Lindsey Nanney. SELF-DETERMINATION THEORY AND MOVEMENT TECHNOLOGY IN COLLEGE PHYSICAL ACTIVITY CLASSES. (Under the direction of Dr. Matthew T. Mahar) Department of Kinesiology, July 2014.

The college-age population is not sufficiently physically active and physical activity declines markedly during the college years. Interventions in university and college settings are potential avenues for increasing physical activity in this population. **Purpose:** The purpose of this study was to examine the effect of need-supportive class environments and conventional class environments, with and without the use of movement technology, on college students' self-determined motivation for physical activity and physical activity levels. A secondary purpose was to examine changes in physical activity enjoyment and physical activity Stage of Change. **Methods:** The thesis was designed as a main study and a substudy. For the main study, a self-determination theory based, need-supportive teaching intervention was developed and implemented with a group of randomly selected graduate student instructors (n = 7) of a basic instruction college physical activity class (n = 34 classes and 730 students). The other instructors (n = 7) received conventional training for graduate student instructors and were told to teach as usual (n = 36 classes and 775 students). Students (N = 1,505, M age = 19.4 ± 1.4 years) completed online questionnaires at the beginning, middle, and end of the semester. Self-determined motivation was assessed with the Revised Behavior Regulation in Exercise Questionnaire. Physical activity was assessed using the 30-Day Physical Activity Recall, the 8-response physical activity self-report measure, and the International Physical Activity Questionnaire-short form. Level of need satisfaction for physical activity was assessed using the Perceived Need Satisfaction in Exercise Scale and student perception of need support was assessed using an expanded version of the Learning Climate Questionnaire. Physical activity enjoyment was assessed using a five-item version of the Exercise Enjoyment Scale and Stage of

Change was assessed using a four-item questionnaire. For the substudy, a sample of students (*N* = 75) wore pedometers at the beginning and end of the semester for one week to objectively assess physical activity. In the substudy, a randomly selected sample of students ($n = 34$) wore a Fitbit Flex (Fitbit) everyday throughout the semester. The substudy comparison group ($n = 41$) did not wear a Fitbit monitor. The Fitbit is a commercially available monitor that can be used to assess physical activity, provide feedback, self-monitor, and set goals. Intervention effectiveness was evaluated with a series of mixed model analyses of variance and effect size estimates via Cohen's delta (*d*). **Results:** Results indicated no meaningful differences in students' perception of need-support between the need-supportive and conventional teaching conditions ($d = 0.13$ to 0.19). For the main study, changes in self-determined motivation for physical activity, self-reported physical activity level, physical activity enjoyment, and Stage of Change across time points did not differ by teaching condition ($p > .05$, $d < 0.15$). In the substudy, students in the conventional teaching condition increased an average of 621 steps per day from time 1 to time 3, while students in the need-supportive teaching condition decreased by an average of 816 steps per day from time 1 to time 3. The difference in step changes from time 1 to time 3 across teaching conditions was medium to large ($d = 0.66$). In the substudy, all students showed decreases in objectively measured steps per day from time 1 to time 3, possibly due to the time of the semester in which the pedometer assessment was conducted. However, students who wore a Fitbit had a lesser decrease in steps per day (decrease of 104 steps per day, $d = -0.05$) compared to students who did not wear a Fitbit (decrease of 461 steps per day, $d = -0.18$). The effect size of the difference in changes in steps per day between Fitbit groups was small ($d = 0.16$). From time 1 to time 3, self-reported physical activity increased more in the students who wore a Fitbit than in students who did not wear a Fitbit ($d = 0.28$ to 0.32). Changes in self-determined motivation for physical activity, physical activity enjoyment, and Stage of Change were similar for Fitbit groups ($p > .05$, $d \leq 0.16$). Intrinsic regulation was the only motivational variable that increased more among students who wore a Fitbit compared to students who did not wear a Fitbit (d = 0.33). **Conclusion:** The need-supportive teaching condition had no meaningful effect on changes in any variable across time. A true disparity between the need-supportive and conventional teaching conditions was not created in the current study, which may explain why no teaching condition effect was found. Results of the substudy suggest that commercially available activity monitors, such as the Fitbit, can have a small positive impact on physical activity and intrinsic regulation for physical activity. Further intervention research should be conducted in university and college physical activity class settings to determine aspects of teaching environments that help students make choices that result in physically active lifestyles.

