Emotional Response to an Exercise Questionnaire in Overweight Women

by

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ABSTRACT

This study aimed to identify the emotional/affective sources of discrepancies between physical activity behavior and a widely used self-perception measure of physical activity motivation. Overweight women (body mass index [BMI] ≥ 25 kg/m^2, 18-64 years of age; N=37) were recruited from Arizona State University community through flyers and online newsletters. Participants wore a SenseWear accelerometer for 6 nights and 7 days and followed their normal patterns of daily living. Participants then completed a single lab visit and verbally responded to questions from the Behavorial Regulation Exercise Questionnaire (BREQ-2) while being video and audio recorded. Captured emotional responses were evaluated with facial recognition software (Noldus FaceReader). Discrepancies between BREQ-2 responses and physical activity behavior were associated with happiness and sadness emotional responses extracted from the facial recognition software using regression-based analyses. Results indicated an association between monitored physical activities and captured emotional response - specifically sadness - and that as intensity in physical activity increases, motivation increases. Associations between happiness/sadness and physical activity were not observed for all intensities of physical activity. A marginally significant association was observed for amotivation and sedentary, light-intensity physical activity, and moderate-vigorous physical activity in the sample. This study demonstrates a proof-of-concept for the integration of an empirical evaluation of happiness and sadness emotional states into the relationship between physical activity motivation and behavior.

My thesis is dedicated first and foremost to my husband, who without your love and never-ending support along this three-year journey would not have been conceivable.

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CHAPTER 1

INTRODUCTION

Physical inactivity has become as much of a health concern for public health officials today as smoking cessation was in the early 2000s. Roughly 3.2 million people die every year due to lack of physical activity ("Physical Inactivity," 2014). Unfortunately, by being physically inactive, individuals increase their risk for cardiovascular disease, stroke and mortality. Insufficient physical activity has been linked with most major risk factors for chronic disease including hypertension, increased blood glucose levels, dyslipidemia, and overweight/obesity (Brinks & Franklin, 2012).

A key determinant of physical activity – motivation - is defined as "a force or influence that causes someone to do something" ("Motivation," 2014). Deci and Ryan described one perspective on motivation through the Self-Determination Theory (SDT) (Deci & Ryan, 1985b). SDT focuses on the intrinsic (internal forces) and extrinsic (external forces) propensities that lead individuals to make certain decisions every day, especially behaviors associated with well-being. Intrinsic motivation is an individual's own desire to engage in a behavior. Extrinsic motivation can be further described as external reward driven behavior (Deci & Ryan, 2000) and wherein the following behavior regulations: *external, introjected* and *amotivation*. *External regulation* is when a person is "controlled" in completing their behavior by outside sources in order to obtain a specified incentive or to avoid potential consequences (Deci & Ryan, 2000). *Introjected regulation*, similar to the aforementioned, is an individual's consequences placed on themselves, usually in the form of pride or guilt (Deci & Ryan, 2000). Due to these regulations both involving "controlled" motivations, individuals are more likely to

perform the specified behavior (Verloigne et al., 2011). *Amotivation*, also a behavior regulation, is when a person is completely lacking self-determination and has no desire to change their current behavior, regardless of future outcome ("The Theory," 2014; Guzman & Kingston, 2012) including no intention to be motivated due to other priorities and daily demands of life (Teixeira, Carraca, Markland, Silva & Ryan, 2012). Research has also shown that individuals report lacking motivation as one of the top reasons for not engaging in physical activity, (Fortier, et al., 2011), therefore the lack of autonomy is also linked to negative emotions (Guzman & Kingston, 2012).

SDT, like other theoretical approaches to understanding motivation in the physical activity domain, only accounts for a limited amount of the variance in physical activity behavior, (approximately 36%) (Brunet & Sabiston, 2009). A number of other factors account for this poor overall explanatory power. Measurement error in both the theoretical constructs and the behavior itself likely play an important role. The theory itself could be a limiting factor as it's only measuring motivation and therefore additional factors not fully accounted for in the theory (e.g., environmental factors) may impact the behavior. Research compiled from a 2012 review, on the association between exercise, physical activity and SDT, showed that the majority of studies calculating Relative Autonomy Index had a positive relationship with exercise (Teixeira, Carraca, Markland, Silva & Ryan). However, as emotional states are not well accounted for in SDT and other individual-level behavioral theories, further investigation into emotional factors are necessary.

Emotion is more than a 'strong feeling', it is "a conscious mental reaction (as anger or fear) subjectively experienced as a strong feeling usually directed toward a

specific object and typically accompanied by physiological and behavioral changes in the body" ("Emotion," 2014). Such mental reactions are more than how a person speaks as they include auditory and body posture measurements (Mauss & Robinson, 2009). Emotions (e.g. happy, sad, anger, fear, disgust and surprise, and neutral) can be more objectively quantified via facial expressions ("Facial expression," 2014; Johannsen et al., 2010). By investigating this new variable, a researcher may be able to determine whether underlying emotions may be linked to physical activity behavior and SDT-based motivation. This relationship could then be further explored in terms of their association with optimism and stress.

Optimism is defined as the "belief that good things will happen in the future" (Optimism, 2016) or where an individual can obtain their goals while maintaining control (Karademas, 2006; Dumitrache, Windle & Herrera, 2015). This variable is similar to self-determination because those with higher levels of optimism usually will have more happiness in their lives, overall well-being (Hart & Hittner, 1995) and lowered amounts of stress (Karademas, 2006). Therefore, those with more happiness or optimism, usually have a greater defense mechanism when dealing with negative and stressful situations (Dumitrache, Windle & Herrera, 2015). Unfortunately, it is the individuals who do not have control over their emotions or self-regulation that are usually left vulnerable and stressed (Lok & Bishop, 1999). A study completed in 1999 found that such individuals would likely experience "emotional inhibition," that which had higher levels of illness due to not dealing with the emotional issues effectively and in a timely manner (Lok & Bishop).

The amount of emotional inhibition an individual has can sometimes have a direct correlation to their health. By deterring emotions, stress will most likely increase, thereby lowering defense mechanisms. Once the defense shield is down, it is highly anticipated that either physical or psychological illness will occur (Lok & Bishop, 1999) since there are no coping strategies being employed (Hart & Hittner, 1995). Evidence has shown that as stress increases, an individual's risk for chronic diseases does too; illnesses such as poor mental health, hypertension or diabetes among with an increased risk for a heart attack, stroke and cancer (Achat, Kawachi, Levine, Coakley & Colditz, 1998; Achat, Kawachi, Spiro III, DeMolles & Sparrow, 2000).

There may also be an association between an individual's emotion and their behavior and motivation towards physical activity, wherein those with higher levels of happiness should exhibit greater motivation and behavior towards physical activity. Therefore, individuals on the opposite end of the spectrum, with lower levels of happiness, would lack motivation and behavior when coupled with physical activity. As emotions are tied to behavior, they too are the driver of change, however if the individual is not yet exhibiting their emotion publicly, the facial analysis software may be able to uncover so that further examination may occur.

Facial expression recognition, a noninvasive software detection system that records in real-time, determines an individuals' state of mood through complex algorithms. As such, these same mathematical equations require numerous amounts of ram and processor speed (Acasandrei & Barriga, 2013) as they usually are applied at three levels: initial detection of face, face verification and eye socket detection (Kawulok & Syzmanek, 2012). As with any facial recognition software, there are two tasks it has to

complete: *detection* and *extraction*. First, the face of the individual is recorded or 'detected' and then facial features are obtained or 'extracted' for detection (Lau, 2010). One of the most extensively used algorithms, since its creation in 2004 by Paul Viola and Michael Jones, is the *Viola-Jones* face detection algorithm (Acasandrei & Barriga, 2013). The algorithm, which attains high rates of detection and processing efficiency ('t Hart, Abresch & Einhauser, 2011), works on an equation containing integral images and weak recognition classifiers that then calculates and outputs a face pattern (Aiken & West, 1991). In terms of which facial expressions are best detected: happy, sad, angry and scared, earning an 89% accuracy rate in terms of detection and recognition (Lau, 2010; Terzis, Moridis & Economides, 2013).

Active appearance models (AAMs) is another software program that models and shapes the face using face detection. This method first configures the geometric shape of the individual's face then fits it with their facial features. AAMs also use algorithms, which when first created by Cootes, Edwards and Taylor in 1998, used a simple least square regression technique (Lee, Park & Kim, 2009). As with any software program though, speed and accuracy are key components for top-rated performance. Algorithms might also be affected in terms of accuracy when facial features cannot be fully detected, wherein covered or hidden (e.g. hair, glasses, jewelry) (Lau, 2010). Therefore, in 2007 when Noldus Information Technology introduced FaceReader 1.0, it forever changed the software arena, as FaceReader was the "first truly automated system for the recognition" of emotions. The software not only fulfilled the speed and accuracy components that had been missing from earlier facial analysis creations, but there were the additional benefits

of saving time, resources and being able to integrated the data with other software packages ("Why use FaceReader," n.d.).

An additional component within Noldus is head tracking, wherein angles/degrees of head movements within the left and right hemispheres are obtained (Ross, Prodan, & Monnot, 2007); the researchers coded this data the x-y-z axis. This information, which the software tracks, is extremely important in detecting since certain emotions (e.g. sad and angry) are not always easily identifiable to a human investigator (Martinez & Du, 2012). Identifiers in the face, by employing face width and length between mouth and brows (Martinez & Du, 2012), one is able to distinguish factors for detecting sadness or anger; when reviewing the face in a 2-dimensional format, sadness and anger are indecipherable. Researchers Mignault and Chaudhuri stated in 2003 that it was the angle of the head that was a key factor in determining specific emotions; wherein an angle closer to -30 degrees of the head would reflect sadness versus happiness, which occurred at 30 degrees.

Therefore, in order to further examine emotions in this study, the facial analysis software FaceReader 6.0 for measuring emotional status via facial expression during administration of the Behavorial Regulation Exercise Questionnaire-2 (BREQ-2) in overweight women was employed. Objective physical activity behavior was measured via the SenseWear accelerometer (armband) for seven consecutive days prior to the completion of the BREQ-2 (Johannsen et al., 2010; Lewinski, Fransen & Tan, 2014). The accelerometer yields reliable and valid energy expenditure estimates while worn (Johannsen et al., 2010). Combined, the BREQ-2 and physical activity monitoring create an accurate picture of the participant's motivation and physical activity level.

Understanding the role of emotional response regarding physical activity may enhance our knowledge of factors influencing the propensity for physical activity.

Purpose, Hypotheses and Aims

The purpose of this study was to examine emotional responses to a validated physical activity, self-perception questionnaire in overweight adult women using facial analysis software.

Aim: To examine whether emotional response (measured via validated facial analysis software) could provide additional explanatory power of physical activity behavior beyond SDT-based physical activity motivation in overweight women.

Hypothesis 1: Happy and sad emotions independently predict variation in physical activity behavior after accounting for physical activity motivation.

Hypothesis 2: Happy and sad emotions moderate the relationship between physical activity motivation and physical activity behavior, such that individuals exhibiting higher levels of happiness and lower levels of sadness have a stronger motivation-physical activity behavior relationship.

Definition of Terms

1. BREQ-2: The Behavioral Regulation in Exercise Questionnaire (BREQ), which measures extrinsic and/or intrinsic motivation (Dec & Ryan, 1985), was developed to identify and measure forms of regulation of exercise behavior (Mullan, Markland & Ingledew, 1997). As amotivation remains an important factor to explore, this variable was added to the questionnaire in 2004, thus creating the instrument known as BREQ-2 (Markland & Tobin, 2004).

2. SenseWear accelerometer: a wearable armband that objectively measures the amount of physical activity, including calories burned and steps taken, in free-living settings. SenseWear collects data at 32 times per second ("SenseWear," 2013).
3. Physical Activity: Physical activity as defined by the World Health Organization is "any bodily movement produced by skeletal muscles that requires energy expenditure – including activities undertaken while working, playing, carrying out household chores, travelling, and engaging in recreational pursuits ("Physical activity," 2014).

Delimitations and Limitations

The inclusionary criteria included adult women, ages 18-64 with a BMI ≥ 25kg/m^2. As this was an exploratory study, we expected a wide range of emotional responses from completing the BREQ-2 survey. Therefore, we limited our sample to overweight women to focus on the unique characteristics of this group and to restrict, as much as possible, the large heterogeneity in responses that were anticipated.

There were some limitations with this study such as sample size and lack of prior research on the specific topic. Due to potentially having a small group of participants, it was difficult to find significant relationships within the data or a representative distribution. In addition, as the Noldus FaceReader has not been used in conjunction with physical activity studies and the examination of emotions, no additional resources were available for supporting/understanding the need for this research study.

CHAPTER 2

REVIEW OF LITERATURE

After completion of an exhaustive electronic search, there weren't any published articles that have used facial analysis software to examine emotions related to physical activity motivation and behavior. The following review will focus on use of the BREQ-2 measure in physical activity settings and the correlation to motivation (SDT) while using Noldus facial analysis software to examine emotions.

