group are all correlated with levels of physical activity (Pharr et al., 2020; Prince et al., 2016; Scharff et al., 1999). The purpose of this dissertation will extend this research by examining how wives' positive affect, and their husbands' positive affect, can influence the wives' physical activity behavior. To better promote the physical activity behavior of women, these factors should be further investigated. By looking at how women's positive affect can influence their physical activity behavior, more personalized interventions or guidelines for women may emerge (Fukuoka et al., 2018).

Research has shown that affect can influence certain health behaviors such as medication adherence and risky sexual behavior (Deichert et al., 2008), but the relationship to physical activity is lacking (Forster et al., 2021). Exploring the affect-physical activity relationship will help provide additional understanding of individual and interpersonal influences on physical activity which could help inform new and novel physical activity promotion strategies.

Another key component of the affect-physical activity relationship may be partners. When looking at physical activity among partners, research has often been disease specific. For example, Helgeson and colleagues (2016) showed that partners' relationships can lead to increased exercise in individuals with newly diagnosed diabetes (Helgeson et al., 2016) and that partners can be influential in their spouse's management of osteoarthritis, specifically their exercise management (Yorgason et al., 2010). In order to increase physical activity among U.S. adults, a broader, health promotion perspective (e.g., not disease specific) needs to be utilized (Office of Disease Prevention and Health Promotion [ODPHP], 2020).

1.3 Purpose of the Study

This dissertation draws from Fredrickson's broaden and build theory of positive emotions (BABT) (Fredrickson, 2004) to examine how positive affect can influence physical activity behaviors of married women. Additionally, as part of women's social network, husbands' positive affect may be influential on wives' physical activity and will be explored as well.

This project utilizes the Health and Relationships Project (HARP) data set to examine the associations between positive affect and subsequent physical activity among married women (Umberson, (2015). There are many strengths to this data set including data within individuals, daily assessments of physical activity and positive affect, the longitudinal nature of the data, and a high daily diary completion rate. Weaknesses of this data set include a non-nationally representative sample and use of an adapted short form of the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988). To our knowledge, this data set has not been used to analyze the relationship of affect and physical activity and could provide valuable information that shapes future individual-level and couple-level physical activity promotion. The HARP study also provides data on many important variables that are to be used as covariates including baseline physical activity levels, baseline marital quality, age, race, and education level.

1.4 Specific Aims & Hypotheses

Specific Aim: To examine the relationship between positive affect and subsequent moderate to vigorous physical activity (MVPA) behaviors of women.

Hypothesis A: On days where wives have indicated higher positive affect, they will have higher levels of same day MVPA.

Hypothesis B: On days where wives have higher positive affect, they will have higher levels of next day MVPA.

Hypothesis C: Husbands' positive affect will impact wives' same day MVPA beyond the impact of wives' own daily positive affect.

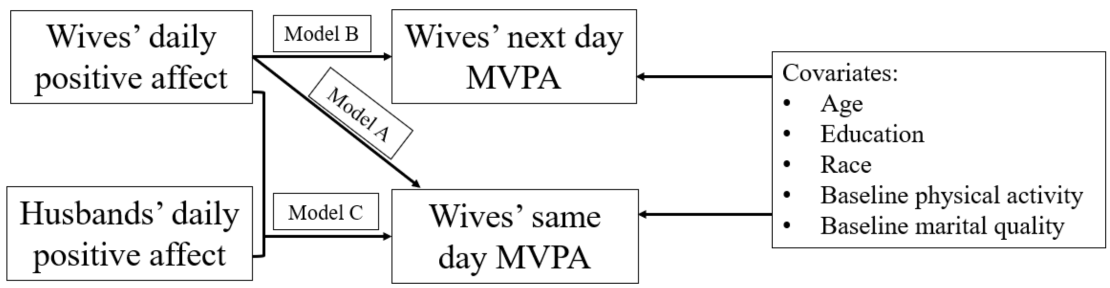

Figure 1. Conceptual framework.

CHAPTER 2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Theoretical Approach

The conceptual framework for this dissertation (Figure 1) is guided by Fredrickson's (2001) broaden and build theory of positive emotions (BABT). Broaden and build theory (Fredrickson, 2001) details how positive emotions can lead to enhanced health (i.e., increased MVPA) (Figure 2). This theory also incorporates other factors into the framework including social support, novel thoughts, skills, and knowledge, which are all key components for enhanced health (Fredrickson, 2001; Pender et al., 2011). Overall, Fredrickson's BABT states that positive emotions (e.g., positive affect) broaden individuals' mindsets which can, overtime, increase their motivation for positive health behaviors (Fredrickson, 2001; Van Capellen et al., 2018). These positive emotions, happy and calm, can help individuals build both their physical and intellectual resources, which can lead to more variety and acceptance of behaviors (Fredrickson, 2001). While it is important to consider the additional components of BABT (e.g., social support, skills, and knowledge), this study will mainly focus on the relationship between positive affect and enhanced health (i.e., physical activity participation).

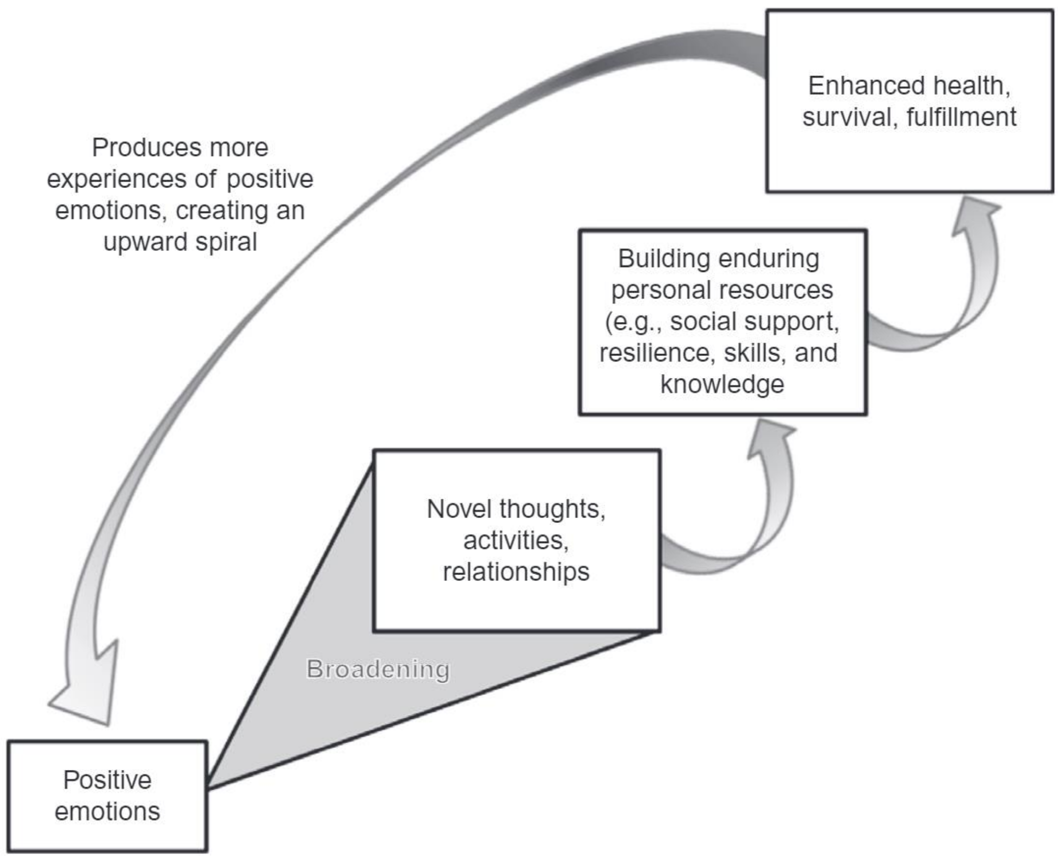

Figure 2. Fredrickson’s (2013) broaden and build theory of positive emotions.

The tenets of BABT, combined with the knowledge that positive affect may increase physical activity engagement, could demonstrate a pathway to influence positive health behaviors, such as physical activity (Williams & Evans, 2014). General positive affect has been shown to be more predictive of intentions, than specific emotions (Ferrer & Mendes, 2018), and BABT takes a broader approach to the term affect. Within the framework, affect is referenced to as “positive emotions” and not one specific emotional state (Fredrickson, 2013). Additionally, experiencing positive affect can prompt an individual to engage with their environment and initiate certain activities, potentially physical activity (Fredrickson, 2001). When possible, utilizing an average score for positive affect would be beneficial. For example, using the full positive affect scale of the PANAS would be preferred to using individual emotion scores.

It is also important to mention that there is theoretical support outside of BABT for the importance of social support in relation to health behaviors. Both Pender's health promotion model (HPM) and Bandura's social cognitive theory (SCT) recognize the importance of interpersonal influences to promote a health behavioral outcome. The HPM recognizes the influences of interpersonal factors, positing that social support (e.g., partners) can be influential on the behaviors, beliefs, and attitudes of the individual trying to make a health behavior change (Pender et al., 2011).

Bandura's SCT also addresses the influence of interpersonal factors, in the form of the social environment, when it comes to behavior change (Bandura, 1986). The social environment has been shown to be a strong predictor of physical activity participation via supportive friends (Jekauc et al., 2015) and low social support increasing inactivity two-fold (Ståhl et al., 2001). A major tenant of SCT is self-efficacy, or one's belief in their own capability to complete an action, which may be influenced by the social support of a partner (Bandura, 1989). This could be through the partner's influence on emotional states or the social persuasion of the individual trying to make a behavior change (Bandura, 1989). While self-efficacy is important to behavior change, it is not the focus of this dissertation. Intervening on affect and interpersonal factors may prove beneficial for influencing a health behavior change.

The framework of BABT shows that affect and interpersonal factors may be influential for enhancing individual health. As Chopik and O'Brien (2017) have outlined in previous research, individuals do not live in a vacuum. While BABT supports this idea, other theoretical frameworks also support the importance of the social environment and could be incorporated in future work. This dissertation will further investigate the relationship between positive affect and physical activity by using Fredrickson's (2013) BABT framework as a guide (Figure 1, Chapter 1 and Figure 2, Chapter 2).

2.2 Review of Literature

2.2.1 Women and physical activity

This dissertation study focuses on women due to the increased need to improve physical activity behaviors of women in the U.S. and the lack of research on women's physical activity behaviors. In order to develop new physical activity promotion strategies for women, it is important to further investigate novel individual and interpersonal influences of women's physical activity behaviors.

There are numerous health benefits of physical activity including a lower risk of heart disease, stroke, type 2 diabetes, depression, and various cancers (including breast, endometrial, and ovarian cancer in women specifically, Edwards & Sackett, 2016; PAGAC, 2018). Physically active individuals tend to sleep better, feel better, and function better overall (PAGAC, 2018). Moderate to vigorous physical activity is known to reduce the risk of fall-related injuries and reduce the risk of clinical depression and symptoms of anxiety (DiPietro et al., 2019; PAGAC, 2018).

There are also many benefits of physical activity specific to women. Meeting physical activity recommendations can improve bone health by reducing the risk of bone fractures (Kujala et al., 2000; Warburton et al., 2006) and improve bone density among high-risk women (Liu-Ambrose et al., 2004). In older women specifically, increased light physical activity has been shown to lead to a decreased risk of cardiovascular events (LaCroix et al., 2019).

Not only are women underrepresented in physical activity research, but they are also often less likely to meet the physical activity guidelines when compared to men (Keadle et al., 2016). This statistic holds true in older age as well, with physical activity levels declining as women age (Scharff et al., 1999; Keadle et al., 2016). For all adults (including women), to achieve the most health benefits, the national physical activity guidelines recommend at least 150 minutes (2 hours and 30 minutes) of weekly moderate-intensity aerobic physical activity (i.e., brisk walking) *or* at least 75 minutes (1 hour and 15 minutes) of weekly vigorous-intensity aerobic physical activity (PAGAC, 2018). An equivalent combination of these two recommendations, spread across the week is acceptable as well (PAGAC, 2018). Muscle strengthening activities (such as weightlifting or use of resistance bands) of moderate or high intensity should be done two or more days per week (PAGAC, 2018).

In 2020, 25% of U.S. women were categorized as inactive versus 22% of men (United Health Foundation, 2021a). This number is even higher in Indiana at 29% for women and 24% for men (United Health Foundation, 2021a). Additionally, only 21% of U.S. (19% of Indiana) women met the physical activity guidelines in 2019, whereas 25% of U.S. (23% of Indiana) men met the guidelines (United Health Foundation, 2021b). In all categories women are less active and meet the physical activity guidelines less often than men. These statistics show that increasing physical activity among women in the U.S. is a public health priority.