Self-determination Theory and Movement Technology

in College Physical Activity Classes

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Lindsey W. Nanney

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SELF-DETERMINATION THEORY AND MOVEMENT TECHNOLOGY IN

COLLEGE PHYSICAL ACTIVITY CLASSES

by

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Chapter 1: Introduction

Regular physical activity prevents many chronic diseases, reduces the risk of all-cause mortality, and improves mental health and quality of life (Kim et al., 2012; Kruk, 2007; Warburton, Nicol, & Bredin, 2006). Physical activity participation can also increase the number of mentally and physically healthy days (Brown et al., 2003). To reap health benefits, published recommendations for physical activity encourage adults to accrue a minimum of 150 minutes of moderate aerobic physical activity each week, 75 minutes of vigorous aerobic physical activity each week, or a combination of the two (USDHHS, 2008). Though the benefits of physical activity are well supported, only 48% of adults self-report meeting aerobic physical activity recommendations (CDC, 2007) and fewer than 5% meet aerobic recommendations when measured objectively with accelerometer (Troiano et al., 2008).

College students are of special interest because research suggests they are in a critical time of physical activity decline (Kwan, Cairney, Faulkner, & Pullenayegum, 2012). Trends in physical activity engagement show a marked decrease during the transition to college-age years (Caspersen, 2000). Several publications have reported that a large portion of the college-age population is not accruing enough physical activity to meet aerobic recommendations (Huang et al., 2010; Irwin, 2004; Mack, Wilson, Lightheart, Oster, & Gunnell, 2009). College physical activity classes may be a potential intervention environment to promote physical activity. Access to students for potential positive impact is great due to the prevalence of required basic instruction physical education in colleges and universities (Hensley, 2000; Kulinna, Warfield, Jonaitis, Dean, & Corbin, 2010). Currently, evidence is insufficient to assess the effectiveness of these programs (Guide to Community Preventive Services, 2000). The college physical activity class setting is one that could use strong intervention and instruction to positively impact physical activity engagement (Keating et al., 2005).

Potential strategies to increase physical activity in college physical education classes should be considered. One avenue for developing intervention strategies is to incorporate theoretical constructs that have been associated with physical activity participation. One such theory is self-determination theory [SDT] (Deci & Ryan, 2000). The theory proposes motivation fits into three categories, amotivation, extrinsic motivation, and intrinsic motivation that lie along a continuum, in that order. When an individual's motivation lies closer to intrinsic motivation along the continuum, his or her motivation is said to be more self-determined and more sustainable. Across studies, findings suggest that more self-determined motives for physical activity lead to greater adherence, exercise frequency, intensity, and duration (Duncan et al., 2010; Ryan et al., 1997; Silva et al., 2011). Self-determination theory also proposes three innate psychological needs that, when met, move individuals closer to intrinsic motivation. These psychological needs include autonomy, competence, and relatedness. Intervention approaches based on SDT that include autonomy, competence, and relatedness support (deemed need-supportive) are theorized to provoke higher self-determined motivation and higher physical activity levels (Deci & Ryan, 2000). Research in physical education settings shows that need-supportive teaching can increase self-determined motivation for physical activity (Cheon et al., 2012; Edmunds et al., 2008; Standage et al., 2005; Zhang et al., 2011).

Another potential avenue for increasing motivation is through activity monitors. New, easily obtainable, activity monitors are quickly emerging and may be a potential physical activity motivator in the college-age population. This "movement technology" includes activity measures such as steps, calories burned, and distance traveled. Most measures are displayed instantly on the device. Though these devices have not been studied extensively, they might impact physical activity similarly to pedometers because they include instant step measures and facilitate self-monitoring, goal setting, as well as provide instant feedback. Research supports that pedometers can increase physical activity (Bravata et al., 2007; Croteau, 2004a; Scofield, Mummery, & Schofield, 2004; Shore, Sachs, DuCette, & Libonati, 2013; Van Dyck et al., 2013). The new devices' features on the display and the many features of their websites and phone applications make them a potential motivator, beyond the scope of pedometers. Therefore, the motivational effects of these devices should be studied apart from pedometers.

Considering the age-related decline and low physical activity prevalence in the college-age population, ways to positively influence this population should be studied (Sparling, 2003). Testing self-determination theory-based teaching styles that adopt need-support and the use of movement technology may offer insights on strategies to increase physical activity motivation and behavior in the college-age population.