Self Determination Theory

The SDT is a model that evaluates an individual's motivation and personality while gauging the type of performed behavior: independent or controlled. The theory postulates that individuals have the need for independence, skill and feeling connected (Lim & Wang, 2009; Huang, Backman, Chang, Backman, & McGuire, 2013) and while subscales can change depending on behavior, obtaining complete autonomy is key (Rutten, et al., 2014). Specific components within the theory are motivation, behavior, attitude and value, which were compiled into frameworks that could measure intrinsic motivation, extrinsic motivation and amotivation (Deci & Ryan, 1985a; Ferrand, Martinent & Bonnefoy, 2014). Self-determination or *intrinsic motivation*, the highest level of autonomy (Rutten, et al., 2014) is that which an individual performs a behavior accompanied by an optimistic feeling of attainment (Ryan, Frederick, Lepes, Rubio & Sheldon, 1997). It is also this component that, according to researchers Brunet and Sabiston (2011), which has a strong correlation to an individual's behavior – specifically physical activity. While *extrinsic motivation*, or the reversal of self-determination, are behaviors that are completed in order to obtain a specific positive or negative effect. Each

motivation can be further separated to gauge individuals' motivation – moving from least autonomous being amotivation, then controlled regulations [external and introjected] to the highest level of self-determination [identified and integrated] (Riiser, et al., 2014). Similar to that of the BREQ-2, identified regulation falls under the *intrinsic motivation* category as this describes the behavior as self-chosen, whereas introjected regulation, external regulation and amotivation are part of the *extrinsic motivation* due to the fact they are states where individuals lack self-determination and choice to complete the behavior (Stephan, Boiche, & LeScanff, 2010). It is best to notate that amotivation, while housed under extrinsic motivation, is a non-regulatory subscale, perceived as impersonal (Deci & Ray, 2000) and usually depicts passive or non-behavior (Webb, Soutar, Mazzarol & Saldaris, 2013). Daley and Duda (2006) defined amotivation as "learned helplessness" since individuals who reside in this category display lack of motivation and usually a lack of understanding as to why they are performing the behavior. However, since it depicts an array of regulations, this instrument is widely used in projects involving physical activity and exercise (Wilson, Rodgers, Fraser & Murray, 2004).

It was stated that in 2013 (Sebire, Standage, Gillison & Vansteenkiste) that research still needed to be completed in the area of determining what goals/cues internally and externally motivate women to exercise. A study completed by Teixeira and Palmeira (2015) as well as Silva, Markland, Carraca, et al. (2011) found that individuals with higher levels of autonomy also indicated increased satisfaction toward exercise (Ryan, Frederick, Lepes, Rubio & Sheldon, 1997) or the desired behavior (Webb, Soutar, Mazzarol & Saldaris, 2013) versus other known indicators: past behavior, intention, etc.; wherein more autonomy yielded higher outputs, specifically those individuals with

increased levels of identified regulations followed by introjected (Wilson, Rogers, Fraser & Murray, 2015; Daley & Duda, 2006). This could pose interesting results since the SDT places intrinsic motivation above all other subscales, however when focusing on behaviors such as exercise or physical activity, higher levels of extrinsic motivation are normally present (Daley & Duda, 2006; Sabiston, et al., 2010). Individuals studied in 2010 with higher levels of intrinsic motivation were found to have a direct correlation to their free-living physical activity versus exercise (Silva, Markland, Vieira, et al.), since it is the self-determination of the individual that leads to their specific behavior choice (Webb, Soutar, Mazzarol & Saldaris, 2013; Daley & Duda, 2006). Self-determined regulation was further validated by a study conducted in 2010 by Puente and Anshel concluded that evaluating emotions and motivations would also have an effect on exercise. The theory, while measuring quality of motivation, is often used together with the BREQ-2, since they both measure intrinsic and extrinsic motivation and amotivation, while the questionnaire focuses on the value of physical activity (Fortier, et al., 2011). An additional insight from the SDT is that, intrinsic motivation should coincide with higher levels of the variability being measured while the opposite exist for extrinsic motivation (e.g. low levels) (Stephan, Boiche & LeScanff, 2010; Daley & Duda, 2006). For individuals to perform a particular behavior (e.g. physical activity), results have shown it is the higher levels of autonomy and enjoyment that supersede the controllable external forces with unforeseen outcomes (Ferrand, Perrin & Nasarre, 2008; Mack, Kouali, Gilchrist & Sabiston, 2015; Vancampfort, De Hert, Vansteenkiste, et al., 2013). It is the SDT that helps detect the best atmosphere for aiding an individual in their motivation and behavior (Ferrand, Perrin & Nasarre, 2008; Webb, Soutar, Mazzarol & Saldaris, 2013), a

key predictor of behavior adherence (Longbottom, Grove & Dimmock, 2012) and a health determinant for an individual's lifestyle (Roman, Navarrete, Carron, Castuera & Rabaz, 2011).

Behavior and Exercise Questionnaire

BREQ-2, a shorter version of its predecessor, was revised in 2004 by Markland and Tobin to include four questions to assess amotivation (Markland & Tobin, 2004). This questionnaire is one of the most valid and reliable tools for studying exercise motivation (Lewinski, Fransen & Tan, 2014) and based on the SDT. The BREQ-2 questions encompass three areas of motivation: intrinsic, extrinsic and amotivation (Moustaka, Vlachopoulos, Vazou, Kaperoni & Markland, 2010). As motivation is a key factor in exercising, by administering the BREQ-2, the underlying motives can be detected (Sibley, Hancock & Bergman, 2013; Vancampfort, De Hert, Stubbs, et al., 2015). Several studies have shown how individuals have become autonomous in their behavior related to exercise (Rosa, et al., 2015) or how to measure motivation during exercise after testing several behavior regulations (Cid, Moutao, Leitao & Alves, 2012). A study conducted in 2012 concluded that individuals, after completing the questionnaire, revealed identified regulation as the key motivator for physical activity (Wilson, Sabiston, Mack & Blanchard). While motivation and exercise are highly associated, the BREQ-2 is not an excellent predictor of actual physical activity behavior. However, the questionnaire has been proven to be a "reliable and valid" instrument (Pila, Stamiris, Castonguay & Sabiston, 2014).

Measurement of Physical Activity

To further strengthen results of the physical activity compiled from the BREQ-2 as self-reports have low validity, participants will wear a SenseWear accelerometer, which has been a staple monitoring device in physical activity behavior studies (Johannsen et al., 2010; Lewinski, Fransen & Tan, 2014). The accelerometer yields reliable and valid energy expenditure estimates while worn (Fruin & Rankin, 2004; Berntsen, et al., 2010; Johannsen et al., 2010; Youngwon, Jungmin, Yang, Gaesser & Welk, 2012; Brazeau, et al, 2011) and has been set as the *gold standard* device (van Gestel, et al., 2012). Studies have shown that the data output, regardless of speed, is one of the most accurate device comprised of a multitude of parameters that link into the algorithms (King, Torres, Potter, Brooks & Coleman, 2004; Calabró, Lee, Saint-Maurice, Yoo & Welk, 2014). As the participant will wear the armband for 6 nights and 7 days, following their normal daily living (i.e. free-living), the SenseWear device has worked well in this area (Jakicic et al., 2004; Calabro, Stewart & Welk, 2013; Cox, et al., 2014; van Hoye, Mortelmans & Lefevre, 2014). In order to compile an accurate accumulation of an individual's free-living activities, a minimum of four valid days (Di Fabio, Blomme, Smith, Welk & Campbell, 2015) including one weekend day (Saturday or Sunday) were required (Baptista, et al., 2012), thereby allowing for true representation of how the individual conducted their physical activity outside the normal work week (Ward, Evenson, Vaughn, Rodgers & Troiano, 2005). Baseline for a valid wear day, based on minimum number of wear time, was 10 hours (600 minutes) of wake time (Troiano, et al., 2008; Semanik, et al., 2012). By having individuals wear the device for seven days and only removing for water activities (e.g. showering, swimming), the

accelerometer collected a consistent approximation of their physical activity (Trost, McIver & Pate, 2005).

A concern of the armband is that during high intensity exercise (>10 METS), energy expenditure (EE) might not be accurate (Drenowatz & Eisenmann, 2011; van Hoye, Mortelmans & Lefevre, 2014). As the study population has a BMI of ≥ 25 kg/m^2 this may not be an issue; it was found that additional algorithms needed to be applied (Jakicic, et al., 2004), specifically for obese individuals (Papazoglou, et al., 2006) in obtaining EE results, however the accelerometer was proven to have one of the "best" EE estimates in 2014 by Ryan, Walsh and Gormley.

By wearing the device on the back of the upper arm over the triceps versus a waist-mounted apparatus, EE would also be significantly improved while the individual is wearing the device (McClain, Welk, Gregory, Wickel, & Eisenmann, 2005). This small detail of placement is especially important when measuring sedentary versus light activities (Leung, et al., 2012). Combined, the BREQ-2 and exercise monitoring creates an accurate picture of the participant's motivation and activity. This study aims to examine the element missing for direct correlation of these two methods through facial recognition of emotional response.

Facial Analysis and Emotions

As this study is looking to determine if underlying emotions are tied to exercise motivation, the intent is to see what emotions are evoked per participant when reading the questionnaire. Emotions are normally communicated verbally and/or nonverbally through an individual's facial expression (Choliz & Fernandez-Abascal, 2012), therefore by using an automated facial analysis software which constructs itself from data more than 40

years old and tied to Ekman (Lewinski, den Uyl & Butler, 2014), seven facial expressions can be measured: happy, sad, angry, surprised, scared, disgusted and neutral (What's new in FaceReader 6, n.d.). The software first locates the individual's face following an algorithm created by Viola-Jones, then the Active Appearance Model creates the face-modeling and lastly the emotion is classified into one of the seven facial expressions (Danner, Haindl, Joechl & Duerrschmid, 2014).

Over the last few decades, exploring elements to detect on-going facial analysis has increased due to association with psychology. By viewing different features and elements of the face, further research has confirmed association between facial expressions (emotions) and dimensional axes of the face. Each of the basic predefined emotions, which are universal across races and nationalities, has a specific dissemination for which features within the axes are engaged (Zhang, Tjondronegoro & Chandran, 2014).

As with emotions, facial expressions are a key element in understanding how another individual feels or reacts to a situation or behavior. Therefore facial expressions and the facial action units that define each emotion should be recognizable using automation; the output, categorized as a number or character and filtered through an algorithm, would dictate intensity and relationship of each emotion (Zhang, Tjondronegoro & Chandran, 2014) within the dimensional space, or specific point or region (Ekman, Friesen & Ancoli, 1980).

The action units created by Ekman and Friesen and more commonly known as Facial Action Coding System (FACS), was devised to observe all facial movement and expressions (Ekman, Friesen & Ancoli, 1980). There are a total of 44 FACS and each

one is associated with various facial muscles that then produce a specific expression and detect the precise time the expression begins and ends (Ekman, Friesen & Ancoli, 1980). This research has allowed for the detection of copious facial expressions, all while employing just a few or even a single FACS (Zhang, Tjondronegoro & Chandran, 2014). However, it was also Ekman and Friesen that postulated blending of emotions could occur, wherein finding facial expressions such as sadness, contempt and anger (Ekman, Friesen & Ancoli, 1980).

It has been discovered that while expressions of the face used to be deciphered moving right-to-left that actually employing the top-down method is more accurate (Ross, Shayya, Champlain, Monnot & Prodan, 2013). The researchers found that a blending of emotions, some masking hidden feelings, may occur and therefore divided the face into four quadrants. While different emotions lie within each quadrant, more negative (e.g. sadness and anger) are generally displayed within the lower surface; it is best practice to advise viewer to read facial expressions from left-to-right, just atop the horizontal axis (Diaz & Flores, 2001; Ross, Shayya, Champlain, Monnot & Prodan, 2013; Neely, Lisker & Drapekin, 2014). Due to added markers (eyebrows and eyes) in the upper quadrants versus lower (mouth), facial expressions across both axes are more complex and detailed allowing the individual to communicate their story (Neely, Lisker & Drapekin, 2014). Therefore, when detecting the upper portion of face comprised of positive reactions (e.g. happiness), by viewing only from the left region with focus held on the individual's ear, decoding is greatly improved (Ross, Shayya, Champlain, Monnot & Prodan, 2013).

FaceReader has been used in numerous arenas, from marketing research, consumer behavior, user-experience, educational research, etc., due to it being a quick and passive observation system (Danner, Haindl, Joechl & Duerrschmid, 2014). Nevertheless, the software is 89% reliable in determining the type of displayed emotion (Lewinski, den Uyl & Butler, 2014; Lewinski, Fransen & Tan, 2014; Danner, Haindl, Joechl & Duerrschmid, 2014). The software is found to have a 75.6% match when compared to self-reported data on emotions and reduces the amount that researchers and analysts need to code individuals behavior. Additionally, researchers last year determined that almost 95% of FaceReader outputs are highly concurrent (Fujiwara, Mizuki, Miki & Chemtob, 2015). It is also that software, that while research continue to explore numerous concepts surrounding emotions, brings together commonality on facial expressions, emotions and the states of emotions (Harley, Bouchet, Hussain, Azevedo & Calvo, 2015). Understanding the numerous elements that can effect emotions, such as age, gender, outside influences and medical disorders, can further pinpoint influence (Choliz & Fernandez-Abascal, 2012).