Knowing that physical activity participation is low among women, it is imperative that future research focus on identifying factors that promote physical activity. The next section will look at the key determinants of the physical activity behaviors of women being analyzed in this dissertation.

2.2.2 Determinants supported in physical activity research

Age. As individuals age, they are prone to increased sedentary behavior and decreased physical activity participation (Chastin et al., 2015; Choi et al., 2017; Kaplan et al., 2001). Generally, physical activity tends to decrease among individuals older than 45 years of age (Zenko et al., 2019). In women, physical activities of daily living (e.g., work in the home, yard work, and home repair) has been seen to decrease from 29% in the youngest surveyed categories to 11% in the oldest population (Scharff et al., 1999).

Education and income. Both men and women with higher education levels (e.g., completing a university education) typically complete more MVPA when compared to those with a lower level of education (Kantomaa et al., 2016; Pharr et al., 2020). Additionally, women who participate in sports for physical activity are more likely to be college graduates (Pharr et al., 2020). Further, differing levels of aerobic physical activity are found among different socioeconomic (SES) levels. Individuals with middle and high SES are more likely to engage in aerobic physical activity when compared to low SES individuals (Manz et al., 2018).

Race and ethnicity. Meeting physical activity and muscle strengthening guidelines decreases an individuals' risk for all-cause mortality independent of their race and ethnicity (Boyer et al., 2020). Overall, White, non-Hispanic adults reported more physical activity than any other race (Armstrong et al., 2018) and Hispanics had the highest prevalence of inactivity at 32% (Montgomery, 2019). Both race and ethnicity are important determinants to consider when addressing physical activity.

2.2.3 Definition of affect

Affect is an umbrella term that encompasses a range of feelings including mood and emotion (Liao et al., 2015; Rottenberg et al., 2005). Mood is defined as a slow-moving state, over the course of hours to days, which influences feelings and perceptions (Rottenberg et al., 2005). Emotions are quick moving states, over seconds and minutes, which can change one's feelings, behaviors, and physiology (Rottenberg et al., 2005).

Affect can be positive or negative and is measured on a continuum. One of the most widely used assessments tools is the Positive and Negative Affect Schedule (PANAS) (Rottenberg et al., 2005; Watson et al., 1988). The PANAS-Extended Form (PANAS-X) outlines four different categories of scales for measuring affect, 1) General Dimension Scales, 2) Basic Negative Emotion Scales, 3) Basic Positive Emotion Scales, and 4) Other Affective States (Watson & Clark, 1994). The individual scale breakdowns for each category can be found in Table 1 below. Positive affect is defined as the extent to which a person feels enthusiastic, active, and alert, whereas negative affect includes distress and unpleasurable engagement (Watson et al., 1988). An individual is considered to have high positive affect when they have high energy, full concentration, and full engagement and high negative affect when anger, disgust, or guilt is present (Watson et al., 1988). Since affect is measured on a continuum, certain emotional states can be both positive and negative. For example, fatigue (sleepy, tired, sluggish drowsy) is considered a high negative and low positive affect, and serenity (calm, relaxed, at ease) is considered an indicator of low negative and high positive affect (Watson & Clark, 1994).

Table 1. PANAS-X scale.

Scale	Descriptors
General Dimension Scales	
Negative Affect	afraid, scared, nervous jittery, irritable, hostile, guilty, ashamed, upset, distressed
Positive Affect	active, alert, attentive, determined, enthusiastic, excited, inspired, interested, proud, strong
Basic Negative Emotion Scales	
Fear	afraid, scared, frightened, nervous, jittery, shaky
Hostility	angry, hostile, irritable, scornful, disgusted, loathing
Guilt	guilty, ashamed, blameworthy, angry at self, disgusted with self, dissatisfied with self
Sadness	sad, blue, downhearted, alone, lonely
Basic Positive Emotion Scales	
Joviality	happy, joyful, delighted, cheerful, excited, enthusiastic, lively, energetic
Self-Assurance	proud, strong, confident, bold, daring, fearless
Attentiveness	alert, attentive, concentrating, determined
Other Affective States	
Shyness	shy, bashful, sheepish, timid
Fatigue	sleepy, tired, sluggish, drowsy
Serenity	calm, relaxed, at ease
Surprise	amazed, surprised, astonished

Note: Watson, D., & Clark, L. A. (1994). The PANAS-X: Manual for the positive and negative affect schedule – expanded form. doi: https://doi.org/10.17077/48vt-m4t2.

2.2.4 Positive affect and physical activity

A key component of the framework used in this dissertation is positive affect. Fredrickson's BABT refers to affect in the form of general positive emotions (Fredrickson, 2001). This dissertation will use general daily positive affect, measured by an adapted form of the PANAS (Watson et al., 1988), as a predictor variable.

Much of the current research looks at how physical activity can improve well-being, life satisfaction, and/or affect (Kim et al., 2017). Research on the reverse association is far more limited. Affect is an emerging determinant of physical activity with heterogeneous findings, where both negative and positive affect have shown to be contributing factors to individuals' physical activity behavior (Forster et al., 2021). The findings surrounding affect and physical activity are varied, with some studies showing negative affect being influential (i.e., Castonguay et al., 2017; Powell et al., 2009) and others showing positive affect to be relevant to activity levels (i.e., Niermann et al., 2016; Sin et al., 2015). For this dissertation, the focus will be on positive affect and its role with physical activity since BABT is based on positive emotions. Further investigations into how an individual's negative affect may influence their subsequent physical activity may provide additional guidance on improving physical activity behaviors among women.

Research has shown that positive affect can be influential on physical activity behaviors (Forster et al., 2021). Individuals with positive affect have been found to participate in increased after work MVPA (Niermann, et al., 2016), to be more active long term (McAuley et al., 2007), and to have an increased likelihood of physical activity later in the same day (Emerson et al., 2017; Liao et al., 2017). Positive affect can also lead to increased odds of being physically active in specific disease populations, such as those with coronary heart disease (Sin et al., 2015).

Findings also show that positive affect can be influential over time. Positive affect has been found to be a significant predictor of physical activity for up to five years following a physical activity intervention (McAuley et al., 2007). Higher baseline positive affect has also predicted more physical activity over the course of 11 years, regardless of the individual's starting activity level, individual health status, or depression diagnosis (Kim et al., 2017). Not only is an increase in physical activity seen, but an increase in *intended* physical activity has also been found (Cameron et al., 2018).

The qualitative research on affect as a predictor of physical activity is also promising. In a study of individuals with metabolic syndrome, positive psychological constructs (i.e., enjoyment, energy, and optimism) helped individuals engage in more physical activity (Millstein et al., 2020).

Even though participants had a difficult time identifying this connection, they were able to express how positive emotions prior to physical activity helped them meet their goals (Millstein et al., 2020).

The studies mentioned here show support for a relationship between affect and physical activity, but the relationship is still heterogeneous (Fiedler et al., 2022; Forster et al., 2020). The populations used have been varied, affect and physical activity measures have been varied, and findings show associations between activity and both positive and negative affect. This dissertation will help further the understanding of how positive affect may play a role in increasing physical activity behaviors of women.

2.2.5 Partner's affect and women's physical activity

Individual health and health behaviors are tied to levels of happiness of both the individual and their partner (Chopik & O'Brien, 2017; Fredrickson, 2001). A happy individual will oftentimes have a stronger immune system, be less vulnerable to stress, and live a longer life (Kiecolt-Glaser et al., 2002; Segerstrom & Sephton, 2010; Williams & Schneiderman, 2002). These happier individuals have also been shown to exercise more, as well as engage in other positive health behaviors (Rascuite & Downward, 2010).

While looking at the happiness of the individual is important, it is also critical to look at how the other people in one's life can influence health outcomes. Individuals surrounded by other happy, positive people often have better moods and higher life satisfaction (Fowler & Christakis, 2008; Hill et al., 2010). This assertion is supported by BABT and the idea that positive affective states (i.e., greater life satisfaction) are energizing states that can facilitate action (i.e., increased physical activity). What is less well known is whether the relationship between mood and health remains when considering physical activity as the outcome. Utilizing the framework outlined earlier (Figure 1), a portion of this dissertation will look at how wives' physical activity may be influenced by their husbands' affect.

Overall, having a happy spouse can lead to a lower risk of death over time, when compared to having an unhappy spouse (Stavrova, 2019). A contributing factor of this decreased mortality risk is the increased physical activity behaviors of partners with happy spouses (Stavrova, 2019). Partner happiness has also been shown to directly predict better health behaviors among couples (Chopik & O'Brien, 2017). When an individual has a happy partner, they report more frequent exercise, even when taking in to account the impact of their own personal happiness (Chopik & O'Brien, 2017).

Additionally, spouses often experience the same stressors. What impacts one partner's mood is more than likely going to impact the other partner's mood as well (Ruthig et al., 2012). Marriage is an interdependent relationship where partners' emotions are tied to one another (Ruthig et al., 2012). This interdependence of emotions can contribute to the marital satisfaction of partners, which can also impact health and health behaviors, including regular physical activity (Brazeau & Lewis, 2020), eating a better diet (Robles, 2014), and higher adherence to medical treatments (Trief et al., 2004). Researchers have also shown that higher marital satisfaction can lead to less drug use (Du Bois et al., 2019).

Together these findings support further investigation of the relationship between partners' affect and its influence on physical activity. To further investigate this relationship, husbands' daily affect will be used as a predictor variable of wives' same day MVPA.

2.3 Summary

Increased physical activity among U.S. adults, especially among women is needed. The health benefits of physical activity are clear, but there is still a lack of participation nationwide. In addition, affect has been shown to be an influence on health behaviors (Ammassari et al., 2004; Sacco et al., 2015) including physical activity, but the findings were varied (Forster et al., 2021). Through the use of population average models, this dissertation assesses the relationship between positive affect and same day MVPA among married women using the HARP data set. It also assesses how husbands' positive affect may influence wives' same day MVPA. In the end, this dissertation will provide implications for nursing practice, as well as future research, involving positive affect and physical activity among partners.

CHAPTER 3. METHODS

This is a secondary data analysis that examines the associations between positive affect and physical activity behaviors of married women. The factors examined in this analysis are based on Fredrickson's (2013) BABT. This dissertation involves quantitative analysis of the HARP data set (Umberson, 2015).

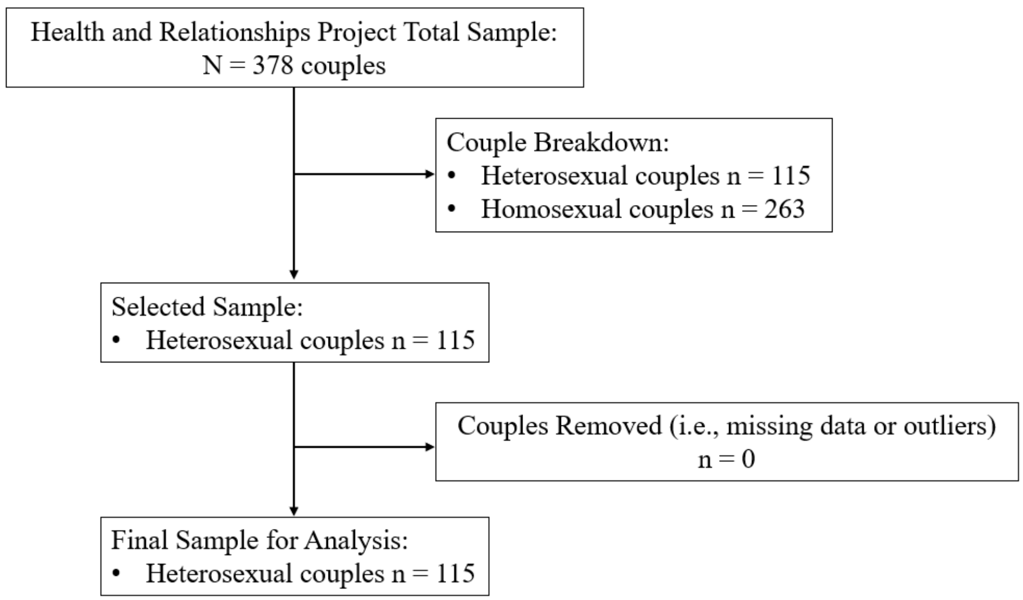

Figure 3. Flowchart of HARP data set sample.

Table 2. Sample demographics, N=115 couples.