Purpose Statement

The purpose of this study was to examine the effect of need-supportive class environments and conventional class environments, with and without the use of movement technology, on college students' need support, need satisfaction, self-determined motivation for physical activity, and physical activity levels. A secondary purpose was to examine changes in physical activity enjoyment and physical activity Stage of Change.

Research Hypotheses

The following hypotheses will be tested:

1. Students in need-supportive class environments would exhibit a greater increase in need satisfaction, self-determined motivation for physical activity, physical activity, physical activity

enjoyment, and Stage of Change than students in conventional class environments. Students in the need-supportive class environments would also exhibit greater levels of need support than the students in the conventional class environments.

2. Students who used movement technology would exhibit a greater increase in self-determined motivation for physical activity, physical activity, physical activity enjoyment, and Stage of Change compared to students who did not use movement technology.

Significance of the Study

Considering the physical inactivity trends of the college-age population it is important to study ways to motivate them to adopt physically active lifestyles. Colleges and universities have the opportunity to impact thousands of individuals in this population. Testing how the college and university settings can most effectively motivate this population towards lifelong physically active lifestyles may reveal strategies that could aid in thwarting the declining physical activity observed in college-age individuals.

Definition of Terms

The following terms were defined for the purposes of this study:

Amotivation is a lack of motivation to engage in a behavior.

Autonomous motivation is a self-directed type of motivation, as opposed to a controlled type, where individuals engage in the activity because they want to and not because they perceive they have to participate. Motivation can have various degrees of autonomous motivation.

Conventional class environments are typical class environments that develop as a function of the teacher's teaching style.

External Regulation is a fully extrinsic form of regulation in which a behavior is performed for some external demand or reward. Locus of causality is external.

Extrinsic Motivation is characterized by engagement in a behavior to obtain some separate outcome.

Identified regulation a less extrinsic form of motivation than introjected regulation, yet not fully intrinsic. A behavior is performed out of a consciousness of the value of the behavior. Motivation is characterized by acceptance of the behavior as personally important. Locus of causality is somewhat internal.

Innate Psychological Needs are autonomy, competence, and relatedness and according to self-determination theory are the basis for self-motivation and what drives internalization of a behavior to be more self-determined. When these innate psychological needs are met they can induce well-being, but when not met, can contribute to ill-being or less self-determined motivation.

Autonomy is a feeling of personal volition.

Competence is feeling effective and capable.

Relatedness is a feeling of acceptance and belonging and being significant in the eyes of others of importance.

Integrated regulation is a more intrinsic form of motivation than identified regulation, yet not fully void of extrinsic causality. A behavior is assimilated into an individual's values and needs and is performed out of congruence with one's identity.

Intrinsic Motivation/Regulation is a preference toward mastery, interest, preference, and/or study of a behavior that represents a source of enjoyment and inherent satisfaction of the activity itself. Locus of causality is completely internal.

Introjected Regulation is a predominantly extrinsic form of regulation in which a behavior is performed to avoid feelings of guilt or to attain feelings of ego enhancement. Locus of causality is somewhat external.

Movement technology refers to an activity monitor comparable to a pedometer and accelerometer, but marketed to and used by the general public. These monitors incorporate several technology features for the use of consumers such as Bluetooth® syncing, passive caloric expenditure predictions, pairing with other websites and applications, and social networking.

Need-supportive environments are environments that provide support for an individual's innate psychological needs: autonomy, competence, and relatedness based on SDT (Deci & Ryan, 2000). Meeting these psychological needs is theorized to enhance self-determined motivation.

Need-thwarting environments are environments that hinder the perception of autonomy, competence, and relatedness and can diminish more self-determined forms of motivation for a behavior associated with the environment. They can encourage more extrinsic regulations for the behavior.

Self-determination is a type of free-will and self-governing of the behavior in which to engage.

Chapter 2: Review of Literature

The purpose of this chapter is to review the literature regarding the prevalence of physical activity among the college-age population and motivational tools that can be used in the context of university-based physical activity classes. This chapter is divided into the following sections: (a) benefits of physical activity, (b) physical activity prevalence in the college-age population, (c) self-determination theory, (d) technology to motivate physical activity, and (e) summary. The intent of this review is to demonstrate the need to promote physical activity among individuals in college and university settings. This review will also examine motivational strategies that can be implemented in college and university physical activity classes.