In looking at additional ways to measure emotion, as the area of physical activity seems to be well maintained with numerous accelerometers, the most efficient and cost effective tool is always going to be the self-report. However, self-reports need to be completed in real-time versus being filled out based on prior emotional experiences (Mauss & Robinson, 2009). Use of additional verbal and nonverbal measurement tools (Leitch, Duncan, O'Keefe, Rudd & Gallagher, 2015) could be obtained through means of listening, as usually there is a correlation between emotions and an individual's auditory (e.g. pitch, tone, volume) (Mauss & Robinson, 2009). As with everyday conversation,

body posture could be an additional tool for measuring emotion and lastly the potential measuring of emotions through the joining of neuroimaging and EEG, wherein the brain hemispheres respond to ‘approach and avoidance’ (Mauss & Robinson, 2009).

CHAPTER 3

METHODOLOGY

PARTICIPANTS

The study received 147 responses from the recruitment efforts. Once being assessed for inclusion criteria, 46 participants agreed to be in the study. After data analysis, nine individuals were excluded, wherein final count was 37 participants. Female, adult participants were between the ages of 18-64 with a BMI >25kg/m^2 and our sample was limited to overweight women to focus on the unique characteristics of this group and to restrict, as much as possible, the large heterogeneity in anticipated responses. Furthermore, the findings are more readily generalizable and applicable focused solely on this group. Participants were excluded for the following criteria: male, non-adults (ages 17 or younger), adults (ages 65 or older) and a BMI <25kg/m^2.

Potential participants were recruited through newsletter announcements (e.g. Sparky's Scoop, Well Devils – Appendix A) oriented toward undergraduate and graduate students and staff/faculty at Arizona State University in order to achieve a relative balance across age range. We also sought to recruit both physically active and inactive adults. If additional participants were needed for the study, a flyer (Appendix B) was to be emailed to various locations throughout the ASU community.

STUDY DESIGN

The study was a single-site, prospective observational study. The dependent variable was objectively-monitored physical activity and the independent variables were emotional response and physical activity motivation variables.

PROCEDURES

All interested participants, after reviewing the brief description of the project (the researcher's goal was to examine women's health, exercise and emotions), would click on the link from the recruitment tool and be forwarded to a pre-screening questionnaire (Appendix C) using Qualtrics (Qualtrics, Seattle, WA). Research staff then notified potential participants if they met study qualifications and emailed them the Online Informed Consent (Appendix D) via Qualtrics. If participant agreed to participate, they wore an armband (SenseWear) that would measure physical activity. A mailing address was obtained for armband delivery and a lab visit was scheduled following the seven days of wear. The participant was mailed the armband, a copy of Informed Consent (Appendix E), instructions for wearing monitor (Appendix F), charging the armband (Appendix G) and Accelerometer Log (to monitor 'off' and 'on' time of the monitor; Appendix H). Each female participant was instructed to wear the unit for 6 nights and 7 days, following their normal patterns of daily living. At the completion of the wear time, the participant brought the armband and Accelerometer Log to their scheduled lab visit.

Following the week of armband wear, each participant participated in a 30-minute lab session by completing an interviewer-administered questionnaire (BREQ-2 – Appendix I) while being audio and video recorded (Noldus FaceReader). The participant arrived at lab location, greeted and taken to the designated interview room (Room #436 or #438). Interviewer then reviewed the Informed Consent with participant in detail, advising of study procedures, answering questions/concerns and explaining to participant their right to refuse, guaranteeing no negative consequences should they decide to exit the study. The participant was allotted as much time as necessary for questions and/or

clarifications before taking part in the last phase of the study. If participant agreed to continue in study, the participant was then asked a series of questions from the BREQ-2, administered by the interviewer, regarding their attitudes toward physical activity (Appendix J). The BREQ-2 contains 19 questions that encompass behavior motivations with exercise. However, as exercise is a small intricate part of the overall health equation and we were focused on physical activity, the word 'exercise' was replaced with 'physical activity' in the questionnaire (Vancampfort, De Hert, Vansteenkiste, et al., 2013; Riiser, et al., 2014). This revision to the instrument has previously been accomplished (Vancampfort, De Hert, Stubbs, et al., 2015). The questionnaire is comprised of five areas of motivation: external regulation (e.g. I am physically active because other people say I should), introjected regulation (e.g. I feel guilty when I'm not physically active), identified regulation (e.g. I'm physically active because I value the benefits of physical activity), intrinsic motivation (e.g. I'm physically active because it's fun) and amotivation (e.g. I don't see the point in being physically active) ("BREQ-2 and 3 scoring," 2014; Markland & Tobin, 2004). The participant was video and audio recorded during the survey and the data was later processed using facial analysis software. All lab sessions were conducted in the interview rooms of the Health North building on the downtown campus of Arizona State University and the Arizona State University Institutional Review Board approved the study (STUDY00001630).

MEASUREMENT

All measurements were administered prior to the 30-minute lab session.

Anthropometrics

The participant's height and weight were initially obtained through self-report via the online screener. Height and weight were confirmed using the Health-O-Meter Physicians Medical Doctors Scale 350lb Height/Weight Beam Scale (Continental Scale Corp., Chicago, IL) scale at the beginning of the laboratory visit ("Health-o-Meter," n.d.).

SenseWear Armband

Participants wore the SenseWear accelerometer (SenseWear, BodyMedia, Inc., Pittsburgh, PA) ("SenseWear," 2013), which was set accordingly to each participant's characteristics: height, weight, birthdate, dominant hand and smoking status (Brazeau, et al., 2011). The two-axis physical activity measuring device also contained the following sensors: heat flux, skin temperature, near-body ambient temperature and galvanic skin response. The participant was instructed on how to wear/position the device around the upper left arm (over the triceps brachii muscle), wearing the device continuously for 6 nights and 7 days, removing only for water-related activities and charging, along with cleaning the device and understanding the lights/sounds (Appendix E). Participants completed the Accelerometer Log (Appendix F) recording any time they removed the device, including charging time. As participants wore the device for a week, continuously, the battery was fully charged before it was shipped. Participants were reminded midway through their week of wear to fully recharge the device (Appendix F). Download of participants' accelerometer data, following their scheduled lab visit, was completed using SenseWear proprietary software. The data was converted from the .swl file into a .csv file then summarized into meaningful units of physical activity and sedentary behavior per day (waking hours only). The SenseWear software allowed

researchers to create a report, in second-by-second values, which encompassed the following: total energy expenditure, average METs, time spent in sedentary vs. moderate vs. vigorous vs. very vigorous, total number of steps, active energy expenditure, sleep duration and duration-on-body. This report was emailed to each participant. For analysis, we focused primarily on minutes of moderate-vigorous physical activity per day but will retain other physical activity, sedentary behavior, and sleep outcomes for later analysis.

The SenseWear accelerometer has been validated in a number of studies against measured energy expenditure (EE) and behavioral outcomes. Such studies included using the accelerometer during indoor rowing sessions with 43 overweight and obese adults (Erdogan, Cetin, Karatosun & Baydar, 2010), another study had 31 healthy adults complete a 45 minute ergocycling session (Brazeau et al., 2011), Benito, et al. had 29 moderately healthy participants complete circuit resistance training totaling 8 visits (2012), and 40 individuals at the University of Pittsburgh completed four exercises (treadmill walking, stair stepping, cycle ergometry and arm ergometry) for approximately 30 minutes (Jakicic et al., 2004). The SenseWear accelerometer has been held as a valid instrument for measuring EE at low and moderate intensity levels (Erdogan, Cetin, Karatosun & Baydar, 2010; Brazeau, et al., 2011), but additional work is needed in the areas of high intensity physical activity, resistance training (Benito et al., 2012) and exercise-specific algorithms (Jakicic et al., 2004). An algorithm is "a set of steps that are followed in order to solve a mathematical problem or to complete a computer process" ("Algorithm-Definition," 2014). By having SenseWear create the specific computer processes for each exercise (e.g. cycle ergometer, stair stepping and arm ergometer) completed in the studies, more precise data was produced (Jakicic et al., 2004).

Behavorial Regulation Exercise Questionnaire-2

The Behavorial Regulation Exercise Questionnaire-2 (BREQ-2), created in 2004 by Markland and Tobin, consists of 19 questions that determine the reasons people decide to participate in physical activity. The concept of the questionnaire is to understand what barriers the individual is trying to overcome in correlation to their exercise participation. The score, measured on a five-point Likert scale from 0 (Not true for me) to 4 (Very true for me), categorizes self-determination into the following five motivational subscales: external regulation, introjected regulation, identified regulation, intrinsic regulation and amotivation ("BREQ-2 and 3 scoring," 2014; Markland & Tobin, 2004). The Relative Autonomy Index (RAI) is the final weighted score of all regulations, which determines wherein an individual lies in terms of self-determination. Using a specific weighting for each subscale then summing, a higher score signifies increased independence versus a lower score signifying more control: (sum of amotivation X -3) + (sum of external regulation X -2) + (sum of introjected regulation X -1) + (sum of identified regulation X 2) + (sum of intrinsic regulation X 3) = RAI ("BREQ-2 and 3 scoring," 2014). Lower RAI scores express an individual with less or nonexistent self-determination whereas high RAI signifies individual autonomy (Fortier, et al., 2011).

The BREQ-2 has measured motivation/behavior regulation and received validation from the following: a 2013 study where 576 regular gym members in Italy completed the questionnaire (Cohen, Morrison & Callaway, 2013); in 2007, 561 adults who participated in non-competitive sports/physical activity in Spain completed the instrument (Murcia, Gimeno & Camacho, 2007); and a 2010 study in Greece, 733 individuals, were all members were from private fitness centers, completed the

instrument (Moustaka, Vlachopoulos, Vazou, Kaperoni & Markland, 2010). The BREQ-2 seems to be a valid and reliable instrument, so as long as it is used in conjunction with the SDT questionnaire (Cohen, Morrison & Callaway, 2013). Furthermore, the BREQ-2 has such "good factorial validity" (Moustaka, et al., 2010) that it has been translated into several different languages including Greek, Spanish and Italian (Costa, Oliva, Cuzzocrea & Larcan, 2013; Murcia, Gimeno & Camacho, 2007).

Noldus FaceReader

Noldus FaceReader (FaceReader) (Noldus FaceReader, Noldus Information Technology, Wageningen, Netherlands) is real-time facial analysis software that recognizes six basic facial expressions (happy, sad, scared, disgusted, surprised and angry) in addition to neutral ("Facial expressions," 2014). This software "is capable of automatically analyzing facial expressions, providing users with an objective assessment of a person's emotion" ("Innovative Solutions for Human Behavior Research Catalog," 2012). While video and audio are captured, frame-by-frame, of participants' responses, the video will be analyzed for facial analysis using FaceReader proprietary scoring algorithms and summarized into meaningful measures.

FaceReader is comprised of three areas: face finding, face modeling, and face classification. The software first employs the Active Template Method, which acquires an accurate position of the face. It then creates an artificial face using the Active Appearance 3D Modeling which is able to not only describe the texture but also the location of 491 'key points' on the face. Lastly, face classification is wherein the software can accurately evaluate an individual's facial expressions. The software is so precise, that it categorizes the following movements: mouth open-closed, eyes open-shut, and

eyebrows raised-neutral-lowered, head orientation and gaze direction. In order to extrapolate participant's facial expressions, FaceReader creates easy-viewing visuals (e.g. continuous indicator, pie chart, bar graph) of all seven emotions being displayed; this will also determine which mood the participant resides: positive, neutral, or negative ("Noldus Innovative," 2012). Using one the four face models will find the best fit for the individuals face; emotions are scaled from 0 (not present at all) to 1 (maximum strength). The models include: general (used as default), children (ages 3-10), East Asian and elderly (age 60+).

The software has already been used in a number of different research areas, including consumer behavior, market research, usability testing, human-computer interaction, education and psychology; thus resulting in over 45+ publications which validate the real-time facial analysis software. A study by Cohen, Morrison & Callaway (2013) investigated 28 individuals with psychometric schizotypy while completing an array of tasks in a laboratory setting; the researchers were focused on evaluating the feasibility, reliability and construct validity of the software (Cohen, Morrison & Callaway, 2013). In terms of facial expressions, the study concluded that the FaceReader had "excellent reliability;" however, a recommendation was incorporating a "calibration" period with each individual, as to allow for the best recording variables (Cohen, Morrison & Callaway, 2013).

STATISTICAL ANALYSIS

Means, standard deviations, frequencies, and percentages of all variables will be computed for all variables. The distribution of the primary outcome variables were examined (via visual inspection and standard error of skewness and kurtosis estimates). If

this variable is found to be non-normally distributed, square root or natural logarithmic transformations will be performed prior to analysis. Ordinary least squares regression analysis will be used for the primary analyses using the SPSS statistical software (Version 22, IBM, Armonk, NY). The dependent variable was moderate-vigorous physical activity. To address hypothesis 1, in a stepwise fashion, BREQ-2 scores were entered as an independent variable followed by happiness and sadness emotional response variables in separate models according to State (Figure 1). The categorical States were: State 1 – the period of as participant is stating the question; State 2 – time when participant is contemplating their answer; State 3 – time period when participant is answering question; and All States – included all States. Multicollinearity was explored among these variables (including correlation with BREQ-2) prior to their entry and they were orthogonalized. To address hypothesis 2, an additional interaction term (i.e., emotional response x BREQ-2 score) were added to the model to test whether emotion response moderated the relationship between motivation and physical activity behavior. Prior to entry, emotional response and BREQ-2 scores will be centered to improve interpretation of the regression coefficients using the same aforementioned States. If significant, interaction effects will be displayed visually for interpretation. To examine the internal consistency of the BREQ-2 for responses related to amotivation to moderate RAI, Cronbach's Alpha was calculated. Significance level will be set at $p < 0.05$ (Aiken & West, 1991).