Characteristic	Males	Females
	Mean (SD)	Mean (SD)
Age (in years)	46.48 (8.11)	45.04 (7.62)
Years married	13.48 (8.48)	13.48 (8.48)
Education		
Less than high school	2 (1.74)	0 (0.00)
Some high school	1 (0.87)	0 (0.00)
High school/GED	11 (9.57)	7 (6.09)
Some college	21 (18.26)	21 (18.26)
College graduate	37 (32.17)	30 (26.09)
Post-graduate/professional	43 (37.39)	57 (49.57)
Employment status		
Full-time	87 (76.32)	65 (56.52)
Part-time	4 (3.51)	23 (20.00)
Retired	5 (4.39)	2 (1.74)
Disabled/unable to work	6 (5.26)	4 (3.48)
Unemployed/looking for work	5 (4.39)	3 (2.61)
Homemaker	2 (1.75)	16 (13.91)
Other	5 (4.39)	2 (1.74)
Race/ethnicity		
White/Caucasian	97 (84.35)	98 (85.22)
Black/African American	9 (7.83)	6 (5.22)
American Indian/Alaskan Native	1 (0.87)	1 (0.87)
Asian or Pacific Islander	3 (2.61)	5 (4.35)
Other	7 (6.09)	6 (5.22)
Don't know	0 (0.00)	1 (0.87)
Ethnicity – Hispanic/Latino(a)		
Yes	8 (6.96)	7 (6.09)
No	106 (92.17)	108 (93.91)
Don't know	1 (0.87)	0 (0.00)
Household income	n (%)	
No household income	0 (0.00)	
$1 - $24,999	4 (3.54)	
$25,000 - $49,999	12 (10.62)	
$50,000 - $74,999	22 (19.47)	
$75,000 - $99,999	32 (28.32)	
$100,000 - $149,999	21 (18.58)	
$150,000 or more	22 (19.47)	

3.1 Sample

The total HARP sample is comprised of 378 same and different sex couples. The couples have been legally married for at least three years at the time of the baseline survey. Ages range from 35 to 65 years of age. To be included in the daily diary data set, couples had to complete at least six of the ten daily entries. Ninety percent of the couples completed all ten days (Umberson, 2015). For this dissertation only heterosexual couples are analyzed. The final sample used for analyses consists of 115 couples. See Table 2 (Table 2) below for a list of final sample characteristics.

3.2 Instruments and Measures

In order to assess the relationship of women's positive affect on their physical activity, daily diary happy, calm, and MVPA levels were used. Husbands' daily diary positive affect (i.e., happy and calm) scores were also used as predictor variables of wives' daily physical activity. Additionally, age, education, race, baseline MVPA, and baseline marital quality were used as covariates in the model. How both the independent variables, dependent variables, and covariates were measured within the HARP data set is outlined below.

3.2.1 Independent variable

3.2.1.1 Daily diary survey of positive affect

Within the 10-day daily diary, participants were asked to assess their positive affect over the past 24 hours. This item was adapted from the National Study of Daily Experiences, which utilized the Positive and Negative Affect Schedule (PANAS) (Ryff & Almeida, 2009). Positive affect is typically measured using a ten-item scale consisting of the descriptors attentive, interested, alert, excited, enthusiastic, inspired, proud, determined, strong, and active (Watson et al., 1988).

To assess positive affect, the HARP used an abbreviated version of the PANAS (Watson et al., 1988), and included only calm and happy descriptors. Calm is part of the serenity subscale and is a low negative, high positive affect descriptor (Watson & Clark, 1994). Happy is part of the positive affect general dimension subscale (Watson & Clark, 1994). Since calm and happy are a part of two different subscales but are both defined as positive affect variables according to the PANAS-X (Watson & Clark, 1994), it was deemed reasonable to use them as separate affect variables in the final analyses.

Participants were asked to what extent they felt calm and happy over the past 24 hours. Response options included: (1) not at all, (2) a little, (3) moderately, (4) a lot, or (5) extremely. Calm and happy scores ranged from 1-5 with higher scores indicating higher positive affect. Both wives' and husbands' scores for positive affect were used to predict wives' total physical activity. Calm and happy were analyzed as separate continuous variables.

3.2.2 Dependent variable

3.2.2.1 Daily diary physical activity

Daily self-reported physical activity was assessed for ten days with two items. These questions were adapted from the Physical Activity Assessment Tool (PAAT) (Meriwether et al., 2006). The PAAT has been validated in adults against the International Physical Activity Questionnaire Long Form (IPAQ) (r=0.562, p<0.001) and objective assessment with accelerometers (r=0.392, p=0.015) for MVPA (Meriwether et a., 2006). The seven-day retest reliability of the PAAT (r=0.618, p<0.001) is comparable with accelerometers as well (r=0.527, p<0.001) (Meriwether et al., 2006).

Participants were asked how many minutes they engaged in moderate and vigorous activity over the past 24 hours. One text entry box was provided for participants' responses for each type of activity (moderate and vigorous). The daily minute totals of activity were summed to create one daily MVPA variable. This was used to represent overall daily engagement in physical activity and was analyzed as a continuous variable.

3.2.3 Covariates

3.2.3.1 Age

An open text box for respondents to enter their current age at the time of the baseline questionnaire was provided. All respondents were between 35 and 65 years of age. Age was analyzed as a continuous variable.

3.2.3.2 Education

Respondents indicated their highest level of formal education completed. Options included (1) less than high school, (2) some high school, (3) high school graduate (or GED), (4) some college or technical school, (5) college graduate, or (6) post-graduate/professional. Education was dichotomized to (1) college graduate or (2) not college graduate since women who have completed a university education typically complete more MVPA when compared to those with a lower level of education (Kantomaa et al., 2016; Pharr et al., 2020).

3.2.3.3 Race

Respondents indicated which race they primarily identify with and were allowed to check "yes" or "no" to any that applied. Options included White/Caucasian, Black/African American, American Indian or Alaskan Native, Asian or Pacific Islander, other (with provided text box), and don't know. A race variable was dichotomized into two categories of "White" and "non-White" since White adults tend to report higher levels of physical activity versus their non-White counterparts (Armstrong et al., 2018).

3.2.3.4 Baseline physical activity

Four items were used to assess baseline physical activity that were adapted from the PAAT (Meriwether et al., 2006). See the above section on daily diary physical activity for the psychometrics of the PAAT.

Each participant was asked how often they engage in moderate and vigorous activity. Response options included (1) never, (2) less than once a month, (3) about once a month, (4) several times a month, (5) about once a week, or (6) several times a week. A baseline MVPA variable was created for each participant. Baseline MVPA was dichotomized into (1) active or (2) inactive, with active being a combined score >10 (active most days of the week) and inactive scores ranging from 2-10 (active once a week or less).

3.2.3.5 Baseline marital quality

The baseline questionnaire included four questions on marital quality. Participants were asked questions regarding their happiness with their relationship and interactions with their spouse. Questions were adapted from the Couples Satisfaction Index (CSI) (Funk & Rogge, 2007), which has been used previously to measure marital quality (Lamela et al., 2019). The CSI has been shown to have excellent internal consistency ($p<0.001$) and strong convergent validity with other existing measures, such as the Marital Adjustment Test and the Dyadic Adjustment Scale (Funk & Rogge, 2007). This measure has also shown greater precision and power of measurement compared to its counterparts the Marital Adjustment Test and the Dyadic Adjustment Scale (Funk & Rogge, 2007).

The following four items were used in a scale to determine marital quality, “I have a warm and comfortable relationship with my spouse,” “I feel I can confide in my spouse about virtually anything,” “How rewarding is your relationship with your spouse?”, and “Please indicate the degree of happiness, all things considered, of your relationship” The first two items have a response range of “Not at all true” (1) to “Completely true (6). The third item has a response range of “Not at all” (1) to “Completely” (6). The fourth item has a response range of “Extremely unhappy” (1) to “Perfect” (6). The marital quality scale scores can range from 4 to 25 and has an alpha score of α = 0.904 for wives, indicating strong internal consistency (Riffenburgh, 2012).

3.3 Data Analysis

This dissertation used population average models to examine the relationship between positive affect and MVPA among married women. For this analysis, multiple responses from the same couples over time were correlated. The population average model accounts for this correlation directly by modeling the data covariance structure separately from the mean structure. The mean structure estimates the population average effects of the independent variables on the dependent variables such as how positive affect and MVPA are related (SAS Institute, Inc., 2019). The following statistical analyses were used.

Descriptive statistics and regression analyses were performed using SAS version 9.4 (SAS Institute, Inc., 2014). A population average was used to examine whether positive affect is associated with MVPA among married women. Covariates for the analyses included age, education, race, baseline physical activity (MVPA), and baseline marital quality due to their known influence on physical activity behaviors. These covariates are discussed in further detail in previous sections (see page 10 and page 21). The correlations of the covariates and outcome variables can be found in Table 3 below. Missing data was determined based on the availability of diary data, which includes daily minutes of physical activity and daily affect. For the main independent and dependent variables missing data ranged from 2.17% (husbands' happiness) to 2.78% (wives' daily MVPA).

Table 3. Correlations for wives' study variables.

Variable	*n*	*M*	*SD*	Min. of MVPA in past 24 hrs.	Extent felt calm over past 24 hrs.	Extent felt happy over past 24 hrs.
1. Age	1150	45.04	7.58	0.130***	0.000	0.000
2. Education	1150	0.76	0.43	-0.076**	0.000	0.000
3. Race (White, non-White)	1150	0.85	0.36	0.100**	0.000	0.000
4. Baseline MVPA[+]	1150	0.38	0.49	0.244***	0.000	0.000
5. Marital quality scale	1130	19.84	4.12	0.096**	0.000	0.000
6. Husbands' extent calm over past 24 hrs.	1124	0.00	0.64	0.043	0.191***	0.175***
7. Husbands' extent happy over past 24 hrs.	1125	0.00	0.62	0.026	0.218***	0.240***
8. Extent felt calm over past 24 hrs.	1124	0.00	0.72	0.050	-	0.636***
9. Extent felt happy over past 24 hrs.	1124	0.00	0.65	0.069*	0.636***	-
10. Min. of MVPA in past 24 hrs.	1118	51.76	55.52	-	0.050	0.069*

*Note: Variables are for wives unless otherwise noted. MVPA = moderate to vigorous physical activity; * p <0.05 ** p <0.01 *** p <0.001. [+] Baseline MVPA is the combined responses for baseline moderate activity frequency and baseline vigorous activity frequency. Each item was assessed as never (1), less than once per month (2), about once a month (3), several times a month (4), about once a week (5), or several times a week or more (6). Baseline MVPA was dichotomized into (1) active or (2) inactive, with active being a combined score greater than ten and inactive scores ranging from 2-10.*

Normality of the MVPA data was assessed by examining skewness and kurtosis of the data in SAS. A skewness and kurtosis index were determined to indicate non-normality of the data. Outliers were assessed and data were truncated due to unrealistically high daily minutes of physical activity. Also, a generalized linear model was determined to better model the error distribution and was deployed using a Proc Glimmix statement (Ali & Bhaskar, 2016; Grech & Calleja, 2018). Additional details on how outliers were handled and how the appropriate model structure was determined are discussed later in the Data Cleaning section below.

3.3.1 Data cleaning

3.3.1.1 Identifying outliers

Outliers within the daily physical activity minutes data were determined using cutoff points (e.g., three standard deviations above or below the mean) (Aguinus et al., 2013). The population average models were run with and without the outliers to see if the results were significantly influenced (Aguinus et al., 2013). In order to account for the outliers, a truncated daily MVPA variable was created. Both the daily moderate and daily vigorous activity variables were truncated to 180 minutes. This was done following the IPAQ scoring protocol which recommends that any walking, moderate, or vigorous variables exceeding three hours or 180 minutes be truncated to equal 180 minutes (IPAQ Research Committee, 2004). These truncated totals (i.e., daily moderate and daily vigorous activity totals) were then used to create a daily MVPA variable. Using this truncation, no MVPA variable used was greater than 360 minutes. This method was chosen to preserve as many responses as possible.

3.3.1.2 Zero inflation in daily MVPA data

Within the daily MVPA variable data, there were a high number of days that had no physical activity recorded (n=307). These zero values can be considered censored data points. A censored value is when the reported value is less than a specified value, greater than a specified value, or an interval (Millard & Neerchal, 2001). These zeroes are a problem as the best fitting distribution to the positive valued data is the Gamma distribution which is a strictly positive distribution (zero is not in the support). To handle this, a very small number of minutes (0.0167) was added to each zero entry. Adding a small value such as this, allows the model to use all the available MVPA data, instead of dropping the zero entries and is motivated by the idea that the zero entries arise from left censoring (Wilks, 1990). Left censoring occurs when a data value is below the limit of detection and the true value is unknown (Canales et al., 2018; Millard & Neerchal, 2001). In this study, the individuals that recorded zero minutes of MVPA may have in fact completed some type of activity. For example, if the individual only considers MVPA to be a dedicated workout time, they might not have recorded the five minutes they spent walking from their car to a store or the stairs they climbed at the office. Other strategies for handling zeros in the data include creating a two-part model that would model the zeros separately from the positive values, however this intense analytic process is beyond the scope of this dissertation as user friendly estimation procedures that both account for the zeroes and the correlation within subjects was not found.