Physical Activity Benefits

Based on the scientific evidence, it is irrefutable that physical activity has many health benefits. A critical literature review assessing physical inactivity's role in chronic disease development and premature death supports many health benefits to active lifestyles. Warburton et al. (2006) found support for the effectiveness of physical activity in the prevention of cardiovascular disease, type II diabetes mellitus, colon and breast cancer, hypertension, obesity, depression, osteoporosis, and premature death. Another critical review revealed similar support for the health benefits of physical activity. Kruk's (2007) analysis of the literature demonstrated strong evidence that physical activity reduces the risk of colon and breast cancer, heart diseases, and diabetes.

Further supporting the benefits of regular physical activity, Brown et al. (2003) reported that individuals who participated in the recommended amount of moderate and vigorous physical activity reported fewer physically and mentally unhealthy days than those who did not. This study suggests that regular physical activity may positively impact overall quality of life. Kim et al. (2012) provided evidence to support physical activity's benefits to mental health. Through surveillance of 7,674 adults, the researchers revealed that those who participated in at least two and a half hours of physical activity each week were 1.39 (95% CI: 1.1, 1.75) times more likely to have better mental health than those who did not. However, despite the support for the benefits of physical activity, activity participation remains low in the college-age population.

Physical Activity Prevalence in the College-age Population

Caspersen et al. (2000) obtained data for physical activity levels from the 1992 National Health Interview Survey-Youth Risk Behavior Survey for 10,645 males and females aged 12-21 years. Among other questions, the survey asked respondents about physical activity. Respondents were considered physically inactive if they reported no vigorous physical activity, walking, or bicycling. Analysis of the data showed an increase in the prevalence of physical inactivity with age, with the highest prevalence of inactivity during the ages of 18-21 years. Specifically, physical inactivity increased from about 6% at age 14 to 24% by age 20 (Caspersen et al., 2000). These data suggest that the college-age years are a pivotal time for decreased physical activity. Due to the benefits of regular physical activity, special attention should be given to understand and reverse this trend in the college-age population.

More recent data from the 2007 Behavioral Risk Factor Surveillance System (BRFSS) revealed that 41% of Americans between the ages of 18 and 24 years did not participate in any physical activity or did not accumulate adequate amounts of physical activity. Compared to this national percentage, North Carolinians had an even lower percentage of physically active young adults with 49.6% reporting no physical activity or inadequate amounts of physical activity (CDC, 2007).

Additional research supports these physical activity trends among college-age individuals. Mack, Wilson, Lightheart, Oster, and Gunnell (2009) surveyed 127,794 students (7.2% unidentified gender, 64% of identified were female) beginning in 2000 from various universities and colleges throughout the United States. Most were enrolled in a 4-year university (95.0%), their mean age was 22.07 years (*SD* = 5.89) and their mean BMI was 23.83 kg/m^2 (*SD* = 4.68). A survey was administered to assess the extent to which Healthy Campus 2010 physical activity objectives were being met. These objectives were: increase the proportion of college students who engage in cardiovascular training at least 3 days per week at moderate intensity for at least 30 minutes, or vigorous intensity for at least 20 minutes; increase the proportion of college students who perform physical activities to enhance and maintain strength and endurance at least twice per week, and increase the proportion of college students who receive information on physical activity from their school. The survey consisted of demographic questions (gender, age, body mass index, self-reported perceived general health), and questions to assess frequency of cardiovascular and resistance training exercise over the past 7 days. An additional question asked the students if they had ever received information about physical activity from their university. Their results revealed that the mean number of days students participated in cardiovascular training was 2.3 days (*SD* = 2.01) with 32,921 (26.4%) engaging in no cardiovascular training during the survey time period. The mean number of days for strength training was 1.88 days (*SD* = 1.95) with 46,181 (37.1%) reporting no resistance training. These data show that college students did not achieve the Healthy Campus 2010 objectives and suggests inadequate amounts of physical activity among college students. However, those who reported that they had received information about physical activity from their university (*n* = 40,824) engaged in more frequent cardiovascular training sessions (*M* = 2.62, *SD* = 2.03) and strength training session (*M* = 2.16, *SD* = 1.98) than those who did not receive information (*M* = 2.14, *SD* = 1.98 and *M* = 1.74, *SD* = 1.9). These differences were small (*d* = 0.24 for cardiovascular training sessions; *d* = 0.22 for strength training sessions), but statistically significant. Though these results may be discouraging, they reflect that colleges may be able to influence an increase in physical activity, by at the very least, providing information about physical activity to their students.