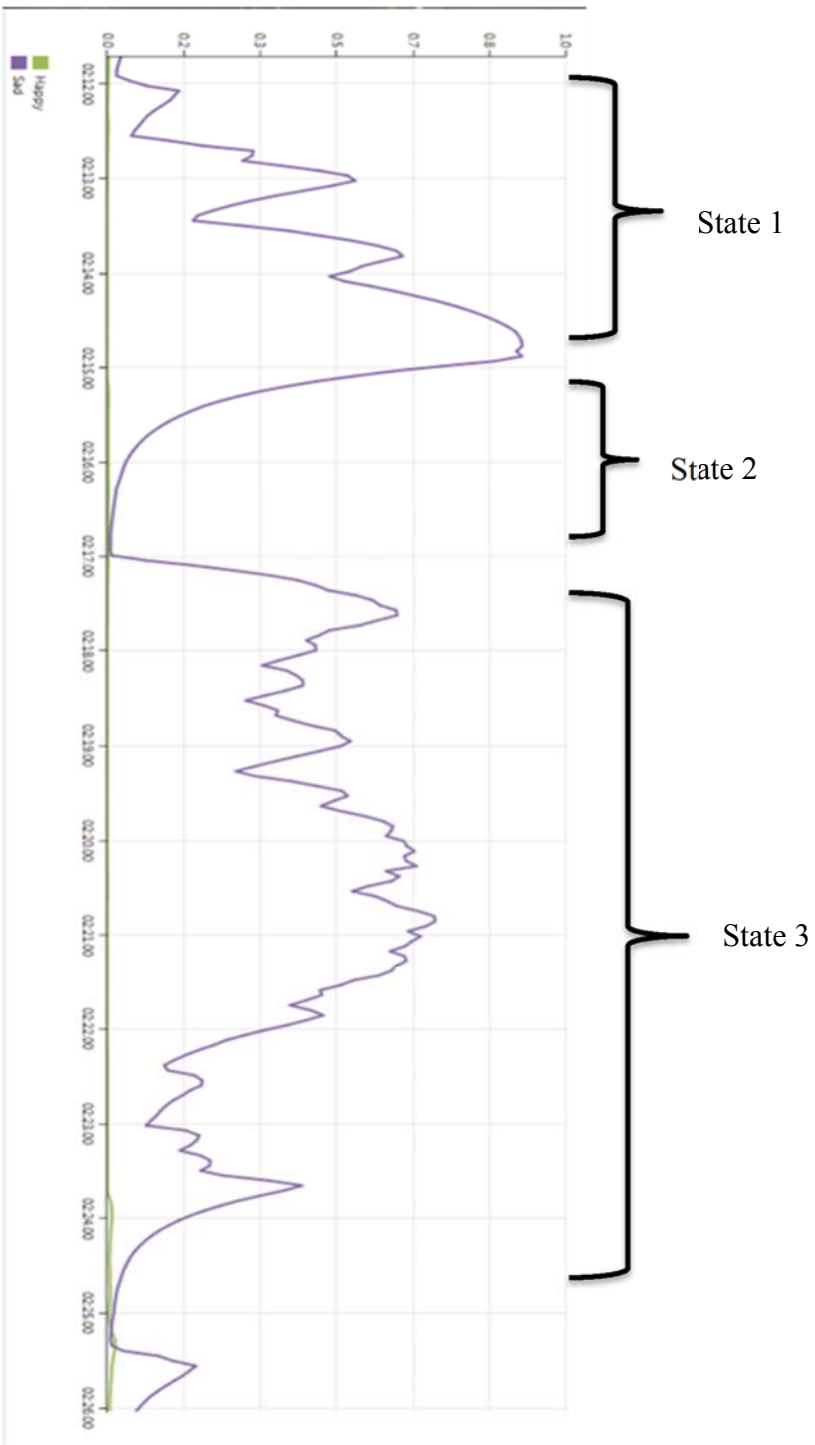


Figure 1. Emotional out of Happiness and Sadness by States

CHAPTER 4

DATA ANALYSIS AND RESULTS

Figure 1 explains the flow of initially screened and eligible participants. A total of 147 women were screened for eligibility and 46 completed all aspects of the research protocol. One-hundred one participants were excluded from the study for not meeting inclusion criteria, being un-responsive, or no longer interested. Forty-six participants consented to the study and completed all aspects of the protocol. Nine participants were excluded due to technology and/or inadequate SenseWear wear time, producing 37 participants for analysis.

Demographics

Table 1 describes the demographic characteristics of the study participants. The sample of women was predominantly middle-aged (age 35 and older) women. Participants were balanced among overweight and obese status, and primarily married with higher levels of education.

Physical activity characteristics measured by SenseWear

Table 2 displays the amount of physical activity recorded by the SenseWear accelerometer. The participants' data included a high amount of wear time with an average of seven valid days. The average amount of steps recorded per day was approximately 7,000. Participants' were predominantly sedentary time, interrupted by brief period of activity totaling an average of 716 mins per day. Light-intensity physical activity was the second highest level of physical activity recorded, showing participants logged approximately 190 minutes per day. Due to the small amounts within moderate-

intensity and vigorous-intensity, these were combined to form moderate-vigorous intensity and this time average a total of 49 minutes per day.

Hypothesis 1: Happy and sad emotions will independently predict variation in physical activity behavior after accounting for physical activity motivation.

Tables 3 through 6, separated by states, describe the results associated with Hypothesis 1 regarding the association of happiness and sadness with physical activity outcomes. Table 3 describes the results for happiness and sadness with all three states combined. There were non-significant associations between happiness and sadness and physical activity variables. Amotivation was negatively associated with sedentary time and positively associated with light-intensity physical activity and moderate-vigorous physical activity (marginal). There was also a trend toward significance for RAI such that intrinsic motivation was negatively associated with sedentary time (marginal) and positively associated with light-intensity physical activity and moderate-vigorous physical activity.

Table 4, comprised of State 1, describes results for happiness and sadness before the start of the interview question. There were significant associations with amotivation; within sedentary time the association was negative but positively associated during light-intensity physical activity. As with the previous model, Table 3, there was no association between amotivation and moderate-vigorous physical activity, but there was a significant association between RAI and sedentary time and a marginal significance between RAI when coupled with light-intensity physical activity.

State 2, as seen in Table 5, exhibits results for happiness and sadness after the interview question has been read. Significant associations were seen between amotivation

and all three levels of physical activity – negative during sedentary time and positive within light-intensity and moderate-vigorous physical activity. Autonomy was only negatively associated with sedentary time, however there may be a slight marginal association with light-intensity physical activity. This state had the most significant values.

The final model, Table 6, illustrates State 3 wherein results for happiness and sadness occur just before the start of the interview question answer. There was a significant association (negative) between amotivation and sedentary time. During light-intensity physical activity, the significant association was positive when coupled with amotivation.

Hypothesis 2: Happy and sad emotions will moderate the relationship between physical activity motivation and physical activity behavior, such that individuals exhibiting higher levels of happiness and lower levels of sadness will have a stronger motivation-physical activity behavior relationship.

Marginally significant interactions were observed were between sadness and autonomy in State 3 (Figure 5). The association was observed for sedentary time and light-intensity physical activity, but not moderate-vigorous physical activity. Among participants with higher level of sadness, the negative relationship between autonomy sedentary times was stronger than for participants with lower levels of sadness.

Similar to sedentary time, light-intensity physical activity (Figure 6), showed comparable results. Participants with a higher level of sadness displayed a positive relationship between autonomy and light-intensity physical activity. However, the low

sadness amounts in the activity level revealed only a small change in movement when moving within motivation.

Table 1. Demographic characteristics of the study sample.

	N (%)
N	37
Age (years), M ±SD	43.90 ± 11.9
18-34 years	9 (24.0)
35-49 years	14 (38.0)
50-65 years	14 (38.0)
Body mass index (kg/m^2), M ±SD	30.46 ± 4.8
Overweight	22 (59.0)
Obese	15 (41.0)
Marital Status	
Single/Dating	7 (19.0)
Divorced	7 (19.0)
Married/Partnership	23 (62.0)
Education	
High School/Some College	5 (13.5)
2/4-year Degree	10 (27.0)
Advanced Degree	22 (59.4)

Table 2. Acceleromtery-derived physical activity characteristics measured by Sensewear Armband.

	Mean	±SD	Minimum	Maximum
Total wear time, min	1344.2	± 51.7	1156	1423
Wear day time, min[a]	960.0	± 50.5	851	1073
Valid Days[b]	6.9	± 1.0	5	9
Steps/day	7071.6	± 2828.0	2544	13873
Sedentary time, %[c]	74.6	± 12.7	45	92
Light-intensity physical activity, %[d]	19.8	± 9.5	7	42
Moderate-intensity physical activity, %[e]	4.8	± 4.0	0	14
Vigorous-intensity physical activity, %[f]	0.3	± 0.5	0	2

[a] A valid wear day was defined non-sleep time categorized as "on body" time by Sensewear Arm band. Only days with a minimum of 10 valid hours were retained.

[b] A minimum of four valid days, including one weekend day, was also required.

[c] Activities < 1.5 METs

[d] Activities ranging between 1.5 to < 3.0 METs

[e] Activities ranging between 3.0 to < 6.0 METs

[f] Activities > 6.0 METs

Table 3. Multiple regression models for self-determined behavior and happiness and sadness variables during All States as correlates of sedentary time, light-intensity physical activity, and moderate-vigorous physical activity.

	beta	*SE*	*p*
Sedentary time			
RAI	-0.05	0.03	0.05
Amotivation	-1.18	0.55	**0.04**
Happiness	-1.36	5.59	0.81
Sadness	-1.31	1.97	0.51
Happiness X RAI	-0.64	1.67	0.71
Happiness X Amotivation	-1.07	33.80	0.98
Sadness X RAI	-0.32	0.39	0.43
Sadness X Amotivation	-11.17	12.11	0.37
Light-intensity physical activity			
RAI	0.06	0.03	0.09
Amotivation	1.73	0.71	**0.02**
Happiness	0.24	7.19	0.97
Sadness	0.87	2.54	0.73
Happiness X RAI	0.72	2.15	0.74
Happiness X Amotivation	1.77	43.52	0.97
Sadness X RAI	0.47	0.50	0.36
Sadness X Amotivation	14.83	15.57	0.35
Moderate-Vigorous physical activity			
RAI	0.05	0.03	0.15
Amotivation	1.43	0.74	0.07
Happiness	4.41	7.53	0.56
Sadness	-0.84	2.66	0.75
Happiness X RAI	-0.28	2.26	0.90
Happiness X Amotivation	-16.25	45.47	0.72
Sadness X RAI	-0.38	0.53	0.48
Sadness X Amotivation	-11.02	16.46	0.51

All models are adjusted for age, body mass index, marital status and education.

Table 4. Multiple regression models for self-determined behavior and happiness and sadness variables during State 1[a] as correlates of sedentary time, light-intensity physical activity, and moderate-vigorous physical activity.

	beta	*SE*	*p*
Sedentary time			
RAI	-0.05	0.03	**0.04**
Amotivation	-1.30	0.53	**0.02**
Happiness	-0.08	2.10	0.97
Sadness	-0.05	1.39	0.97
Happiness X RAI	-0.82	1.30	0.54
Happiness X Amotivation	-5.17	16.35	0.76
Sadness X RAI	-0.04	0.34	0.90
Sadness X Amotivation	-13.15	10.44	0.22
Light-intensity physical activity			
RAI	0.06	0.03	0.07
Amotivation	1.86	0.67	**0.01**
Happiness	-0.46	2.65	0.86
Sadness	-1.50	1.75	0.40
Happiness X RAI	1.00	1.64	0.55
Happiness X Amotivation	8.31	20.58	0.69
Sadness X RAI	0.08	0.43	0.86
Sadness X Amotivation	12.88	13.33	0.34
Moderate-Vigorous physical activity			
RAI	0.05	0.04	0.19
Amotivation	1.42	0.71	0.06
Happiness	0.83	2.83	0.77
Sadness	-0.07	1.87	0.97
Happiness X RAI	0.64	1.76	0.72
Happiness X Amotivation	-7.91	22.00	0.72
Sadness X RAI	-0.17	0.45	0.71
Sadness X Amotivation	-3.19	14.49	0.83

All models are adjusted for age, body mass index, marital status and education.

[a] State 1 is period of time as participant is stating the question.