3.3.1.3 Centering

Another data cleaning step was to center the daily happy and calm variables. Within person centering involves subtracting the person-specific average from the raw observation (Enders & Tofighi, 2007). In most cases, individuals' daily positive affect scores are going to be more similar to their own scores rather than other individuals in the sample. Utilizing within person centering allows the data to capture the fluctuations in each person's positive affect relative to their own average positive affect score across the ten days (Bolger & Laurenceau, 2013). Within person centering was done for both husbands' and wives' positive affect variables since all were used as predictors in the models. In this case, the average positive affect score for calm and happy was determined for the ten days. This was then subtracted from each daily score for each individual. The centered variables for calm and happy were then used in each of the three analysis models.

3.3.1.4 Testing model fit and robustness

Once all covariates and variables were finalized, model fit was tested for the same day model. The MVPA values were simulated from the fitted model and their distribution was compared to the actual MVPA values using a Q-Q plot. Data points on the scatter plot that follow a straight line indicate a good fit of the model (i.e., the model is able to reproduce the observed MVPA distribution). The Q-Q plot was created, and it was determined that the models were a reasonable fit. The robustness of the model was also tested. The small value (0.0167) that was previously added to the daily MVPA variable was adjusted to see if the resulting coefficients were altered. A new value of 0.0001 was added to the zeroes instead and it was determined that there was not a significant change in the coefficients. There was no change to the significance of the predictor variables; those that were significant using 0.0167 remained significant using 0.0001 and vice versa. There were no changes to the positive affect coefficients. The largest changes observed were the moderate exercise frequency (16.67% increase from 0.12 to 0.14) and education covariates (8.11% increase from 0.37 to 0.40). This indicates that the smoothing value of 0.0167 is an appropriate value (i.e., model results are not sensitive to the particular value chosen). Similar Q-Q plots were created for the time-lagged model and the model containing husbands' and wives' positive affect. The model with husbands and wives was found to be a reasonable fit. The time-lagged model had issues of non-convergence, and it was determined that the correlation structure needed to be adjusted (details in the paragraph to follow). Once the non-convergence was handled, model fit was tested, and the time-lagged model was also found to have a reasonable fit.

The correlation of within subject effects for the time-lagged model was originally modeled using random intercepts for each individual within a multilevel model framework, but the estimation procedure failed to converge. This necessitated the search for an alternate way to model the correlation of MVPA values from the same couple over time and the population average model was chosen. This model requires determining a covariance structure that was appropriate for this data. To do this, a covariance comparison was done between different correlation structures (e.g., compound symmetry (CS), Huynh-Feldt (HF), and First Order Factor Analytic (FA (1))) and the raw data (Kincaid, NA). A 9x9 covariance matrix was created for each structure type. The raw data was also converted to the log scale for easier comparison to the proposed model structures. The covariance structures were compared both in table and graph form to determine which was the best fit when compared to the raw data. Based on these comparisons the model structure CS was determined to be the best model structure for the data.

3.4 Specific Aims and Hypotheses

Specific Aim: To examine the relationship between positive affect and subsequent moderate-vigorous physical activity (MVPA) behaviors of women.

Hypothesis A: On days where wives have indicated higher positive affect, they will have higher levels of same day MVPA.

Hypothesis B: On days where wives have higher positive affect, they will have higher levels of next day MVPA.

Hypothesis C: Husbands' positive affect will impact wives' same day MVPA beyond the impact of wives' own daily positive affect.

To assess wives' MVPA behavior, a multilevel model using the Glimmix Procedure (PROC Glimmix) in SAS version 9.4 was created. Three models were built in a series of steps, beginning with the unconditional means model (e.g., intercept-only, including no predictors). The unconditional model was specified as:

$$WivesMVPA_{ij} = \beta_0 + r_{ij}$$

where $WivesMVPA_{ij}$, individual j's level of MVPA on day i, is modeled as a function of β_0, the overall average MVPA, and r_{ij} a series of residuals for each observation. The root mean square error (RMSE) was also calculated for each hypothesis using the following equation: √(total prediction error/sample size) (Barnston, 1992). The RMSE is a measure of model fit in that it is essentially the standard deviation of the differences between the modeled and observed values. To put the RMSE in context it was compared to the mean using the scatter index (SI), which was calculated using the equation (RMSE/mean MVPA) x 100 (Neill & Hashemi, 2018). All RMSE findings can be found in the following results chapter.

Additionally, the following equation shows the covariates (age, education, race, baseline MVPA, and baseline marital quality) that were included in all final models.

$$WivesMVPA_{ij} = \beta_0 + \beta_1(\text{Age}_j) + \beta_2(\text{Education}_j) + \beta_3(\text{Race}_j) + \beta_4(\text{BaselineMVPA}_j) + \beta_5(\text{BaselineMarQual}_j) + r_{ij}$$

These five covariates will be referred to as $\beta_{1\text{-}5}(\text{covars}_j)$ in all model notation from here onward in the text.

3.4.1 Hypothesis A – Model A

Hypothesis A examined the relationship between wives' daily positive affect (happy and calm) and their same day MVPA. This was achieved by adding level one predictors (wives' happy and calm) to the unconditional means model. The wives' positive affect variables were within-person centered. The following model was used:

$$WivesMVPA_{ij} = \beta_0 + \beta_{1\text{-}5}(covars_j) + \beta_6(Wcalm_{ij}) + \beta_7(Whappy_{ij}) + r_{ij}$$

where $WivesMVPA_{ij}$, individual j's level of MVPA on day i, was modeled as a function of β_0, the overall average MVPA, $\beta_{1\text{-}5}$, the population average effects of each of the covariates, β_6, the population average effect of calm on MVPA, β_7, the population average effect of happy on MVPA, and r_{ij} a series of residuals for each observation.

3.4.2 Hypothesis B – Model B

Hypothesis B examined the relationship between wives' daily positive affect (calm and happy) and their next day MVPA. To do so, a time-lagged model was created. In a time-lagged model, the independent variables (wives' calm and happy, within-person centered) on day i were correlated with the outcome (wives' MVPA) on day i + 1 for assessment (Kleiman, 2017). The following model was used:

$$WivesMVPA_{i+1,j} = \beta_0 + \beta_{1\text{-}5}(covars_j) + \beta_6(Wcalm_{ij}) + \beta_7(Whappy_{ij}) + r_{ij}$$

where $WivesMVPA_{i+1,j}$, individual j's level of MVPA on day i+1, was modeled as a function of was modeled as a function of β_0, the overall average MVPA, $\beta_{1\text{-}5}$, the population average effects of each of the covariates, β_6, the population average effect of calm on MVPA, β_7, the population average effect of happy on MVPA, and r_{ij} a series residuals.

3.4.3 Hypothesis C – Model C

Hypothesis C examined the relationship between both husbands' and wives' daily positive affect (calm and happy) and wives' same day MVPA. This analysis specifically looked at whether or not husbands' positive affect is associated with wives' same day MVPA beyond the impact of wives' own positive affect. This was achieved by adding additional level one predictors (husbands' calm and happy). All positive affect variables (for husbands and wives) were within-person centered. The following model was used:

$$WivesMVPA_{ij} = \beta_0 + \beta_{1\text{-}5}(\text{covars}_j) + \beta_6(\text{Wcalm}_{ij}) + \beta_7(\text{Whappy}_{ij}) + \beta_8(\text{Hcalm}_{ij}) + \beta_9(\text{Hhappy}_{ij}) + r_{ij}$$

where $WivesMVPA_{ij}$, individual j's level of MVPA on day i, was modeled as a function of β_0, the overall average MVPA, $\beta_{1\text{-}5}$, the population average effects of each of the covariates, β_6, the population average effect of calm on MVPA, β_7, the population average effect of happy on MVPA, β_8, the population average effect of husbands' calm on MVPA, β_9, the population average effect of husbands' happy on MVPA, and r_{ij} a series of residuals.

CHAPTER 4. RESULTS

The overall aim of these analyses was to examine the relationship between positive affect and subsequent physical activity behaviors of women. Three hypotheses were tested related to this relationship and the results are presented here.

4.1 Sample Characteristics

A total of 115 couples (heterosexual couples only) were included in the final analyses, which is approximately 30% of the total sample. The average age of husbands and wives was 46 (SD ± 8.11) and 45 years (SD ± 7.62), respectively. Total ages ranged from 35 to 65 years for both. The majority of the sample was White (84% of husbands and 85% of wives) and had a college degree or higher (70% of husbands and 76% of wives). A full description of the sample demographics can be found in Chapter 3, Table 2.

4.2 Model Fit

Before final analyses were completed, model fit was tested in order to determine if the proposed models were able to accurately reproduce the observed MVPA distribution. In order to test model fit, Q-Q plots were created to compare the raw MVPA values to the simulated values. Below (Figures 4 and 5) are the findings for models A and C. When the data points follow a straight line, there is good fit of the model (i.e., the model is able to reproduce the observed data distribution). The Q-Q plots for both models A and C show good fit for up to approximately 200 minutes of MVPA. The fit model tended to underpredict values that were observed as being greater than 200 minutes but was able to reproduce the maximum observed value. The fit was deemed acceptable for this analysis.

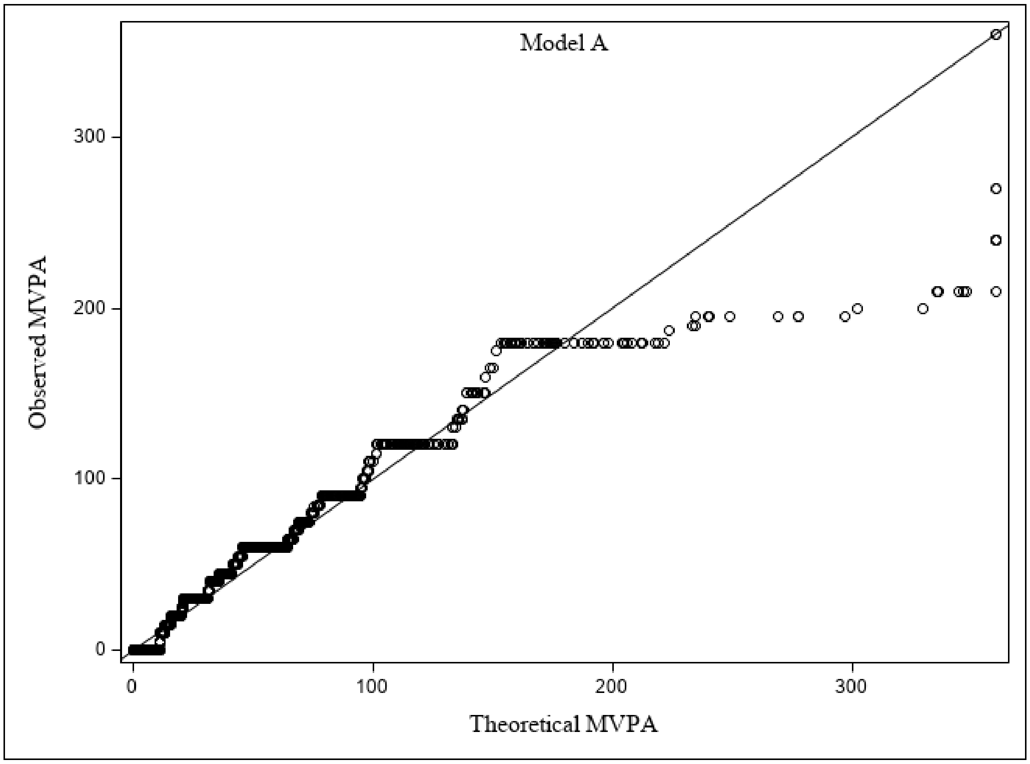

Figure 4. Q-Q plot for Model A.