In a similar study, Huang et al. (2010) asked 736 University of Kansas students aged 18 to 27 years to complete a survey in the spring of 2001 and the spring of 2002 to assess dietary habits and physical activity. Physical activity was measured by using three questions from the Youth Risk Behavior Survey assessing aerobic exercise, strength training, and attending physical education classes over the last 7 days. The student participants reported aerobic activity participation an average of 2.8 days (*SD* = 2.1) in the previous 7 days. Students reported strength training an average of 2.2 days (*SD* = 2.1) in the last 7 days, and physical education class 0.9 days (*SD* = 1.8) over the previous 7 days. Their findings showed slightly higher engagement in aerobic and strength training exercise than in the Mack et al. (2009) study and suggest that college students do not meet the minimum general recommendations for physical activity of at least 30 minutes of moderate to vigorous physical activity on most days of the week. Students 19 years of age and younger were more likely to report aerobic and strength training exercise than those 20 years of age and younger, suggesting that physical activity declines with age while in college. This is an indication that physical decreases through the college years. Considering such a low mean was found for physical education class participation, increasing class participation may be an intervention avenue to encourage physical activity lifestyle changes.

Irwin's (2004) critical review further confirmed these findings by analyzing publications on university student participation in physical activity. Irwin reviewed 19 studies published between 1985 and 2001 and concluded that about 50% of university students did not engage in recommended levels of physical activity. Consideration of the literature reviewed suggests that this population's lack of physical activity may be reduced through intentional study and intervention in the university physical education setting.

It is important to assess the onset of physical inactivity to determine if intervening in this setting would come at an opportune time. Kwan, Cairney, Faulkner, and Pullenayegum (2012) used data from a seven cycle National Population Health Survey (NPHS) in Canada to assess the relationship between age and physical activity decline. During cycle one, they targeted 683 adolescents (age 12-15 years) and interviewed them every two years until age 24-27 years. Using survey data, they estimated total energy expenditure (TEE) from the participants' self-reported leisure time activities. Respondents were asked about physical activities they engaged in over the previous 3 months and were asked to report the typical length of time they engaged in the activities. Results showed a decline in physical activity with age. During the 12-year period the participants were assessed, a 24% or 1.01 METs/day decrease in physical activity on average. This time period represents the transition from adolescence to adulthood, in other words, college-age. When they examined the relationship between physical activity and educational trajectory, the greatest decline in physical activity was seen among men who transitioned to college. Women, on the other hand, who attended college, only reported a 1.7% physical activity decrease. Their study suggests that physical activity is impacted negatively during the transition to adulthood (college-age), and that attending college does not have a protective effect. This supports that college students should be of priority and that college settings may be ideal environments for intervention. Since physical activity levels are low, the college setting could present an opportunity to make a large-scale impact on promoting active lifestyles.

According to Medalie (1981) and Arnett (2000), the college-age years represent an impressionable time for individuals in industrialized countries. This time, between ages 18-25 years according to Arnett, is the time in one's life that is the most volitional and offers the most opportunity for exploration. The opportunity is available because of a culturally acceptable freedom from social roles, independence from expectation standards, lack of complete self-reliance, at least partial continued dependence on parents or guardians, and freedom from obligation to adult responsibilities. Arnett theorizes this as "emerging adulthood". This theory suggests that during this time in one's life, many life directions are still possible and the individuals are exploring the directions which they will choose for adulthood. These ideas offer support that physical activity promotion interventions may come at an opportune time in development. "Emerging adulthood" suggests that the ideals embraced during the college years can be internalized as personal, lifelong values. Intervening in the college physical activity class may be an avenue to provoke changes in physical activity among this impressionable college-age population. A review of the prevalence of such classes needs to be addressed to assess feasibility and breadth of impact these classes could impart.

Kulinna, Warfield, Jonaitis, Dean, and Corbin (2010) emailed 930 department chairs of Kinesiology, Exercise Science, and Physical Education university programs in the United States. The date of email submissions was not given, but was sometime between 2000 and the date of publication. The department chairs received a request to complete a Conceptually Based Fitness and Wellness (CBFW) course questionnaire, even if a program was not offered. Respondents were from 161 different institutions that were primarily universities (50%) and 4-year colleges

(27%). The authors wanted to assess the availability of CBFW courses and whether they were required for graduation. The authors also compared their results to data from two previous studies published in 1990 (Trimble & Hensley, 1990) and 2000 (Hensley, 2000). Of these institutions, 93% of the universities reported that CBFW courses were available, 84% of the 4-year colleges offered a course and 89% of the 2-year colleges offered CBFW courses. A CBFW course was required for graduation by 44% of the universities, 61% of the 4-year colleges, and 27% of the 2-year colleges. Overall, 91% of the schools reported offering a CBFW course and 44% reported requiring one for graduation. Their data were compared to previous data collected in 1990 and 2000. In 1990, only 52% of the reporting institutions offered CBFW courses and 60% offered such a course in 2000. In 1990, 34% of the institutions required a CBFW for graduation and 33% required it for graduation in 2000. This study suggests that the prevalence and requirement of CBFW courses is high and has increased over the years. This review suggested that these courses have a wide scope for reaching many individuals.