Table 5. Multiple regression models for self-determined behavior and happiness and sadness variables during State 2[a] as correlates of sedentary time, light-intensity physical activity, and moderate-vigorous physical activity.

	beta	*SE*	*p*
Sedentary time			
RAI	-0.05	0.03	**0.04**
Amotivation	-1.40	0.56	**0.02**
Happiness	0.33	10.04	0.97
Sadness	1.06	1.92	0.58
Happiness X RAI	0.44	3.69	0.91
Happiness X Amotivation	-27.35	62.09	0.66
Sadness X RAI	-0.17	0.35	0.63
Sadness X Amotivation	-5.20	10.48	0.62
Light-intensity physical activity			
RAI	0.06	0.03	0.09
Amotivation	1.89	0.71	**0.01**
Happiness	-4.82	12.80	0.71
Sadness	-1.35	2.45	0.59
Happiness X RAI	-1.42	4.70	0.77
Happiness X Amotivation	30.80	79.25	0.70
Sadness X RAI	0.29	0.44	0.52
Sadness X Amotivation	8.67	13.31	0.52
Moderate-Vigorous physical activity			
RAI	0.05	0.03	0.18
Amotivation	1.84	0.72	**0.02**
Happiness	4.91	12.95	0.71
Sadness	-3.99	2.48	0.12
Happiness X RAI	-2.65	4.74	0.58
Happiness X Amotivation	22.45	80.30	0.78
Sadness X RAI	-0.40	0.44	0.38
Sadness X Amotivation	-11.40	13.39	0.40

All models are adjusted for age, body mass index, marital status and education.

[a] State 2 is period of time when participant is contemplating their answer.

Table 6. Multiple regression models for self-determined behavior and happiness and sadness variables during State 3[a] as correlates of sedentary time, light-intensity physical activity, and moderate-vigorous physical activity.

	beta	*SE*	*p*
Sedentary time			
RAI	-0.05	0.03	0.06
Amotivation	-1.23	0.52	**0.03**
Happiness	0.58	3.19	0.86
Sadness	-2.16	1.41	0.14
Happiness X RAI	-0.04	0.95	0.97
Happiness X Amotivation	5.83	14.43	0.69
Sadness X RAI	-0.65	0.38	**0.09**
Sadness X Amotivation	-5.84	10.70	0.59
Light-intensity physical activity			
RAI	0.05	0.03	0.12
Amotivation	1.74	0.67	**0.02**
Happiness	-0.88	4.13	0.83
Sadness	2.25	1.83	0.23
Happiness X RAI	0.11	1.24	0.93
Happiness X Amotivation	-5.52	18.75	0.77
Sadness X RAI	0.84	0.49	**0.10**
Sadness X Amotivation	10.67	13.80	0.45
Moderate-Vigorous physical activity			
RAI	0.05	0.03	0.20
Amotivation	1.30	0.73	0.09
Happiness	2.04	4.45	0.65
Sadness	1.06	1.97	0.59
Happiness X RAI	-0.02	1.33	0.99
Happiness X Amotivation	-9.32	20.13	0.65
Sadness X RAI	-0.15	0.55	0.80
Sadness X Amotivation	-6.79	14.97	0.65

All models are adjusted for age, body mass index, marital status and education.

[a] State 3 is period of time participant is answering question.

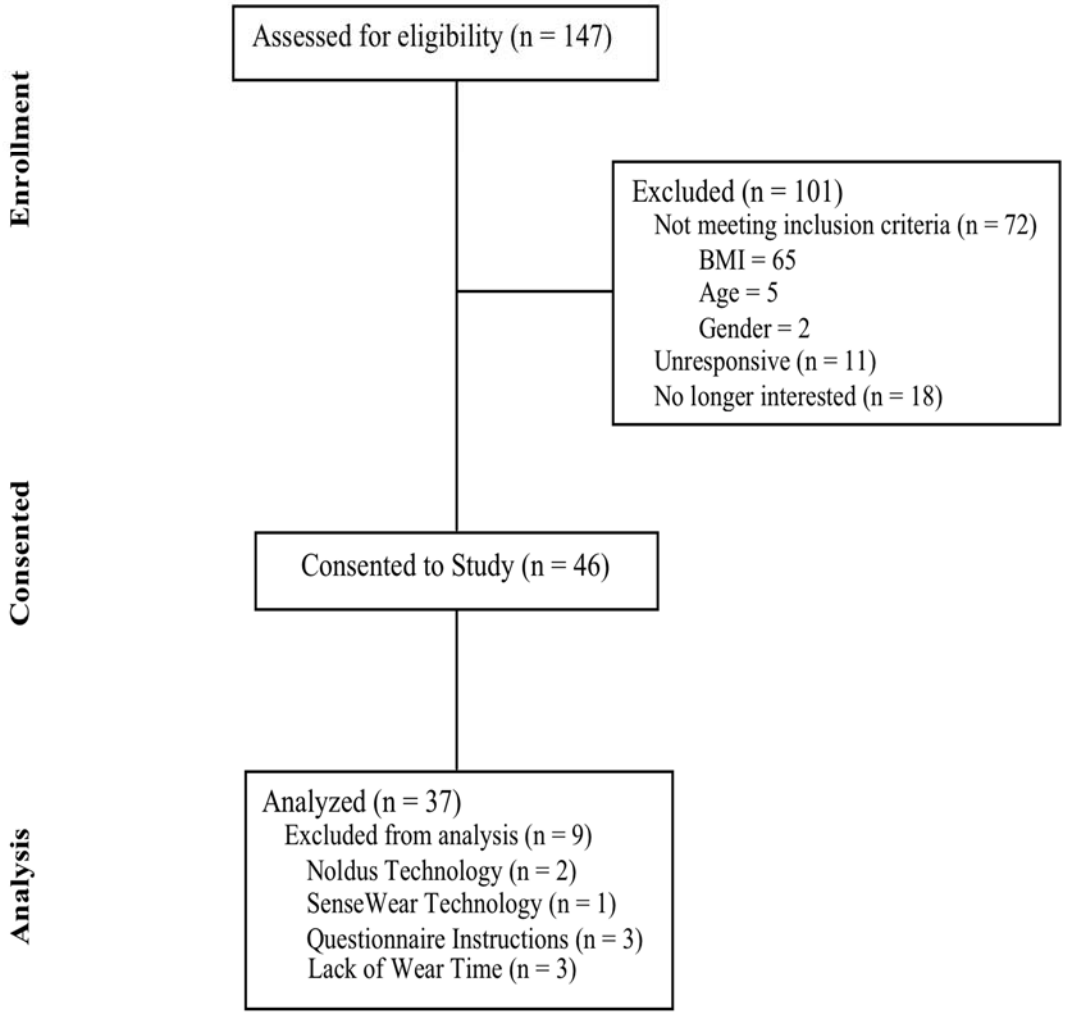


Figure 2. – Flow diagram of study from enrollment to analysis

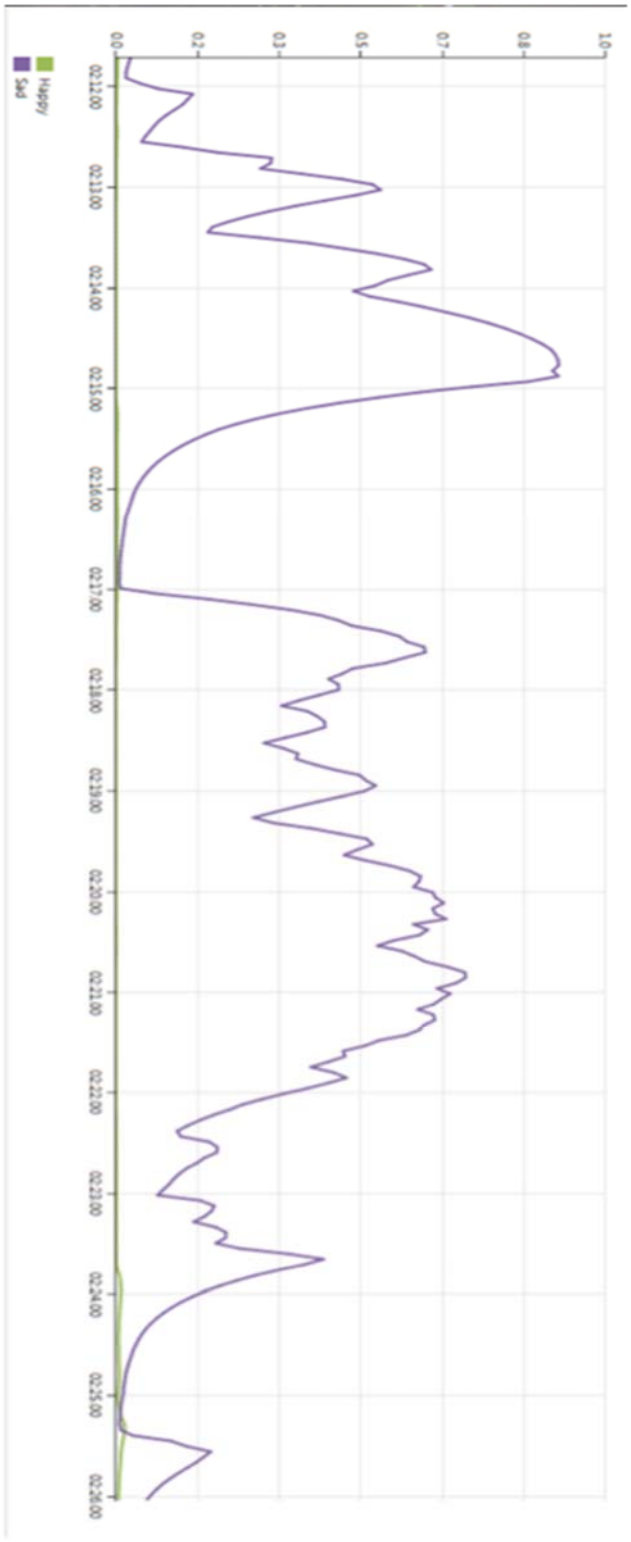
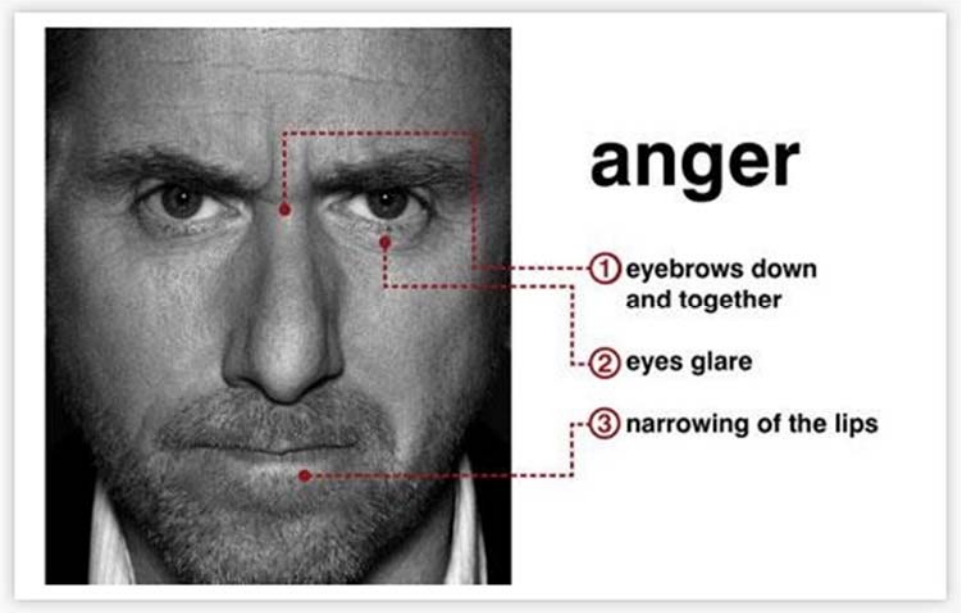