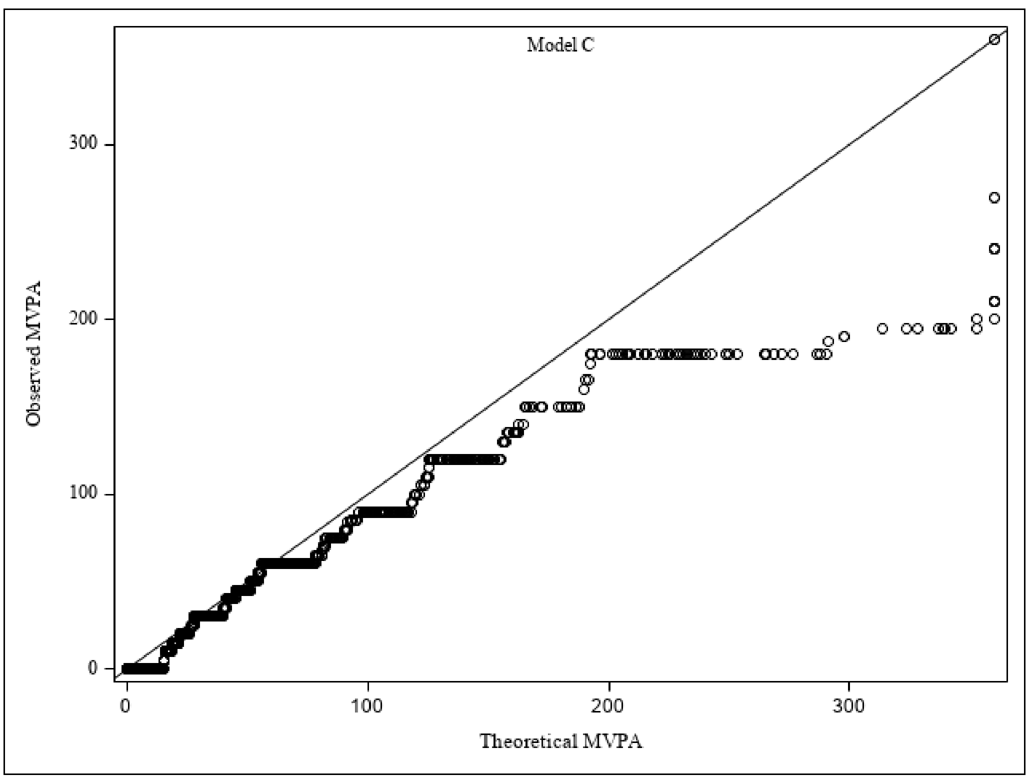

Figure 5. Q-Q plot for Model C.

Model C, the time-lagged model, had issues with non-convergence which were related to a model misspecification of the covariance structure of the residuals. At that time, it was determined that a correlation structure adjustment was needed to correct the non-convergence. Comparisons were made between Compound Symmetry (CS), Huynh-Feldt (HF) and First Order Factor Analytic (FA(1)) correlation structures and the estimated covariance matrix from the raw MVPA data. Below are the 9x9 covariance matrices, presented as heat maps (Figures 6-9). The table labeled as raw is the covariance of the response variable, MVPA. The following three sub-tables give the modeled covariance matrices of the residuals under the assumptions of CS, HF, and FA(1) respectively. Note that the heat maps have different scales.

Figures 10-18 display line plots of the individual rows of these matrices (response and three candidate residual covariance structures) for comparison. The candidate model which tracks most closely to the raw data line (orange) is the best fitting structure for each panel of the figure. Evaluation of the graphs showed which structure type most closely estimated the raw MVPA data. From these quantitative and visual comparisons, it was determined that the CS structure was the best fit for the time-lagged model. Final analyses of model C were made using the CS structure within the PROC GLIMMIX command.

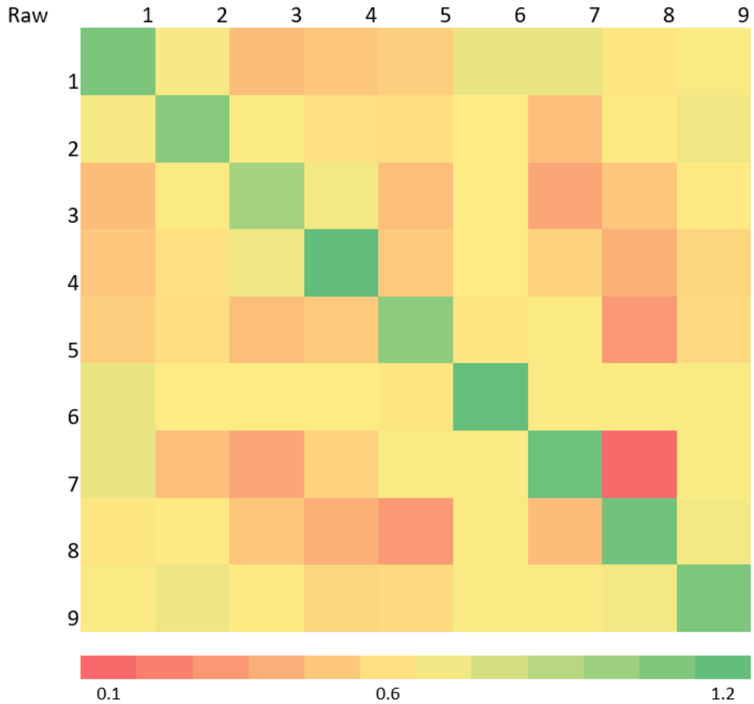

Figure 6. Heat map of the raw covariance structure over 9 days.

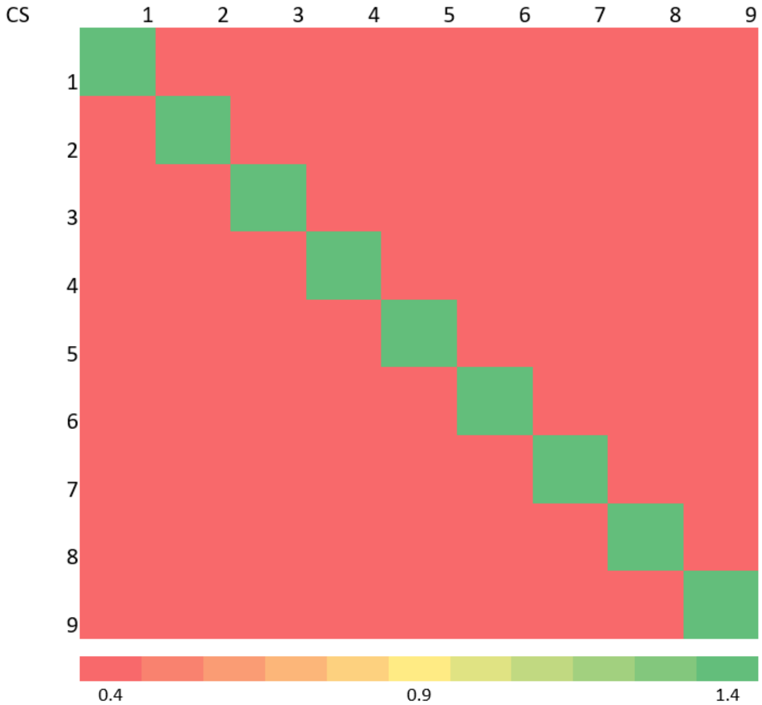

Figure 7. Heat map of the Compound Symmetry covariance structure over 9 days.

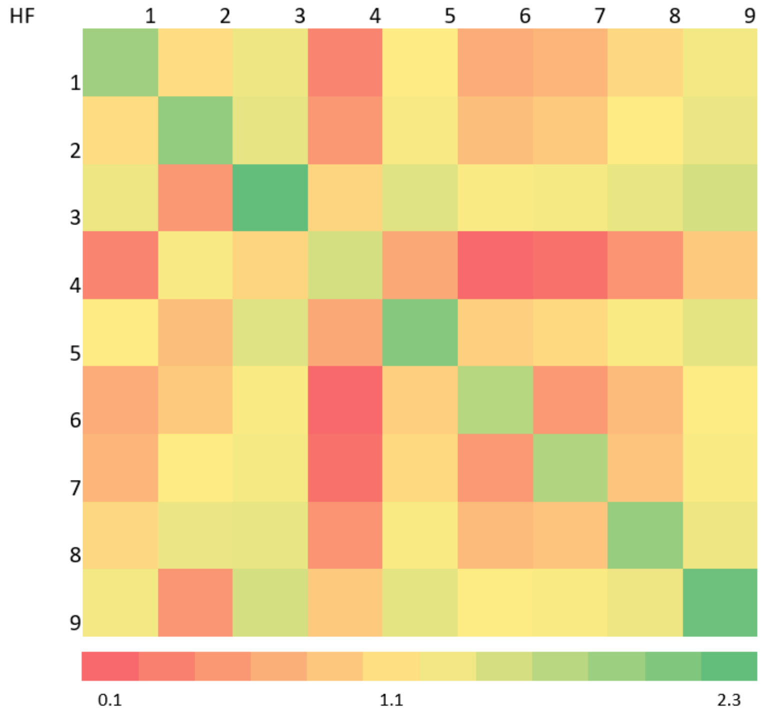

Figure 8. Heat map of the Huynh-Feldt covariance structure over 9 days.

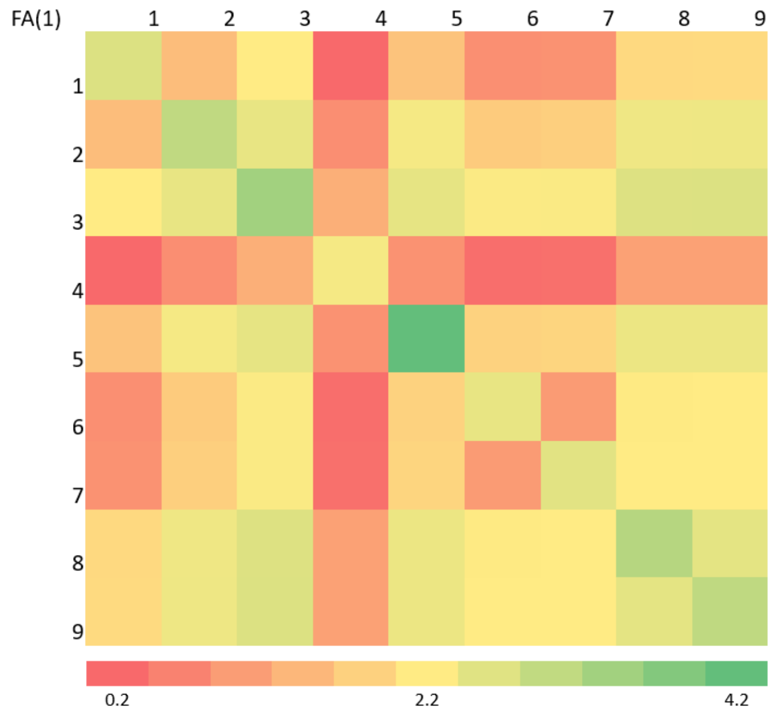

Figure 9. Heat map of the First Order Factor Analytic covariance structure over 9 days.

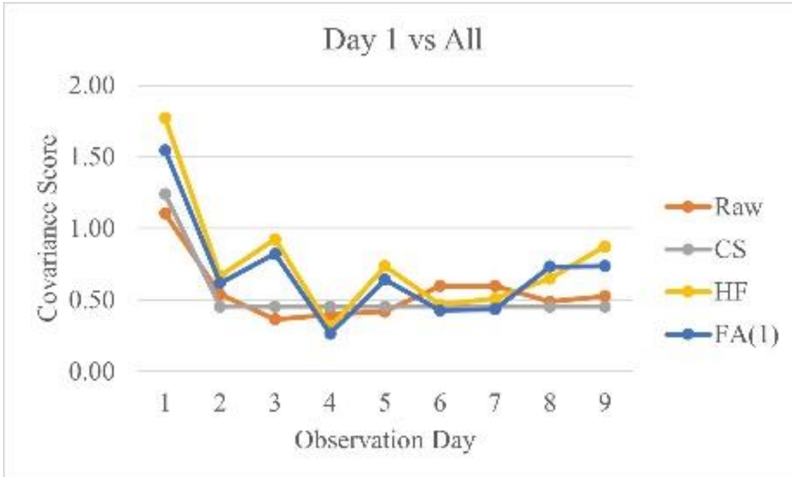

Figure 10. Plot of the raw data versus the covariance structure options for day 1.

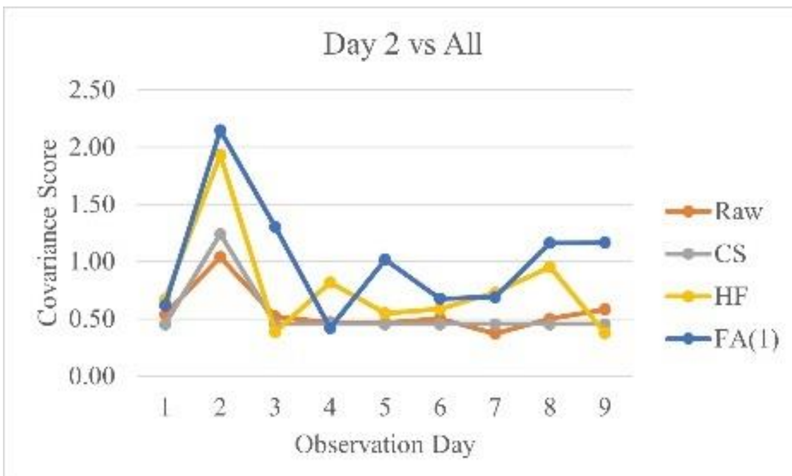

Figure 11. Plot of the raw data versus the covariance structure options for day 2.