Keating et al. (2005) conducted a critical meta-analysis to review the research published on college student's physical activity. They grouped the studies into two categories: studies that were descriptive in nature, describing physical activity of college students; and studies assessing intervention programs. Through descriptive study analysis the researchers found no improvements in physical activity participation while individuals were enrolled in higher education. The three intervention studies assessed used only quasi-experimental designs that were curriculum based and reported only some short-term benefits to physical activity behaviors but no long-term effects. The stark findings of this meta-analysis suggest that more research evaluating college activity classes is needed. Through their review they concluded that it is necessary to better understand physical activity habits of the college students, how physical activity might be increased, and strengthen and improve intervention implementation. Their review of the literature supports that implementing quality interventions in the university physical education setting is needed.

The literature supports that the college-age population is not significantly active. The literature also supports that many colleges and universities require physical activity courses where interventions to increase physical activity could potentially take place. Developing interventions to increase activity levels is important in enhancing college student health. In addition to these benefits, mental health may also increase. Joseph et al. (2013) surveyed 590 university undergraduate students to assess the relationship between physical activity and quality of life. They assessed self-reported physical activity, quality of life, physical self-esteem, exercise self-efficacy, and positive and negative affects. The sample's mean age was 20.4 years (*SD* = 1.7) and mean BMI was 23.6 kg/m^2 (*SD* = 6.5). Students with higher self-reported physical activity levels had significantly greater exercise self-efficacy ($\beta = 0.28$), physical self-esteem ($\beta = 0.10$), and positive affect ($\beta = 0.10$) than those with lower physical activity levels. Higher levels of physical activity among college students could increase exercise self-efficacy, positive physical self-esteem, and positive affect. This study had limitations. Some were the specific sample that makes generalizability difficult (school of education students at a southwestern university), and a sample of mostly healthy weight individuals. Due to the benefits associated with physical activity, interventions focused on activity promotion represent a critical need in college settings.

To date, intervention within this setting and population has not revealed strong, positive results. The Training Interventions and Genetics of Exercise Response (TIGER) study introduced sedentary White, Hispanic, African-American, and Asian college-age participants to regular aerobic training within their training heart rate zone for 30 minutes, three days per week (Sailors et al., 2010). Participants were able to accomplish this protocol 84% of the exercise sessions logged. However, this study required exercising within the study protocol as part of the course credit. The retention in the first semester was only 68%. When students were asked to be part of the classes the next semester, only 20% were retained. Although this approach resulted in short term activity increases, students opted not to participate the next semester.

Another physical activity intervention in the college setting was Project GRAD (Calfas et al., 2000). This intervention was designed to promote and maintain a physically active lifestyle during the transition from college life to adult roles. University physical education classes were the setting for the cognitive-behavioral intervention course and knowledge oriented control course. Sallis et al. (1999) compared the intervention and control classroom students. They found that male students in the intervention and control groups did not significantly differ in physical activity level from pre to post. The intervention females did differ from the control group females, post intervention. Leisure time physical activity, strength training exercise, and flexibility exercise were significantly higher for the intervention group when compared to the control group. However, individually physical activity, strength training and flexibility exercises explained a marginal amount of the variance. Calfas et al. assessed physical activity through self-report at the 2-year follow-up. They concluded that there was no significant difference between the intervention and control groups in physical activity levels. This is disconcerting but may allude to the need for strong theory-based interventions within this population.