Figure 3. – Emotional output – Happiness and Sadness



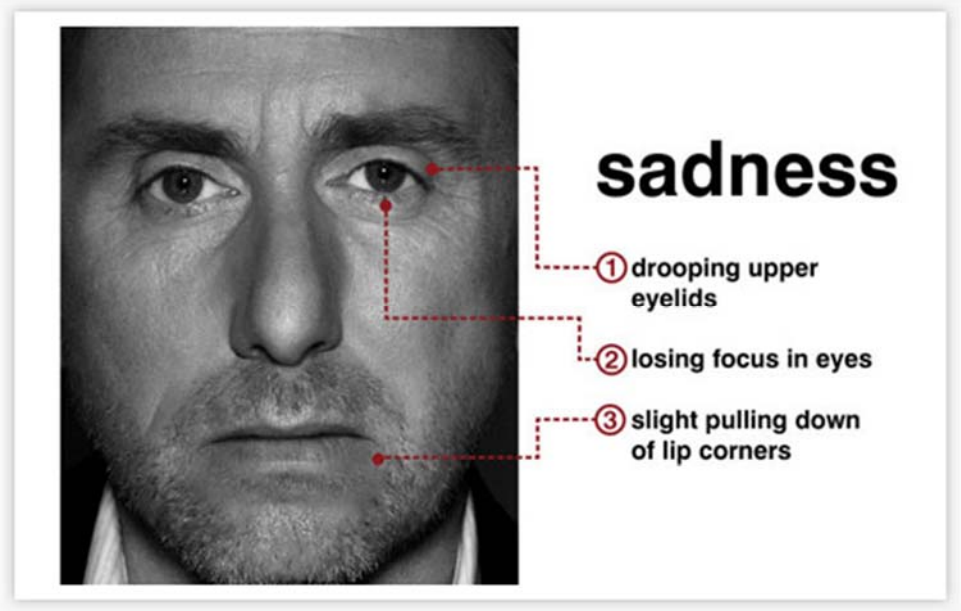


Figure 4. Facial characteristics of Anger and Sadness

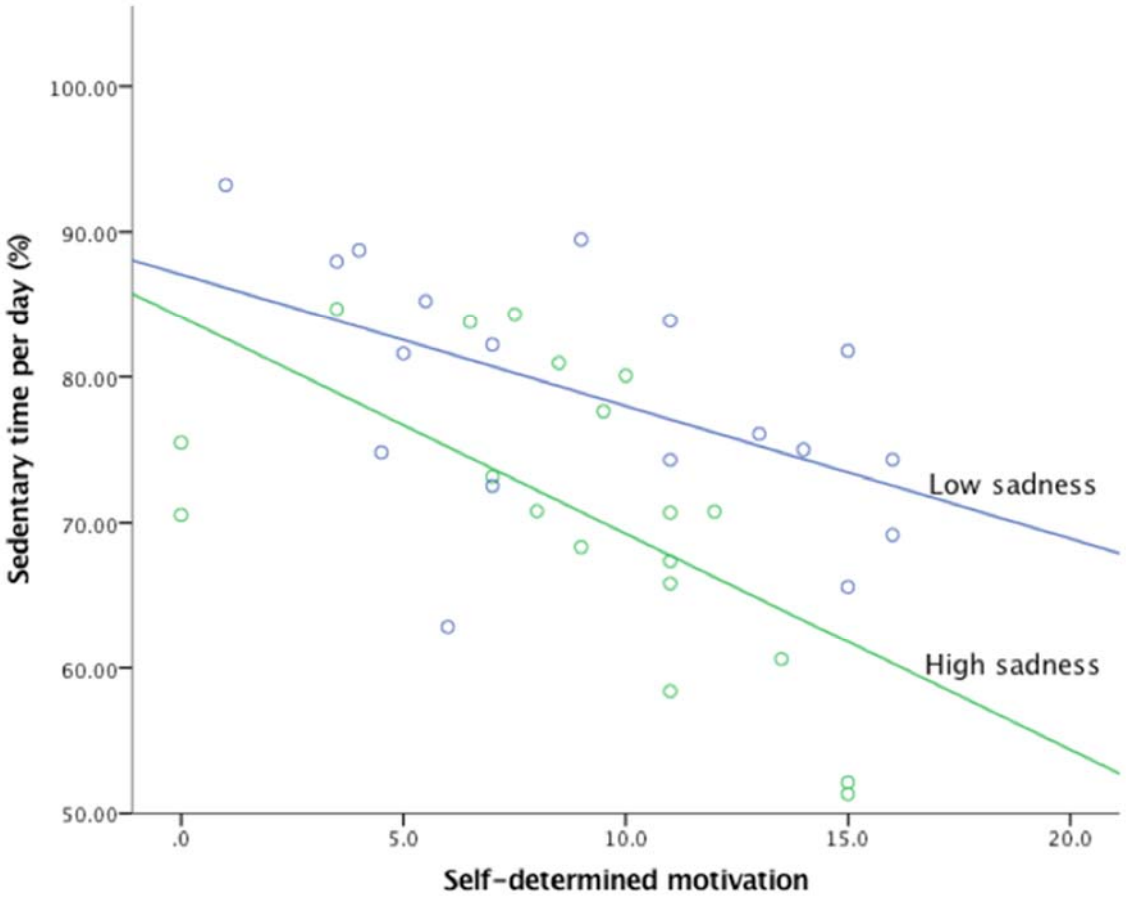


Figure 5. – Model based estimate of low sadness and high sadness in State 3 by sedentary time. Sadness levels were dichotomized at the median split.

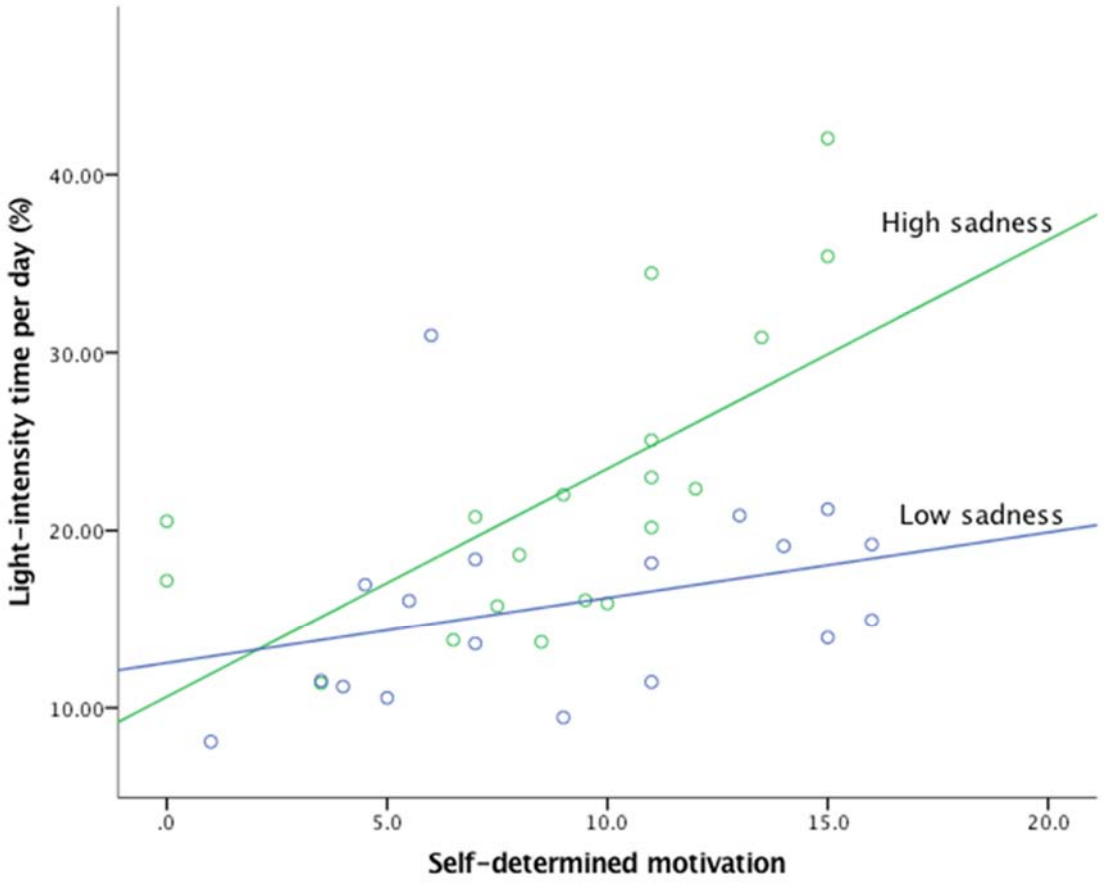


Figure 6. Model based estimate of low sadness and high sadness in State 3 by light intensity. Sadness levels were dichotomized at the median split.

CHAPTER 5

DISCUSSION

The purpose of this study was to examine emotional responses, specifically happy and sad, and its association with physical activity. The research sought to examine this relationship above and beyond the known relationship between self-determined behavior and physical activity in overweight adult women. Objective measures of physical activity and emotional response (via facial analysis software) were used.

Summary of Findings

Few relationships between happiness and sadness and physical activity were observed after accounting for self-determined motivation. Amotivation and intrinsic motivation were modestly associated with physical activity. In some cases, sadness levels modified the relationship between intrinsic motivation and physical activity; however, this relationship was only observed following the verbal responses to self-determined behavior questions (State 3). However Cronbach's Alpha for amotivation was 5.02 and 6.71 for RAI, which indicate poor internal consistency for the subscales.

Self-Determination and Amotivation

This study correlates the collection of self-determination, measured physical activity and emotional response, allowing for a triangulation of data in a sub-set of the population (i.e., women who are overweight/obese). Other prior studies generally examined the factors alone or in pairs, lacking the emotional component (e.g., a 2007 study of 253 college students, which employed the SDT and explored relationships between behavioral regulation and exercise behavior; and in 2009 that explored the relationship between "social physique anxiety (SPA) and physical activity among 381

individuals in relation to the SDT; validation of the BREQ-2 during a 2007 study of 561 Spanish adults who performed physical activities and recreational sports; and studying 513 individuals and the influence of motivation and goals toward physical activity while examining the influence of tobacco and alcohol consumption).

According to past research, one of the most common reasons for not exercising is lack of time; however it is possible participants' perceived "physical activity" during the questionnaire to mean exercise, especially since amounts of MVPA never reached more than five percent. Therefore the explanation surrounding the significance with amotivation, wherein it decreased (negative relationship) during sedentary time and increased during light intensity physical activity (positive relationship) may be explained. By further investigating light intensity physical activities, using the Compendium of PA, an individuals daily to-do list/chores/personal and family responsibilities or the 'stuff of life' can be found, such as (1.5-3 METs): wash dishes, standing [1.8]; cleaning, light effort [2.3]; laundry, putting away clothes [2.3]; cooking/food preparation, walking [2.5]; mopping, light effort [2.5]; putting away groceries, shopping without a grocery cart [2.5]; multiple household tasks all at once, light effort [2.8]; child care, moderate effort [3.0] (Ainsworth, et al., 2011).

Data suggests that what some researchers may perceive as an excuse for not engaging in regular moderate or high intensity physical activity, may in fact be the participant performing "stuff of life"; however they are still performing physical activity despite they just perceived it as completing daily chores of life. In order to encourage those individuals to incorporate exercise, interventions may need to find to focus on quick, easy, and simple ways for them to exercise. The data from this study may suggest

that participants are too busy to exercise but are still obtaining higher amounts of light intensity physical activity. When viewing amotivation, the movement is actually moving in the same direction whether in sedentary time or light intensity physical activity. The results suggest that researchers should look at both angles of how individuals feel about this large amount of 'stuff of life' and how participants can also incorporate exercise based on those with higher levels of sadness. This group may be less satisfied and therefore less happy about all the 'stuff of life' and therefore may be influenced in changing behavior. The opposite may be true with those who did exhibit higher levels of happiness, as despite the high amounts of "stuff of life", amotivation is not going to be the key variable to change.

The mean score of Question 20 from the BREQ-2 "I find physical activity to be a pleasurable activity" was 3.84. On a 5-point Likert scale, these results are closed to four which reads 'Very true for me'. To further explore this hypothesis, the average amount of time participants obtained light intensity physical activity was calculated. Next, those participants with a score greater than mean 195.60, sixteen participants, were segmented and the mean of Question 20 was calculated. The result was a mean score of 4.00 reading as 'very true for me' that they enjoy physical activity. By reviewing the answers to this question along with correlating the amount of time within light intensity physical activity, it is plausible that the participant's comprehension of "physical activity" was the same as "exercise". More research would need to be done to further explore participant perceived definition while also setting standards based on the exact definition the study is researching to remove misperception.

This study adds to the body of knowledge by its findings of significant interactions between sadness and autonomy in the period when participants answered the question (State 3). Additionally, the higher level of sadness associated with more autonomy and less sedentary time demonstrates potential opportunities for behavioral regulation interventions. The results of association between high levels of sadness, a decreased level of motivation and recording more sedentary time shows potential interactions in the observed factors adversely affecting potential physical activity.

Happiness and Sadness beyond Motivation

Participants registering higher sadness and high motivation recorded more light-intensity physical activity thus foreshadowing that this group can decrease sedentary time and stay engaged in physical activity. Participants with similar levels of sadness but with lower motivation logged fewer minutes of activity, whereby increasing their minutes of sitting or lack of physical activity time. Therefore it would be best to affect change with this group so that when the higher motivation days coupled with the higher sadness are present, they feel empowered to get moving. The lack of association between happiness and sadness to the level of physical activity suggests the potential existence of another factor beyond motivation, such as another emotion or trigger (Teixeira, Carraca, Markland, Silva & Ryan, 2012).

Emotional responses moderating motivation-physical activity relationships

The observed associations between happiness and sadness with motivation and autonomy support the potential that levels of optimism and stress may be catalysts or inhibitors with physical activity (Steptoe, Wright, Kunz-Ebrecht & Iliffe, 2006). While this study did not investigate these variables direction, the observed relationships indicate

that interactions may be present. As earlier defined, optimism is where an individual retains control while acquiring their goal (Karademas, 2006; Dumitrache, Windle & Herrera, 2015) while stressed and can align with amotivation. This viewpoint parallels that of the self-determination model due to the individual either having positive or negative momentum, the strength by which to continue in their autonomy. It is the amount of individual drive that will impact happiness and sadness, thereby potentially affecting their health and overall well-being (Hart & Hittner, 1995).

Strengths

The study's strengths include the reliance on valid, reliable instruments including the BREQ-2 questionnaire, validated technology in the SenseWear device and FaceReader software. The utilization of the latter two elements aided in reducing self-reporting errors, either from intentional deception or recency affects. The study's focus on a sub-set of the female population, overweight and obese BMI levels removed potential variability across broader audiences making the ability to detect differences easier.