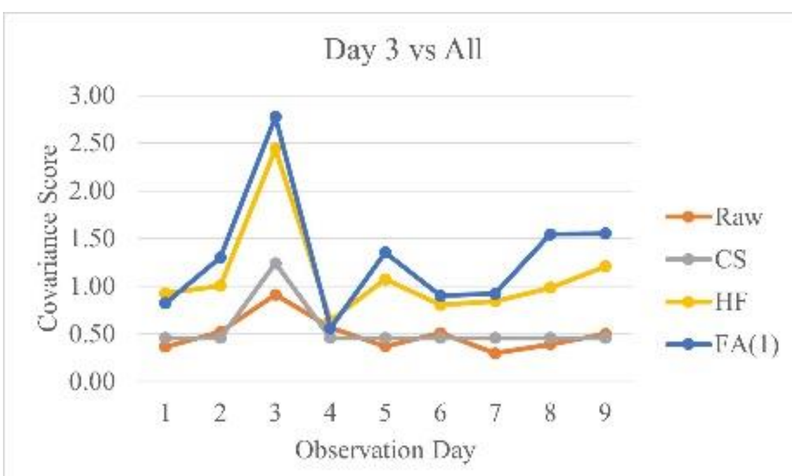

Figure 12. Plot of the raw data versus the covariance structure options for day 3.

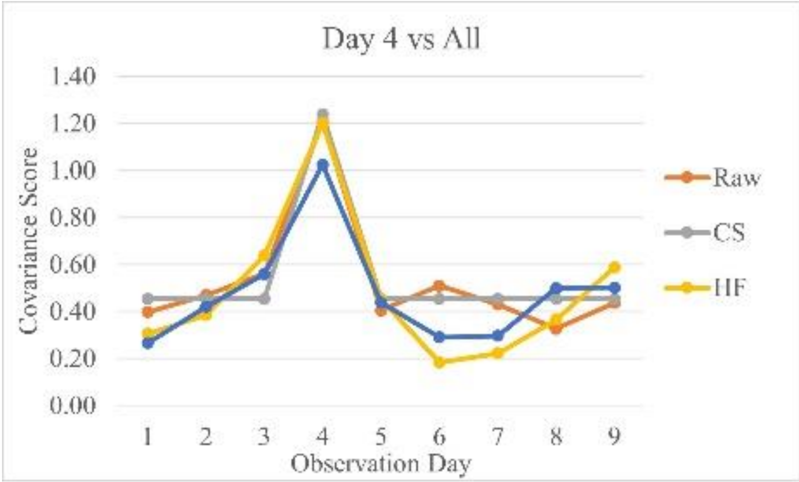

Figure 13. Plot of the raw data versus the covariance structure options for day 4.

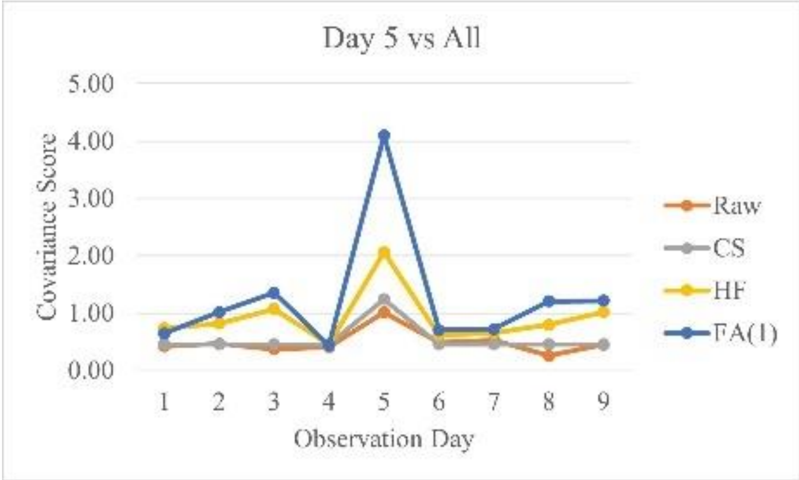

Figure 14. Plot of the raw data versus the covariance structure options for day 5.

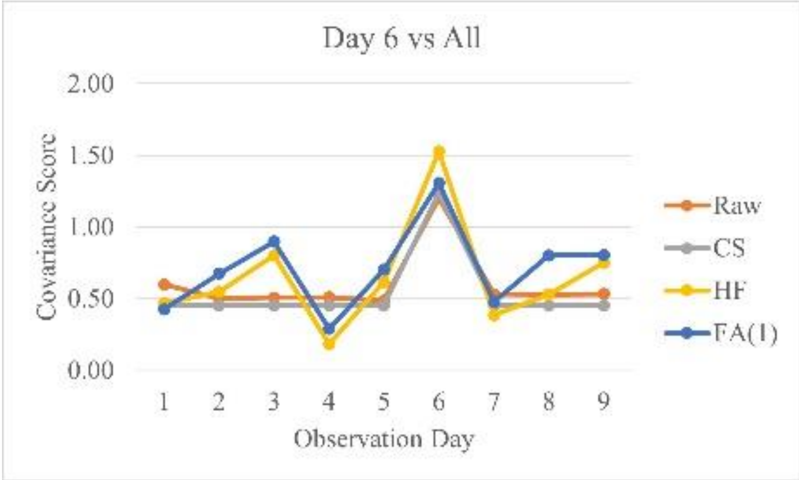

Figure 15. Plot of the raw data versus the covariance structure options for day 6.

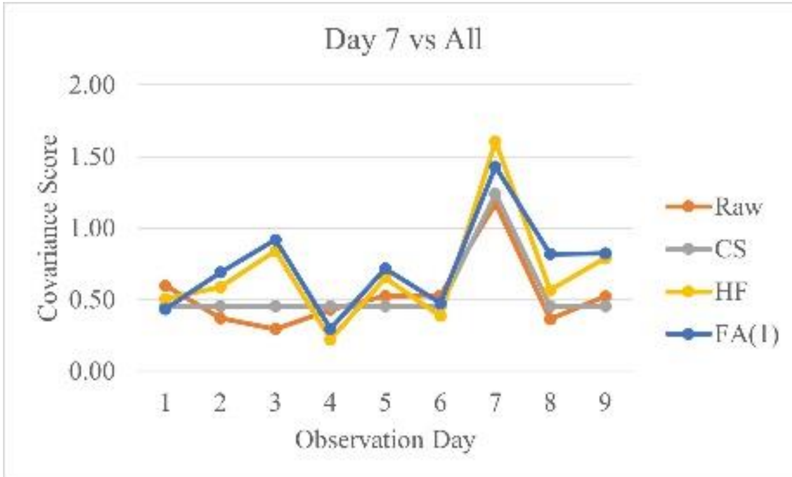

Figure 16. Plot of the raw data versus the covariance structure options for day 7.

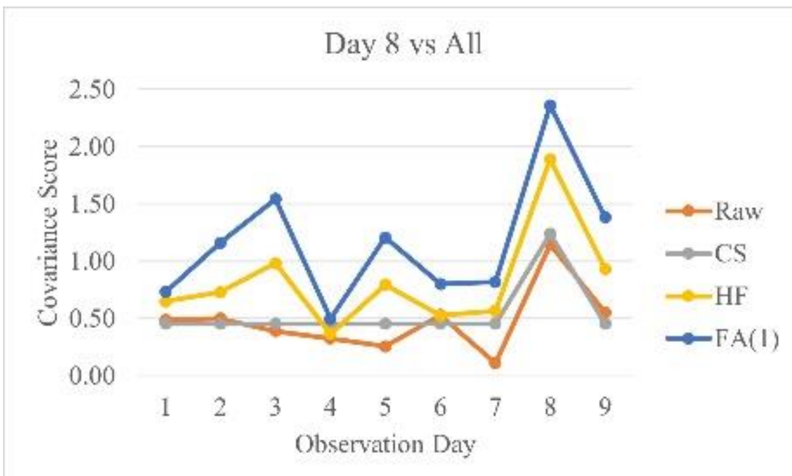

Figure 17. Plot of the raw data versus the covariance structure options for day 8.

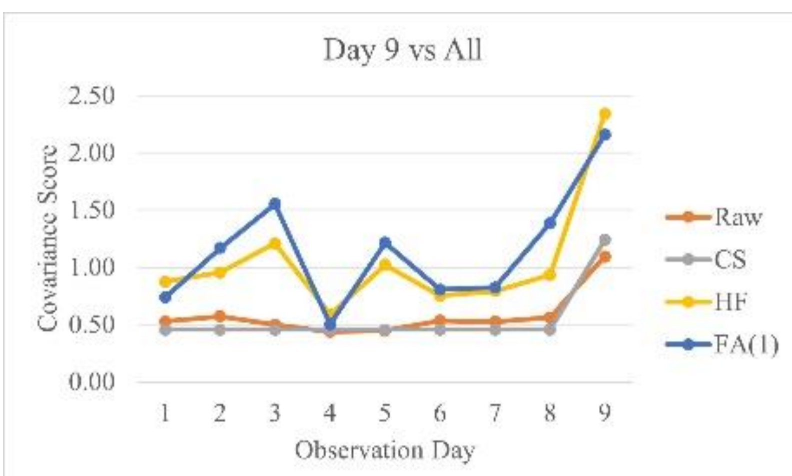

Figure 18. Plot of the raw data versus the covariance structure options for day 9.

4.3 Results

4.3.1 Unconditional model

An unconditional multilevel model (with intercept-only, including no predictors) was fit in SAS version 9.4 using the PROC GLIMMIX command. This unconditional model served as the baseline comparison for all subsequent models (Raudenbush & Bryk, 2002).

The root mean square error (RMSE) was also calculated for each hypothesis using the following equation: √(total prediction error/sample size) (Barnston, 1992). For the unconditional model the RMSE was found to be 73.25. The RMSE is a measure of model fit in that it is essentially the standard deviation of the differences between the modeled and observed values. To put the RMSE in context it was compared to the mean using the scatter index (SI), which was calculated using the equation (RMSE/mean MVPA) x 100 (Neill & Hashemi, 2018). The SI for the unconditional model is 141.5% which means the standard deviation is approximately 42% larger than the mean of MVPA. This measurement indicates that there is a great deal of variability in MVPA that is not accounted for by the variables chosen in this model. This percentage will be used as a comparison for prediction error with each subsequent model. A summary of the results for each model can be found in Table 4.

4.3.2 Model A (Hypothesis A)

On days when wives have indicated higher positive affect, they will have higher levels of same day MVPA. This hypothesis was partially supported by the final analyses. In this model, the RMSE was calculated and found to be 73.18. The SI for model A is 141.4% which means the standard deviation is 41% larger than the mean of MVPA. This measurement indicates that there is a great deal of variability in MVPA that is not accounted for by the variables in this model.

Other factors besides the positive affect variables and chosen covariates are impacting same day MVPA. When compared to the 42% SI of the unconditional model, it can be seen that this model has a small improvement of 1%.

Since the model uses the log link, the regression coefficients have a multiplicative effect. In order to translate the estimated effects back onto the original minutes scale, coefficients are exponentiated and multiplied by the mean daily MVPA amount of 51.76 minutes. Significant covariates for this model include baseline MVPA and education. Compared to individuals that were active, those that were not active (active once a week or less) at baseline completed 22 minutes (41.73%) less of same day MVPA ($\beta = -0.54$, $p < 0.01$) on average. Additionally, compared to individuals with a college degree, those with less than a college degree completed 25 minutes (49.18%) more of same day MVPA ($\beta = 0.40$, $p < 0.05$) on average.

Wives' self-rated happiness was significantly associated with same day MVPA ($\beta = 0.15$, $p < 0.01$), which suggests that differences in wives' happiness are associated with physical activity behavior on the same day. For every one unit increase in happiness (5-point scale), wives completed 16.18% or 8.38 minutes more same-day MVPA for a maximum difference of 94.31 minutes between the lowest (1) and highest (5) levels of self-rated happiness on average. This value was calculated using the following equation: exp(4x0.15)(51.756), where four is the difference between the highest and lowest values of happiness, 0.15 is the MVPA coefficient, and 51.756 is the mean daily minutes of MVPA. Wives' calmness was not significant ($\beta = -0.01$, $p = 0.766$), which indicates no evidence for an effect on MVPA on the same day. The intercept was significant ($\beta = 2.78$, $p < 0.0001$), indicating that the mean daily MVPA was greater than zero.