Self-Determination Theory

Self-determination theory is comprised of several sub-theories focused on explaining motivation (Ryan & Deci, 2000a, 2000b). According to one of the sub-theories, the organismic integration theory, motivation is not simply a matter of being motivated or not motivated. Instead, motivation fits into three different categories of distinct quality that represent the behavior's locus of causality. These motivation types or behavioral regulation, lie along a continuum from amotivation to intrinsic motivation (see Figure 1). Amotivation is defined by a lack of motivation. The next category on the continuum is extrinsic motivation which contains four levels. External regulation is motivation that is externally regulated by rewards or punishments. Introjected regulation is the motivation classification when the behavior is performed due to internal pressures. This could be to avoid internal pressures such as guilt or to encourage internal rewards such as self-approval. Identified regulation is being motivated to perform an activity by personal choice because it is valued. Integrated regulation is present when a behavior is assimilated into an individual's values and needs. The behavior is performed out of congruence with one's identity. The third and final motivation category on the continuum is intrinsic motivation; this is the type of motivation behind doing something simply because it is enjoyable or interesting. As an individual's locus of causality moves closer towards intrinsic motivation on the continuum, the stronger is his or her self-determination. More self-determined motives lead to great behavioral effort and persistence. More self-determined motivation is desirable in behavior change and healthy behaviors.

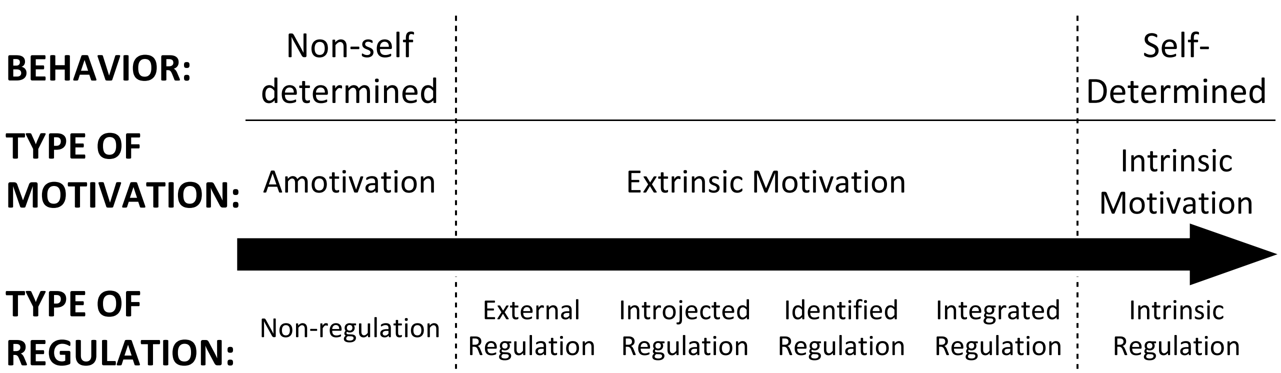

Figure 1. Self-Determination Theory Continuum, Adapted from Deci and Ryan (2000)

Another sub-theory of self-determination theory is the basic psychological needs theory. This sub-theory proposes that there are three innate psychological needs that are the mechanisms through which an individual has or moves toward more self-determined motivation (Deci & Ryan, 2000a, 2000b). These three needs are autonomy, competence, and relatedness. Autonomy is a feeling of free-will of a behavior that does not refer to selfishness or being detached but can be dependent or independent, individual or collective. It is a feeling of choice and opportunity to give input. Competence is feeling effective and capable. Relatedness is reflected by feelings of social acceptance and belonging When an environment or situation provides a person with autonomy, competence, and relatedness, individuals' innate psychological needs are being met and they are receiving need support. This can lead to a feeling of need satisfaction. When these needs are supported, individuals move along the motivation continuum toward more self-determined motivation, which is associated with a range of positive outcomes including behavioral maintenance. Self-determination theory guides an understanding of physical activity behavior (Hagger & Chatzisarantis, 2008). Ingledew and Markland (2009) aimed to test the applicability of self-determination theory in the physical activity context. They surveyed 251 university students with a mean age of 19.48 years (SD = 1.90) of whom 52% were female. These students were surveyed on life goals, exercise participation motives, exercise behavioral regulations, and exercise participation. The authors hypothesized that exercise behavioral regulation would predict participation in exercise, along with several other hypotheses to test self-determination theory. Identified and intrinsic regulations, more self-determined forms of motivation, significantly predicted exercise behavior (r = .29 and r = .24, respectively). Introjected and external regulations, more extrinsic forms of motivation, did not significantly predict exercise (r = .04, r = -.01, respectively). Though integrated regulation was not assessed, their results confirmed the application of the self-determination theory continuum or organismic integration theory, in the context of physical activity.