Limitations

Limitations in this study are related to the size and similarities of the participants in the sample. Although the analysis of the sample produced some sufficient results, some other analyses were not significant but were trending in the hypothesized direction. This suggests that the sample may have been too small to be sensitive enough to detect significant differences in the data. The sample, women in a BMI category of either overweight or obese, is also a limitation for broader application to the entire population. The sample was comprised of higher educated individuals, who generally differ from

their lower educated counterparts in health-seeking behaviors (Qi, Phillips & Hopman, 2006). This investigation of only two emotional factors may have further limited the results of the study. The perception of how participants defined physical activity may have also been a limiting factor. Participants may have perceived 'Physical activity' as 'exercise' since no standard definition was set forth prior to administering BREQ-2. The insight of how each participant defines the term physical activity could potentially yield better results, as this would eliminate any confounding definitions. There are potential limitations associated with the single iteration of data collection on emotion and a longitudinal collection coupled with observed activity may produce differing results related to correlation of sadness and activity. As the design of this study was a single observation, it is possible that the emotional response of the participant may have been contingent on or influenced by other factors related to recency. The collection of multiple data points for a single participant over-time would aid in determining if other factors influence the emotional response. Due to the number of post hoc tests and subsequent decrease in degrees of freedom, the possibility of Type 1 error is increased. As this study is exploratory, the area of research has little previous study according to the literature; future study is necessary to confirm the associations of this empirical investigation. The nature and purpose of this study was to examine potential relationships between variables, but not designed to confirm relationships. Future investigation, further refinement and additional analysis may yield a more definitive understanding of the relationship within variables as well as provide additional research questions and techniques ("Exploratory Design," n.d.)

Future Directions

A larger sample with greater diversity in BMI and levels of physical activity would potentially yield different results. In analysis of the data for this study there was no baseline of emotions for comparison using all BMIs and all activity levels. This means that other significant differences may exist between the sample population and the general population that is not calculable due to lack of baseline data for the population. Given that this was a sample of women who are overweight and only engaged in sedentary or low levels of physical activity, they may differ in emotional response data from women with lower BMI's or higher levels of physical activity.

Additionally, investigation into the full emotional profile between the period at the conclusion of a question and the start of the next question, wherein a flurry of emotional activity occurred, would provide additional insight into the range and sequence of emotions when answering the questionnaire. It is possible that the emotions during the period of time between questions may be important in the overall understanding of the emotional response. The addition of instruments to measure optimism and stress would also provide additional insight into potential co-variables or confounders. This increased scope of study with a larger sample size could aid in determining the potentially use of this approach. The incorporation of a longitudinal design may also aid in determining if the correlation of sad and motivation is steady or variable. Obtained data from this study could be transcribed through Layered Voice Analysis to further enhance the emotional state and potentially detect further associations between autonomy and physical activity.

Additional questions should be proctored to participants on if they have children since this variable contributes to the 'stuff of life' equation and have them define, by

way of a multiple choice question (in order to keep the answers same across the board), the definition of physical activity before administering BREQ and using that perception. These Researchers understand the difference between physical activity and exercise however the participants may have perceived the word to mean exercise.

Finally, individualized programs, arranged with the SDT theory, could be constructed for individuals with varying levels of sadness (high and low) in terms of obtaining light intensity physical activity. As the interactions suggested, participants that had higher amounts of sadness exhibited higher amounts of motivation and light physical activity. This might be explained by the 'stuff of life' that the individual has to complete on a daily basis. The high sadness may be attributed to not being content with their current way of life despite the minimum amount of light intensity physical activity was achieved. Low sadness participants while still motivated, acquired lower amounts of light intensity physical activity. Hence, in order to assist the participants' with higher levels of sadness, it may be worthwhile to implement group or one-on-one programs that allow the women to express their emotions while conversing about the "stuff of life." This strategy, which may lead lower amounts of stress, could be coupled with giving the participant options for obtaining either amounts of light intensity physical activity or potentially moderate-vigorous. By suggesting increased amounts of physical activity, sadness levels may also decrease since exercise or higher MET levels (moderate-vigorous physical activity) increase happiness (Stubbe, de Moor, Boomsma & de Geus, 2007).

Conclusion

This study demonstrates a proof-of-concept for the integration of empirical evaluation of happy and sad emotion into the research of motivation toward physical

activity. While future study is necessary, the results indicate that happy and sad emotion are a factor that should be studied further in relation to motivation and physical activity.

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APPENDIX A

RECRUITMENT BLURB

Blurb for Announcements/Sparky's Scoop/Well Devils:

Participants needed for new ASU health study

A student project in the School of Nutrition and Health Promotion uses innovative technology to examine women's health, exercise and emotions. Qualified participants receive a free gift card. Learn more [link to flier]

Interested in joining the study? Fill out the brief survey.

APPENDIX B

RECRUITMENT FLYER

Participants Needed for New ASU Health Study

Who Can Participate?

- You must be a woman
- Age 18 -65
- Overweight

What do participants receive?

- $25 gift card

What does a participant do?

- Complete a brief survey to determine eligibility
- Wear sensor that measures your activity level and sleep for 7 consecutive days
- Participate in a 1 hour session on the Downtown ASU campus and complete a questionnaire

Interested in participating in this study?

Complete a brief survey:

http://bit.ly/ASUBehaviorStudy

Or you email:

behaviorstudy@asu.edu

APPENDIX C

PARTICIPANT SCREENER

Default Question Block

EMOTIONAL RESPONSE QUESTIONNAIRE by ADULT WOMEN STUDY

Dear Participant:
Thank you for your interest in this study. I am a master's student in the School of Nutrition and Health Promotion at Arizona State University. I am conducting a research study to determine what emotional outcomes on individuals are after verbally answering an exercise questionnaire using facial analysis software.

The following questions are meant to collect some information about you to determine whether you are eligible for the study. The completion of this form does not mean that you are consenting to participate in the study; but rather, you are interested in learning more.

If you are eligible for the study, and wish to participate, you will be asked to wear an activity sensor, which will monitor your daily living activities for 6 nights and 7 days. You will then be scheduled for a 1 hour lab laboratory visit at the ASU Downtown Phoenix campus. You will receive a $25 gift card as compensation for your participation in the study. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. You must be 18 or older to participate in the study.

If you have any questions concerning the research study, please contact my faculty advisor, Dr. Matthew Buman at (602) 827-2289. If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788. Filling out the information below simply will indicate that you are interested in learning more about the study. A research staff member will be in contact to advise if you are eligible and to provide you with more information about the study.

Sincerely,

Sarah Bryant
Graduate Student

What is your current age?

- under 18
- 18-64
- 65+

Gender

- Male
- Female

Name (First, Last)

First

Last

Current Weight (pounds)

NOTE: To ensure your eligibility, please be as accurate as possible.

Current Height (feet and inches)

NOTE: To ensure your eligibility, please be as accurate as possible.

Feet

Inches

Phone Number (include area code)

Preferred Contact Method (pick one)

- Phone
- Email
- Text

Email Address

Most Available Time for Study Participation

	Morning	Afternoon
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		

APPENDIX D

INFORMED CONSENT ONLINE

Arizona State University
Emotional Response to an Exercise Questionnaire in Overweight Women
PARTICIPANT CONSENT

Principal Investigator: Matthew Buman, Ph.D.

Co-Investigators: Eric Hekler, Ph.D.,
Mónica Gutierrez, MSW,
Sarah Bryant
Glenn Brown

INTRODUCTION

The purposes of this form are to provide you (as a prospective research study participant) information that may affect your decision as to whether or not to participate in this research and to record the consent of those who agree to be involved in the study.

RESEARCHERS

Drs. Buman, Hekler, Professors in the School of Nutrition and Health Promotion at Arizona State University, and Ms. Gutierrez and Bryant, have invited your participation in a research study at this institution.

STUDY PURPOSE

The purpose of the research is to examine emotional response when verbally responding to an exercise questionnaire using facial analysis software.

DESCRIPTION OF RESEARCH STUDY

Before you complete Phase One (wearing the activity sensor), as this is part of a larger research investigation, we ask you to sign this Participant Consent indicating that you agree to participate in the study.

If you say AGREE, then your participation will last for up to one week, concluding on your lab visit. First, you will be mailed and wear a SenseWear™ device on your upper left arm for 6 consecutive nights and 7 consecutive days. This device will track your physical activity and sleep. You will complete a log any time you take the device off and report your bed and wake times. Following this week period, you will bring the device and log with you to your in-person lab visit where you be asked to complete a 20 minute survey. This survey will be conducted verbally with a member of our research team. The survey questions will relate to your reasons for exercising. During this survey you will be both video and audio recorded, while seated at a table, having only the upper half of your body, including your face, visible. If you do not want to be video and audio taped, you should not participate in this study. In total, this lab visit will take approximately 1 hour to complete.

RISKS

There is a possibility that you may feel some mild discomfort associated with being monitored and/or recorded. You may also be asked some questions about your exercise that may make you uncomfortable. You are free not to answer any questions. As with any research, there is some possibility that you may be subject to risks that have not yet been identified.

BENEFITS

There are no direct benefits from participation in this study.

NEW INFORMATION

If the researchers find new information during the study that would reasonably change your decision about participating, then they will provide this information to you.

CONFIDENTIALITY

All information obtained in this study is strictly confidential unless law requires disclosure. The results of this research study may be used in reports, presentations, and publications, but the researchers will not identify you. In order to maintain confidentiality of your records, our research team will code all data so that they do not contain any information that could identify you. All confidential information will be kept in a locked filing cabinet in Dr. Buman's office or on a password-protected computer, and will only be available to members of the research team. All study materials will be destroyed 5 years after the study has been completed or upon your withdrawal from the study. All study-related documents will be shredded.

WITHDRAWAL PRIVILEGE

Taking part in this research study is totally your choice. It is ok for you to say no. Even if you say yes now, you are free to say no later. You can decide to stop taking part in this research study at any time for any reason. Your decision will not affect your relationship with Arizona State University or otherwise cause a loss of benefits to which you might otherwise be entitled. Withdrawal from the study will not affect your grade, treatment, care, and employment status, as appropriate.

COSTS AND PAYMENTS

Your decision about participating in the study is to be absolutely voluntary. In order to compensate for your time and travel, you will receive a one-time gift card valued at $25.00. There is no cost to you for participating in this research study.

COMPENSATION FOR ILLNESS AND INJURY

If you agree to participate in the study, then your consent does not waive any of your legal rights. However, no funds have been set aside to compensate you in the event of injury.

VOLUNTARY CONSENT

Any questions you have concerning the research study or your participation in the study, before or after your consent, will be answered by Dr. Matthew Buman. You can contact him at 500 North 3rd Street, Phoenix, Arizona, 85004, matthew.buman@asu.edu, or 602-827-2289.

If you have questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at 480-965-6788.

This form explains the nature, demands, benefits and any risk of the project. By signing this form you agree knowingly to assume any risks involved. Remember, your participation is voluntary. You may choose not to participate or to withdraw your consent and discontinue participation at any time without penalty or loss of benefit. In signing this consent form, you are not waiving any legal claims, rights, or remedies. A copy of this consent form will be given to you.

I have read, understood, and printed a copy of, the above consent form and desire of my own free will to participate in this study.

- ○ Yes
- ○ No

Thank you for agreeing to participate in this study. Please provide the address to which you would like the physical activity device shipped. The address provided must have an individual age 18 or older to sign for delivery.

Name	
Address	
Address 2	
City	
State	
Postal Code	

APPENDIX E

INFORMED CONSENT

Arizona State University
Emotional Response to an Exercise Questionnaire in Overweight Women
CONSENT FORM

Principal Investigator: Matthew Buman, Ph.D.

Co-Investigators: Eric Hekler, Ph.D.,
Jack Chisum, Ph.D.,
Mónica Gutierrez, MSW,
Sarah Bryant
Glenn Brown

INTRODUCTION

The purposes of this form are to provide you (as a prospective research study participant) information that may affect your decision as to whether or not to participate in this research and to record the consent of those who agree to be involved in the study.

RESEARCHERS

Drs. Buman, Hekler, Professors in the School of Nutrition and Health Promotion at Arizona State University, and Ms. Gutierrez and Bryant, have invited your participation in a research study at this institution.

STUDY PURPOSE

The purpose of the research is to examine emotional response when verbally responding to an exercise questionnaire using facial analysis software.

DESCRIPTION OF RESEARCH STUDY

If you decide to participate, then you will join a study involving research that aims to determine what emotional outcomes are present in individuals after verbally answering questions regarding your exercise habits using the Behavioral Regulation in Exercise Questionnaire (BREQ-2). The BREQ-2 survey is a series of 19 questions that measures engagement and motivation with physical activity. As these questionnaires are usually self-reported data, which does not fully capture emotions, the facial analysis software is essential for collecting any underlying emotions.

Before you complete the lab visit, allowing you to ask questions and address your concerns regarding your participation in the study, we ask you to sign this Informed Consent indicating that you agree to participate in the study.

If you say AGREE, then your participation will last for up to one week, concluding on your lab visit. First, you were mailed and wore the SenseWear ™ device on your upper left arm for 6 consecutive nights and 7 consecutive days. This device kept track of your physical activity and sleep. You were asked to complete a log any time you took the

device off and report your bed and wake times. Following this week period, you brought the device and log with you to your lab visit today. During this visit, you will be asked to complete a 20-minute survey. This survey will be conducted verbally with a member of our research team. The survey questions will relate to your reasons for exercising. During this survey you will be both video and audio recorded, while seated at a table, having only the upper half of your body, including your face, visible. If you do not want to be video and audio taped, you should not participate in this study. In total, this lab visit will take approximately 1 hour to complete.