4.3.3 Model B (Hypothesis B)

On days when wives have higher positive affect, they will have higher levels of next day MVPA. This hypothesis was not supported by the final analyses. The RMSE was calculated and found to be 72.89. The SI for model B is 140.82% which means the standard deviation is 41% larger than the mean of MVPA. This measurement indicates that there is a great deal of variability in MVPA that is not accounted for by the variables in this model. Other factors besides the positive affect variables and chosen covariates are impacting next day MVPA of wives. When compared to the 42% SI of the unconditional model, it can be seen that this model has a 1% lower prediction error. The time-lagged model had the same SI as the same-day model (model A).

Significant covariates for this model include baseline MVPA, marital quality score, and education. Compared to individuals who were active, those that were not active (active once a week or less) at baseline completed 21 minutes (31.14%) less of next day MVPA ($\beta = -0.53$, $p < 0.01$) on average. For the individuals that had higher marital quality scores (which could range from 4 to 25 on a continuous scale), they completed more next day MVPA ($\beta = 0.03$, $p < 0.05$), approximately 1.58 minutes (3.05%) on average. Finally, compared to individuals with a college degree, those with less than a college degree completed 22 minutes (43.33%) more of next day MVPA ($\beta = 0.40$, $p < 0.05$) on average.

Neither wives' self-rated happiness nor calmness were significantly associated with next day MVPA ($\beta = 0.11$, $p = 0.0601$ and $\beta = 0.01$, $p = 0.9033$), which suggests that differences in wives' positive affect may not result in more or less next day MVPA. It should be noted that wives' happiness was approaching significance with a *p*-value of 0.0601. The intercept was significant ($\beta = 2.65$, $p < 0.0001$), indicating that the mean daily MVPA was greater than zero.

4.3.4 Model C (Hypothesis C)

Husbands' positive affect will impact wives' same day MVPA beyond the impact of wives' own daily positive affect. This third hypothesis was not supported by the final analyses. The RMSE was calculated and found to be 72.65. The SI for model C is 140.36% which means the standard deviation is 40% larger than the mean of MVPA. This measurement indicates that there is a great deal of variability in MVPA that is not accounted for by the variables in this model. Other factors besides the positive affect variables and chosen covariates are impacting same day MVPA. When compared to the 42% SI of the unconditional model, it can be seen that this model has a 2% lower prediction error. Model C has the lowest RMSE of all three models presented, though the difference is practically very small, and all three models leave much of the variability unexplained.

Significant covariates for this model include baseline MVPA and education. Compared to individuals that were active, those who were not active (active once a week or less) at baseline completed 22 minutes (42.31%) less of same day MVPA ($\beta = -0.55$, $p < 0.01$). Individuals with less than a college degree completed 25 minutes (49.18%) more of same day MVPA ($\beta = 0.40$, $p < 0.05$) when compared to those with college degree or higher.

Similar to model A, wives' happiness was significantly associated with same day MVPA ($\beta = 0.15$, $p < 0.01$), which suggests that differences in wives' happiness are associated with more same day MVPA. The stability of the estimate across models suggests that the finding is fairly robust. Similar to model A, this effect is equivalent to 8.38 more minutes or a 16.18% increase on average. Once again, wives' calmness was not significant ($\beta = -0.03$, $p = 0.6$), which indicates it may not result in more or less MVPA on the same day. Neither husbands' calm or happy variables were significant in predicting wives' same day MVPA ($\beta = 0.09$, $p = 0.066$ and $\beta = -0.03$ $p = 0.616$, respectively), but it should be noted that husbands' calmness was approaching significance with a *p*-value of 0.066. The intercept was significant ($\beta = 2.78$, $p < 0.0001$), indicating that the mean daily MVPA was greater than zero.

Table 4. Model results for wives' MVPA, N=1150.

	Value of category	Unconditional model (n=1118)	Model A (n=1098)	Model B (n=972)	Model C (n=1097)
		β (± SD)	β (± SD)	β (± SD)	β (± SD)
Intercept		3.94 (± 0.07)***	2.78 (± 0.56)***	2.65 (± 0.58)***	2.78 (± 0.56)***
Affect Variables					
Wives' happy		-	0.15 (± 0.05)**	0.11 (± 0.06)$^{+}$	0.15 (± 0.05)**
Wives' calm		-	-0.01 (± 0.05)	0.01 (± 0.05)	-0.03 (± 0.05)
Husbands' happy		-	-	-	-0.03 (± 0.05)
Husbands' calm		-	-	-	0.09 (± 0.05)$^{+}$
Covariates					
Baseline MVPA	Active	-	-	-	-
	Not active	-	-0.54 (± 0.14)**	-0.53 (± 0.15)**	-0.55 (± 0.14)**
Age		-	0.02 (± 0.01)	0.02 (± 0.01)	0.02 (± 0.01)
Marital quality		-	0.03 (± 0.02)	0.03 (± 0.02)*	0.03 (± 0.02)
Race	White	-	-	-	-
	non-White	-	-0.13 (± 0.20)	-0.12 (± 0.21)	-0.13 (± 0.20)
Education	College degree	-	-	-	-
	< College degree	-	0.40 (± 0.17)*	0.36 (± 0.17)*	0.40 (± 0.17)*
Fit Statistic					
χ^2		799.46	847.44	757.35	847.73
-2 Res Log Pseudo-Likelihood		3026.33	3076.21	2478.06	3083.31

*Note. Unstandardized estimates presented, with standard errors in parentheses. Model based on 10 days nested within 115 participants, with a total of 1150 observations used. * p < .05, **p < .01, ***p < .001,* $^{+}$ *p <0.01.*

CHAPTER 5. DISCUSSION

The purpose of this study was to examine the relationship between positive affect and subsequent physical activity behaviors of women utilizing Fredrickson's BABT as a guide (Fredrickson, 2004). Through a secondary data analysis of the HARP data, this study explored three hypotheses: (A) on days where wives have indicated higher positive affect (i.e., happy and calm), they will have higher levels of same day MVPA, (B) on days where wives have higher positive affect, they will have higher levels of next day MVPA, and (C) Husbands' positive affect will impact wives' same day MVPA beyond the impact of wives' own daily positive affect. The positive affect variables happy and calm were used as proxies for general positive affect/predictors of wives' MVPA, along with covariates previously determined to be influential in physical activity research. Results partially supported hypothesis A but not B or C. There were also results trending towards significance that should be noted.

5.1 Summary of the Findings and Discussions

This study aimed to help define the relationship between two measures serving as proxies of positive affect and subsequent MVPA behaviors of married adult women. The results suggest that on days where wives were happier positive affect was associated with more same day MVPA, but calmness was not associated. Additionally, neither wives' calmness nor happiness significantly predicted next day MVPA. Lastly, only wives' happiness was found to have a significant association with same day MVPA when looked at in conjunction with their husbands' positive affect. Neither of the positive affect variables for husbands were found to be significantly associated with wives' same day MVPA, but husbands' calmness was approaching statistical significance.

5.1.1 Theory

The finding that married women's self-rated happiness is significantly associated with greater MVPA on the same day supports the tenets of Fredrickson's (2004) BABT and previous work surrounding positive affect and health behaviors. Fredrickson posits that positive emotions (in this case happy and calm) can lead to enhanced health (Fredrickson, 2001). Participants were asked to rate their positive affect over the last 24 hours. Their response options included (1) not at all, (2) a little, (3) moderately, (4) a lot, and (5) extremely, with the higher values indicating higher positive affect (e.g., happiness or calmness). The results of this analysis show that with every one-point increase in wives' daily happiness, there is an association with more MVPA on the same (approximately eight minutes (16.18%) of MVPA). Over the course of one week, a one-point increase in daily happiness is equivalent to 56 additional minutes of MVPA completed on average.

If an individual is able to experience increased positive emotions, they may be able to improve their MVPA over the course of the day. Fredrickson and BABT posit that a person's positive affect is ever changing, but the resources one obtains during these moments of positivity are longer lasting (Fredrickson, 2004). This enduring change an individual may experience due to positive emotion states could eventually lead to increased healthy behaviors, such as physical activity. Examining other components of the BABT (e.g., resilience, skills, knowledge, and/or novel thoughts) may provide insight into additional ways positive affect is associated with physical activity behaviors of women.

5.1.2 Affect descriptor classifications and measurement timing

In all analyses, married women's self-rated happiness was found to be significantly associated with same-day MVPA, while their calmness never demonstrated a significant relationship with MVPA. This could be due to the nature of each positive affect variable. High positive affect is when an individual has high energy, full concentration, and full engagement (Watson et al., 1988). While both happy and calm fall into this category of high positive affect (Watson & Clark, 1994), it is possible that calm is not as strong of an indicator of positive affect as happy. The PANAS-X manual outlines happy as part of the “Basic Positive Emotion Scale” of “Joviality”, while calm is part of the “Other Affective States” scale of “Serenity.” Joviality is defined as being characterized by good-humored cheerfulness (Merriam-Webster, 2022a), while serenity (the state of being serene) is defined as utter calm and unruffled rest or quietude (Merriam-Webster, 2022b). From these definitions it can be seen that while happy and calm conceptually are both measured as aspects of positive affect, they are unique emotional states. Happy, as part of the joviality scale, is a more upbeat state while calm, as part of the serenity scale, is a more low-key state. This difference in classification could contribute to why happy was significantly associated with MVPA and calm was not.

Timing of affect measurement is also important to consider in this research. According to the PANAS, affect can be measured on a variety of time scales ranging from the last 24 hours to the past month (Watson & Tellegen, 1988). If a healthcare provider is going to measure a patient’s positive affect, they should carefully consider which time scale will provide the most informative results. Measuring positive affect on time scales or at different times during the day, may provide insight on what specific types of positive affect emotions are associated with different types of physical activity. Assessing positive affect over the last 24 hours may provide valuable information on what influenced the patient’s leisure time activity, while assessment over the last month could indicate long term associations with physical activity, including MVPA. Additionally, assessing an individual’s affect early in the morning may yield different results than assessing it in the late afternoon or evening after they have completed a workday.

5.1.3 Physical activity type and intensity

While the focus of this dissertation was on overall MVPA, utilizing different types (e.g., occupational vs. leisure) and intensities (e.g., light instead of MVPA) of physical activity may have yielded different relationships with positive affect. Past research has shown that positive affect is related to physical activity outcomes (Forster et al., 2021), but not all findings were surrounding overall MVPA throughout the day. Specific after-work MVPA has been found to be predicted by positive affect in employed adults aged 25 to 65 years (Niermann et al., 2016). Participants' occupations were masked within this data set, but one's job (including working from home/remotely) may play a role in the amount of physical activity completed during the day. Furthermore, leisure time physical activity and MVPA may be influenced by positive affect in unique ways. Since happy and calm may be considered different measurements of positive affect, one positive affective state could influence certain types of physical activity more than another. For example, those that are in a calm affective state may choose to participate in more light-intensity or relaxing leisure time activities (e.g., going for a walk or yoga), while those in a happy affective state may participate in more vigorous intensity activity (e.g., aerobic activity).

5.1.4 Physical activity in a disease context

Previous research has also been conducted with populations manifesting specific disease states. Individuals who are obese (Carels et al., 2007; Emerson et al., 2017) and have coronary heart disease (Sin et al., 2015) showed significant associations between positive affect and increased physical activity. On the other hand, those that survived breast cancer (Castonguay et al., 2017), or had a joint replacement (Powell et al., 2009) all had significant associations between increased negative affect and increased physical activity. It is possible that individuals who have been diagnosed with a chronic disease or have recently undergone a medical procedure will have other factors impacting their physical activity behavior including physical limitations, pain, and/or fatigue and those should be taken into consideration in future studies.

5.1.5 Partner influence

Results of this dissertation indicate that husbands' positive affect is not significantly associated with wives' same day MVPA, above and beyond the wives' own positive affect. While husbands' positive affect may be contributing to their wives' views on marital quality and/or marital satisfaction, which can influence MVPA (Thomas et al., 2022), it may not be the only way husbands are influencing of their wives' physical activity behaviors.

Partner happiness has been shown to predict better health behaviors among couples, including more frequent exercise when one has a happy partner (Chopik & O'Brien, 2017). Even when taking into consideration one's own happiness, the spouses' level of happiness has been shown to be associated with better self-health, including more frequent exercise, above and beyond one's own happiness (Chopik & O'Brien, 2017). This finding held in both cross-sectional and longitudinal assessments (Chopik & O'Brien, 2017).

While husbands' positive affect may not directly influence wives' physical activity behaviors above and beyond their own positive affect in this study, it may be a moderating variable of wives' positive affect. Next steps of this research examining the relationship between positive affect and physical activity will include assessing the potential for moderating variables. Further studies are needed to examine the interactions that may exist between husbands' and wives' positive affect and physical activity.

5.2 Implications

5.2.1 Theory

There are several important implications of this study. Theoretically, this analysis was guided by Fredrickson's BABT (Fredrickson, 2001) which incorporates positive affect to enhance health behaviors (e.g., physical activity). This theory incorporates other dimensions of the individual's life that should be considered when trying to make a behavior change (e.g., skills, knowledge, and resiliency). For the purpose of this study, these items were not included, but future work should consider their inclusion especially knowing the large percentage of variability that was not explained with the current models. While not all hypotheses were supported, this work does open the door for future studies to continue to build off the BABT framework to understand influences on physical activity behaviors. Direct indicators of husbands' social support could be utilized in future analyses, as well as other measures of physical activity.

5.2.2 Health

This study found that increases in happiness as a measure of positive affect are associated with approximately eight-minutes more of same-day MVPA on average. While eight minutes may seem small, there are positive health outcomes associated with small improvements in physical activity levels. High-intensity short bouts of MVPA are related to a lower body mass index (BMI) and decreased risk of obesity, even in increments of only one to two minutes (Fan et al., 2013). In women specifically, shorter bouts of MVPA were found to be more influential in decreasing BMI than long bouts (Fan et al., 2013). Similarly, a significant relationship has been seen between more MVPA minutes and decreased HbA1c levels of type 2 diabetics (Garcia et al., 2017), reduced risk of mortality between 9-13% (Glebel et al., 2015), and increased bone mineral density, lower limb muscle strength, and shorter timed up and go test results (Wu et al., 2016). Combined with decreased sedentary time, small improvements in MVPA minutes could have potential positive health implications and physiological adaptations, especially for those diagnosed with chronic health conditions (Garcia et al., 2017; Glebel et al., 2015).

5.2.3 Healthcare practice

Finally, the practice implications of the outcomes should be discussed. The results show that an individual’s happiness is associated with their participation in MVPA during the same day. Positive affect is a fluctuating state and can be influenced by multiple factors in patients’ lives (Rottenberg et al., 2005). Positive affect has been shown to play a role in individuals’ ability to adapt to chronic illness and can be beneficial specifically for those facing severe stress (Moskowitz et al., 2014). Positive affect can be utilized as a buffer for stress (Moskowitz et al., 2014), facilitate coping during stress, replenish social resources, and motivate coping efforts (Folkman, 1997; Fredrickson, 1998). In a disease context, positive affect interventions have improved depression scores on the Center for Epidemiologic Studies Depression Scale (CES-D) after one month (Cheung et al., 2016).

Knowing that an individuals’ self-rated happiness can play a role in health outcomes, healthcare providers (i.e., nurse practitioners) should take patients’ positive affect state into consideration during primary care visits when trying to help them make a behavior change. The PANAS or PANAS-X could be utilized during an office visit to assess positive affect over the last week, in order to help determine the best plan of care for each individual. If a patient presents with low positive affect (generally or within a disease context), the healthcare provider might consider incorporating skills to increase the patient’s positive affect, which could in turn help them participate in more healthy behaviors, such as MVPA. These positive affect skills could include noticing positive events, gratitude, mindfulness, positive reappraisal, focusing on personal strengths, and others (Cheung et al., 2016).

Along the same lines, healthcare providers should also consider other social determinants of health that could play a role in an individuals' positive affect state. In addition to providing skills that can help improve positive affect, providers could also assess the barriers and stressors an individual may be facing. For example, those that present with low positive affect may be facing financial hardship, occupational stress, or food insecurity. If these basic needs are not met first, the individual will be less likely to also alter their health behaviors. Additionally, addressing impactful social determinants of health could help resolve symptoms related to depression and/or anxiety. If these barriers exist, once they are addressed, providers can then focus on barriers to physical activity participation.

Positive affect specifically, is a concept not widely studied or utilized in nursing and is most often studied in the field of psychology. The results of this study support that taking ones' positive affect into account could be a valuable tool for improving physical activity behaviors in the primary care setting, but readers should keep in mind that only two positive affect variables were used in the analysis. There are time-efficient assessment measures that can be incorporated into primary care visits that offer valuable information about ones' affective state.

5.3 Strengths & Limitations

The limitations and strengths of this study are related to the data available for use and design of the study itself, which could impact the generalizability of the findings. These strengths and limitations are discussed in further detail here.

5.3.1 Limitations

5.3.1.1 Sampling

This study focused solely on the heterosexual couples in the data set. Due to this the findings cannot be generalized to all couple types, including same-sex couples. Repeating the same analyses, but with the same-sex couples would allow for the comparison of findings across different couple types and would allow for additional generalizability.

Additionally, this sample was mostly limited to one geographical location of Massachusetts. Future work should consider a more geographically diverse sample in order for results to be more generalizable across populations. It is known that different geographical locations have varying levels of physical activity access (Wende et al., 2020).

Lastly, the sample was a highly educated population, with higher-than-average incomes. As with geographic location, this characteristic prevents the findings from being generalized to different populations across the country. Future work should incorporate couples from varying income levels and with different educational experiences.

5.3.1.2 High variability

Across all three models there was high variability in MVPA that was not explained by the positive affect variables or covariates in the models. The scatter indices were either 40% or 41%. This indicates that approximately 40% of the variability in MVPA data was not explained by the positive affect variables or chosen covariates. Future work should consider other variables that need to be included for better model prediction, such as individuals' skills and knowledge related to behavior change, personality traits, and/or resilience.

5.3.1.3 Measures

The traditional PANAS utilizes 10 descriptors for measuring positive affect. For this study, only two positive affect variables were used. While the PANAS is often adapted for use, the adaptation used in this data collection only utilized only two positive affect variables. Being able to utilize the full 10 positive affect measures could have potential impacts on analysis outcomes since a mean positive affect score could have been created.

While this study only examined positive affect's relationship to physical activity, negative affect could be relevant to behavior change as well. For example, negative affect in individuals who have undergone joint replacement surgery is related to increased physical activity over the next hour (Powell et al., 2009). Additionally, breast cancer survivors indicating negative affect, also participated in increased MVPA (Castonguay et al., 2017). If a patient is experiencing symptoms related to depression or anxiety due to a health condition, such as joint replacement surgery or cancer, this should be taken into consideration when encouraging a health behavior change. Assessment with the PANAS or PANAS-X during a primary care visit could indicate whether further treatment of other conditions is needed before behavior change promotion can be initiated.

5.3.1.4 Bias

Data for the HARP was collected via self-report and could be influenced by response or social desirability bias. Respondents could also have made errors when entering their physical activity minutes, which is evidenced by a few high reports of physical activity in one day (e.g., over 500 minutes). Future studies should consider the use of objective physical activity measures, such as accelerometers to validate the subjective responses.

5.3.1.5 Data collection

The data utilized in this study is secondary data and was not collected solely for the purpose of this project. Future studies should consider primary data collection in order to have access to all relevant study variables. For example, the occupations of participants were masked and unavailable for use. Knowing individuals' occupations could have provided insight into their physical activity levels throughout the study since some occupations are more physically demanding than others. Another advantage of primary data collection is having control over what data is collected. An example of this is the use of standardized instruments, like the full PANAS-X (Watson & Clark, 1994), for assessing positive affect. As mentioned previously, utilizing the full positive affect scale from the PANAS could have impacted final analyses.

5.3.1.6 Temporal limits of assessment

. Due to the same day method of data collection of affect and physical activity, the temporal nature of the positive affect-MVPA relationship cannot be defined by the results of this study. Participants were asked to rate their positive affect and indicate minutes of MVPA over the last 24 hours, at the end of each day. Therefore, it is not possible to determine if the participants were referring to their positive affect earlier in the day and then their subsequent MVPA or vice versa. Future work should aim to use multiple data collection points throughout the day in order to better understand the temporal nature of this relationship.

5.3.2 Strengths

To our knowledge, this study is the first time the HARP data set has been used assess the relationship between positive affect and physical activity. The data is longitudinal (ten days) in nature and includes data from both partners regarding their daily positive affect and physical activity. Another strength of this study is that it was theory informed. The utilization of theory both in nursing research and affect work is needed. Past research on affect has not had a strong theoretical drive and often times was not used at all (Forster et al., 2020).

5.4 Directions for Future Studies

5.4.1 Sample demographics and location

This secondary data analysis examined the relationship between positive affect and subsequent MVPA among wives in heterosexual couples. This same approach could be used to research negative affect among heterosexual couples, as well as positive and negative affect among same-sex couples. A comparison of findings between same- and different-sex couples could provide insight and understanding of the influence of affect on health behaviors between couple types, as well as a deeper understanding of health behavior concordance among partners (Holway et al., 2018).

The outcome of MVPA was examined in the wife of the couple, but future analyses could be completed to analyze the same outcome in husbands. While wives' MVPA was not found to be associated with their husbands' positive affect, it is possible that husbands' MVPA could be associated with wives' positive affect. Marriage is an interdependent relationship of emotions that can impact health behaviors (Ruthig et al., 2012). Analyses of the affect-MVPA relationship of husbands could show whether there is similarity between partners.

Future studies could also examine the differences in physical activity in different geographic regions. The data utilized in this assessment was mainly collected on the East coast, in the state of Massachusetts. Comparisons could be made between different areas across the United

States since environment is known to play a role in physical activity participation (Wende et al., 2020).

5.4.2 Physical activity intensity

Future studies could also assess other physical activity outcomes such as leisure time physical activity, light intensity activity, or after work MVPA. It is possible that positive affect has a relationship with other types of physical activity. Associations between affect and leisure time activity have not been well researched. Since happiness was shown to be significantly associated with an more minutes of MVPA on the same day, it is possible that calmness may be associated with more leisure time activity and/or light intensity activity on the same day as well. It is known that approximately 80% of individuals' daily steps are accrued from light intensity activity/activities of daily living, such as walking around the office, making the bed, or washing dishes (PAGAC, 2018). While research is limited, studies have demonstrated that positive affect is associated with after-work MVPA as well (Niermann et al., 2016). Examining different types of activity intensities could help further define the positive affect-physical activity relationship.

5.4.3 Physical activity measurement

Additionally, when collecting future physical activity data, the use of objective measures of should also be considered. Since data from the HARP was collected via self-report, it is possible that individuals misreported their minutes of physical activity due to recall error or social desirability bias. Using an objective measure such as accelerometry would allow for unbiased data to be collected. It would also allow the temporal nature of positive affect and physical activity to be more well defined.

5.4.4 Additional variables to consider

Finally, future work should consider the use of other physical activity predictor variables in conjunction with positive affect, such as optimism and other personality traits. Past research has found that optimism is associated with increased daily step counts, specifically in individuals that are post-acute coronary syndrome, such as myocardial infarction or unstable angina (Huffman et al., 2016). Overall, optimism is related to increased positive health behaviors including physical activity, healthier eating, and being less likely to smoke (Boehm et al., 2018). Relevant to this dissertation, women with high optimism (versus low) are more likely to complete vigorous physical activity over the life course (Progovac et al., 2017).

Additionally, personality traits (known as the five-factor model or FFM) are associated with increased physical activity and could provide an additional link for healthcare providers when determining appropriate physical activity recommendations (Kekäläinen et al., 2021; Newsome et al., 2021). Higher extraversion, conscientiousness and openness, and lower neuroticism (from the FFM) are typically associated with higher physical activity levels (Wilson & Dishman, 2015). Combined with affect assessment, personality trait assessments could indicate which types of activity are the most relevant for each individual (e.g., high-intensity interval training versus a walk in the neighborhood part) (Newsome et al., 2021).

5.5 Conclusion

This research sought to clarify the relationship between positive affect and physical activity behavior outcomes among women that are part of a romantic couple. Through a secondary data analysis, it has been shown that married women's self-rated happiness is associated with an increase in MVPA on the same day, but not next day MVPA. Future work should consider using the full PANAS (Watson et al., 1988) or PANAS-X (Watson & Clark, 1994) for positive affect assessment, assessment of individuals in different geographical locations, and the use of objective physical activity measures. It is important that researchers continue to define the relationship between positive affect and physical activity in order to improve physical activity behaviors of individuals throughout the United States and beyond. Additional ways of Utilizing affect as a means of increasing physical activity among individuals who are part of a romantic dyad could include assessing negative affect's relationship to MVPA, assessing other physical activity outcomes such as leisure time activity, and collecting data from multiple geographic locations.

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