RISKS

There is a possibility that you may feel some mild discomfort associated with being monitored and/or recorded. You may also be asked some questions about your exercise that may make you uncomfortable. You are free not to answer any questions. As with any research, there is some possibility that you may be subject to risks that have not yet been identified.

BENEFITS

There are no direct benefits from participation in this study.

NEW INFORMATION

If the researchers find new information during the study that would reasonably change your decision about participating, then they will provide this information to you.

CONFIDENTIALITY

All information obtained in this study is strictly confidential unless law requires disclosure. The results of this research study may be used in reports, presentations, and publications, but the researchers will not identify you. In order to maintain confidentiality of your records, our research team will code all data so that they do not contain any information that could identify you. All confidential information will be kept in a locked filing cabinet in Dr. Buman's office or on a password-protected computer, and will only be available to members of the research team. All study materials will be destroyed 5 years after the study has been completed or upon your withdrawal from the study. All study-related documents will be shredded.

WITHDRAWAL PRIVILEDGE

Taking part in this research study is totally your choice. It is ok for you to say no. Even if you say yes now, you are free to say no later. You can decide to stop taking part in this research study at any time for any reason. Your decision will not affect your relationship with Arizona State University or otherwise cause a loss of benefits to which you might otherwise be entitled. Withdrawal from the study will not affect your grade, treatment, care, and employment status, as appropriate.

Arizona State University
Emotional Response to an Exercise Questionnaire in Overweight Women
CONSENT FORM

COSTS AND PAYMENTS

Your decision about participating in the study is to be absolutely voluntary. In order to compensate for your time and travel, you will receive a gift card valued at $25.00. There is no cost to you for participating in this research study.

COMPENSATION FOR ILLNESS AND INJURY

If you agree to participate in the study, then your consent does not waive any of your legal rights. However, no funds have been set aside to compensate you in the event of injury.

VOLUNTARY CONSENT

Any questions you have concerning the research study or your participation in the study, before or after your consent, will be answered by Dr. Matthew Buman. You can contact him at
500 North 3rd Street, Phoenix, Arizona, 85004, matthew.buman@asu.edu, or 602-827-2289.

If you have questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at 480-965-6788.

This form explains the nature, demands, benefits and any risk of the project. By signing this form you agree knowingly to assume any risks involved. Remember, your participation is voluntary. You may choose not to participate or to withdraw your consent and discontinue participation at any time without penalty or loss of benefit. In signing this consent form, you are not waiving any legal claims, rights, or remedies. A copy of this consent form will be given to you.
Your signature below indicates that you consent to participate in the above study.

Subject's Signature	Printed Name	Date
Legal Authorized Representative (if applicable)	Printed Name	Date

Arizona State University
Emotional Response to an Exercise Questionnaire in Overweight Women
CONSENT FORM

By signing below, you are granting to the researchers the right to use the audio that you record for presenting or publishing this research.

_____ _____
Subject's Signature Date

By signing below, you are granting to the researchers the right to use the video that you record for presenting or publishing this research.

_____ _____
Subject's Signature Date

INVESTIGATOR'S STATEMENT

"I certify that I have explained to the above individual the nature and purpose, the potential benefits and possible risks associated with participation in this research study, have answered any questions that have been raised, and have witnessed the above signature. These elements of Informed Consent conform to the Assurance given by Arizona State University to the Office for Human Research Protections to protect the rights of human subjects. I have provided (offered) the subject/participant a copy of this signed consent document."

Signature of Investigator_____Date_____

APPENDIX F

POSITIONING SENSEWEAR

SENSEWEAR ACCELEROMETER

The SenseWear accelerometer is an activity monitor worn around the triceps (upper arm) on your **left** arm to record your physical activity and sleep.

HOW TO POSITION THE SENSEWEAR ACCELEROMETER

The monitor should be worn around the triceps (back of the upper arm) on your **left** arm using the provided elastic armband (logo always facing upwards). The monitor should be worn directly over your triceps. Once you put the armband on, slide the monitor to this spot.

Adjust the strap so that it fits on your arm comfortably, then secure the oval pull-tab. Flex the arm a few times to make sure that the strap is neither too tight nor too loose. It should be snug, but comfortable. Once the strap is adjusted to a comfortable tension, you are ready to wear it. You do not need to adjust the strap again in the future. Just slide it on and off.

NOTE: Be careful not to overtighten the armband. If, at any time, you feel constriction or loss of circulation, simply loosen the adjustable strap and refasten it to a more comfortable setting.

HOW TO WEAR THE SENSEWEAR ACCELEROMETER

Keep area around armband and sensor clean, dry and free of lotion and/or oil. You may wear the monitor under your shirts, jackets, dresses, or sweaters.

WHEN TO WEAR THE SENSEWEAR ACCELEROMETER

The monitor should be worn continuously for the 6 nights and 7 consecutive days, **except when you do water-related activities**. The monitor is not waterproof so please take it off before showering, bathing, or participating in any water activities that could get the monitor wet. Make sure you put the monitor back on immediately after water activities and remember to document these activities on the log provided to you.

LIGHTS & SOUNDS

Lights: The green, solid light indicates device has 7+ days of battery life remaining. Should light ever start flashing red, please call the researcher immediately.

SENSEWEAR ACCELEROMETER

Sounds: The device will automatically detect the wearer, usually within 60 seconds, indicated by a series of audio tones. Similar tones will be emitted when device is removed.

CLEANING THE SENSEWEAR ACCELEROMETER
You will probably not need to clean the monitor. However, if it gets dirty, it can be wiped off with a damp cloth. **Do not submerse it in water!**

USING THE SENSEWEAR ACCELEROMETER LOG (see additional handout):
Please use the **Accelerometer Log** to record:

- Any time you take off the monitor for more than 20 minutes. Please record the exact time of day, how long you did not wear the monitor, and the reason for not wearing the monitor.

APPENDIX G

CHARGING SENSEWEAR

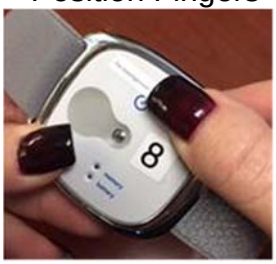
SENSEWEAR ACCELEROMETER

The SenseWear accelerometer is an activity monitor worn around the triceps (upper arm) on your **left** arm to record your physical activity and sleep.

HOW TO CHARGE THE SENSEWEAR ACCELEROMETER

How to remove device?
Please remove the armband by slipping it off your arm. You will need to firmly but carefully press the SenseWear unit out of the armband, in order to access the USB port.

Position Fingers



Press Out

USB Location

How to assemble for charging?
Plug in the charging cable, next insert the cable into the wall charger and lastly, plug the entire unit into an electrical outlet.

Plug Cable into Device

Cable to Wall Charger

Entire Unit Charging

How do I know when it is charged?
The light above the word "battery" will be one of the following colors:

- Green (flashing) = Charged, Ready for Use
- Amber [orange] (flashing) = In process of Charging
- Red (flashing) = Need to Charge Device

You can press the Gray Status button to check battery life.

How to assemble device after charging?
Please align the unit and armband, so that the USB port lines up with the USB rubber bumper. Press firmly as the unit will snap into place. If the USB port is not aligned with the armband correctly, the unit will not fit. You will now be able to slip the device back onto your arm.

Align USBs

Rubber Bumper

Snap into Place

Questions?
Send an email to behaviorstudy@asu.edu if you have any questions or concerns.

APPENDIX H

ACCELEROMETER LOG

PTID: _____

ACCELEROMETER LOG

PLEASE RECORD ANY TIMES DURING WHICH YOU WERE NOT WEARING YOUR DEVICE FOR AT LEAST 20 MINUTES. PLEASE ENTER THE **EXACT** TIME AND ONE OF THE FOLLOWING CODES:

1 - BATHING/SHOWERING 2 - SWIMMING/WATER ACTIVITIES 3 - FORGOT 4 - OTHER (indicate reason)

Date	**Day You Receive Monitor**	Waketime: _____	Waketime: _____	Waketime: _____	Waketime: _____	Waketime: _____	Waketime: _____
	Bedtime:	Bedtime:	Bedtime:	Bedtime:	Bedtime:	Bedtime:	**Day You Return Monitor**
Time	_____	_____	_____	_____	_____	_____	
12:00 AM							
1:00 AM							
2:00 AM							
3:00 AM							
4:00 AM							
5:00 AM							
6:00 AM							
7:00 AM							
8:00 AM							
9:00 AM							
10:00 AM							
11:00 AM							
12:00 PM							
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2:00 PM							
3:00 PM							
4:00 PM							
5:00 PM							
6:00 PM							
7:00 PM							
8:00 PM							
9:00 PM							
10:00 PM							
11:00 PM							

APPENDIX I

BEHAVORIAL REGULATION EXERCISE QUESTIONNAIRE (BREQ-2)

EXERCISE REGULATIONS QUESTIONNAIRE (BREQ-2)

Age: _____ years **Sex: male female (please circle)**

WHY DO YOU ENGAGE IN EXERCISE?

We are interested in the reasons underlying peoples' decisions to engage, or not engage in physical exercise. Using the scale below, please indicate to what ex- tent each of the following items is true for you. Please note that there are no right or wrong answers and no trick questions. We simply want to know how you personally feel about exercise. Your responses will be held in confidence and only used for our research purposes.

		Not true for me		**Sometimes true for me**		**Very true for me**
1	I exercise because other people say I should	0	1	2	3	4
2	I feel guilty when I don't exercise	0	1	2	3	4
3	I value the benefits of exercise	0	1	2	3	4
4	I exercise because it's fun	0	1	2	3	4
5	I don't see why I should have to exercise	0	1	2	3	4
6	I take part in exercise because my friends/family/partner say I should	0	1	2	3	4
7	I feel ashamed when I miss an exercise session	0	1	2	3	4
8	It's important to me to exercise regularly	0	1	2	3	4
9	I can't see why I should bother exercising	0	1	2	3	4
10	I enjoy my exercise sessions	0	1	2	3	4

11	I exercise because others will not be pleased with me if I don't	0	1	2	3	4
12	I don't see the point in exercising	0	1	2	3	4
13	I feel like a failure when I haven't exercised in a while	0	1	2	3	4
14	I think it is important to make the effort to exercise regularly	0	1	2	3	4
15	I find exercise a pleasurable activity	0	1	2	3	4
16	I feel under pressure from my friends/family to exercise	0	1	2	3	4
17	I get restless if I don't exercise regularly	0	1	2	3	4
18	I get pleasure and satisfaction from participating in exercise	0	1	2	3	4
19	I think exercising is a waste of time	0	1	2	3	4

Thank you for taking part in our research

David Markland PhD, C.Psychol
School of Sport, Health & Exercise Sciences
University of Wales, Bangor
E-mail: d.a.markland@bangor.ac.uk
April 2000

APPENDIX J

PARTICIPANT QUESTIONNAIRE

Questionnaire

Emotional Response to an Exercise Questionnaire in Overweight Women

ASU College of Health Solutions

Instructions

Please read each question out loud and then state your answer.

The next question will automatically appear.

Say "OK" When Ready.

Question 1

What mode of transportation did you take to get here today?

Question 2

What is your marital status?

- Married
- Divorced
- Single
- Widowed
- Domestic Partnership
- Committed Relationship
- Dating
- Other

Question 3

What year were you born?

Question 4

What is your gender?

- Man
- Woman

Question 5

What is the highest level of education you completed?

- Less than High School
- High School
- Some College
- 2-year College degree (Associates)
- 4-year college degree (BA, BS)
- Masters degree
- Doctoral Degree/Professional Degree (PhD, MD, JD)
- Other

Do Not Read This Slide Aloud.

BREQ-2 Overview

We are interested in the reasons underlying peoples' decisions to engage, or not in physical activity. Using the scale below, please indicate to what extent each of the following items is true for you. Please note that there are no right or wrong answers and no trick questions. We simply want to know how you personally feel about physical activity. Your responses will be held in confidence and only used for our research purposes.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Say "OK" When Ready.

Do Not Read This Slide Aloud.

Instructions

Please read each question out loud and then state your answer.

Your response will range from '0' to '4.' State the number closest to your answer.

Say "OK" When Ready.

Question 6

I am physically active because other people say I should.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 7

I feel guilty when I'm not physically active.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 8

I value the benefits of physical activity.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 9

I'm physically active because it's fun.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 10

I don't see why I should have to be physically active.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 11

I take part in physical activity because my friends/family/partner say I should.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 12

I feel ashamed when I miss a physical activity session.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 13

It's important to me to regularly be physically active.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 14

I can't see why I should bother being physically active.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 15

I enjoy being physically active.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 16

I am physically active because others will not be pleased with me if I don't.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 17

I don't see the point of being physically active.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 18

I feel like a failure when I haven't been physically active in a while.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 19

I think it is important to make the effort to regularly be physically active.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 20

I find physical activity a pleasurable activity.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 21

I feel under pressure from my friends/family to be physically active.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 22

I get restless if I don't complete physical activities regularly.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 23

I get pleasure and satisfaction from participating in physical activity.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Question 24

I think physical activities are a waste of time.

Not true for me		Sometimes true for me		Very true for me
0	1	2	3	4

Do Not Read This Slide Aloud.

Thank You

ASU College of Health Solutions