Self-Determination Theory in Physical Activity/Exercise. Self-determination theory has been studied in the context of physical activity to understand its application in understanding motivation for activity. A qualitative study designed to understand reasons young women exercise was conducted in response to an intervention, with the expectation of better understanding motivation in that context (O'Dougherty, 2010). The intervention they completed was a clinical trial assessing aerobic training effects on physiological variables, including breast cancer risk. The researcher recruited and interviewed 42 women who participated in a 4-month intervention. O'Dougherty found several apparent reasons for exercise: exercise motivated by something or someone beyond oneself; exercising for oneself; and exercising as a means to an end. Some prominent more specific themes found within these broader themes were not surprising. Twenty-four women reported that they were motivated to exercise during the intervention out of obligation to the study, while 15 said they became physically active for their own benefit. Those that continued to exercise after the intervention said they did so to feel better and/or healthy (n = 20) and for body image and/or weight loss (n = 20) or both. They also found, through analysis of interviews, that individuals could experience multiple motivational regulations at the same time and that their motivation changed with time and context (O'Dougherty, 2010). These themes explained reasons for exercise that parallel self-determination theory and demonstrated that self-determination theory is reflective of human tendencies towards exercise.

Wilson et al. (2003) studied a sample of 44 females and 9 males. The sample's mean age was 41.8 years (*SD* = 10.8), mean body mass index was 27.6 kg/m^2 (*SD* = 5.4 kg/m^2), and mean maximal oxygen capacity was 30.3 mL/kg/min (*SD* = 8.0). They assessed exercise regulation, perceived competence, autonomy, and relatedness in exercise, exercise attitudes, exercise behavior, and aerobic capacity. Perceived competence was modestly related to identified regulation (r = .29) and more strongly related to intrinsic regulation (r = .53). Perceived autonomy was modestly related to identified regulation (r = .33). However, perceived relatedness was not significantly correlated with any regulations. Exercise regulations had a stronger correlation with exercise attitudes, behavior and effects than perceived relatedness. Identified regulation in exercise was moderately related to self-reported physical activity energy expenditure (r = .50), attitudes toward exercise (r = .66), and maximal aerobic capacity (r = .51). Intrinsic regulation was moderately related to self-reported physical activity energy expenditure (r = .45), strongly related to attitudes toward exercise (r = .76), and moderately related to maximal aerobic capacity (r = .53). Though identified and intrinsic regulations accounted for 62% of the variance in attitudes toward exercise, attitudes may predict self-determined motives or self-determined motives may predict attitudes. Either way, these findings support that type of self-determined motivation in exercise could impact attitudes about exercise, the frequency, intensity, and duration of exercise, and physical fitness. These findings also support that perceived autonomy and competence are important predictors of self-determined motives in exercise. Though integrated regulation was not measured in this study, it may have been a strong predictor as well, considering its placement along the continuum.

Wang and Biddle (2001) studied a young population of 2,510 individuals with a mean age of 12.9 years (*SD* = 0.9). In the analysis, they clustered the young people into groups determined by their motivation in exercise. The first cluster had the most self-determined motivation in exercise and contained about 33% of the sample. This group had low amotivation, high relative autonomy, high physical self-worth, active involvement in physical activity, and moderately high perceived competence. The second cluster was still highly motivated and contained about 10.6% of the sample. This group had the highest perceived competence, and significantly higher physical activity and physical self-worth compared to the other clusters. The third cluster had low task orientation and perceived competence and was considered poorly motivated. The fourth cluster had more physical activity than the third cluster yet had neither high nor low values for constructs. The fifth cluster had the lowest scores for competence and highest scores for amotivation and was labeled as amotivated. This information suggests that individuals with intrinsic or integrated regulation in exercise could experience other beneficial qualities such as high physical self-worth, more physical activity, high perceived competence, and less amotivation.

In a review paper, Teixeira et al. (2012) provided evidence to further support the positive impact of self-determined motives on physical activity and even long-term weight management. The researchers concluded that feeling autonomous about physical exercise improved short- and long-term weight loss. Also, they determined that those who found exercise to be rewarding, interesting, and enjoyable were more successful at weight management. This supports the importance of intrinsic regulation. They also found that literature supports the need for competence by recognizing that feeling confident about being physically active was associated with successful weight management.

Gunnell et al. (2013) assessed 155 adults over the age of 17 years, with an average body mass index of 23.5 kg/m^2 who were mostly white (83.2%) and regularly active for more than six months prior to the study (87.6%). The purpose of this study was to examine if the three innate psychological needs affected well-being and ill-being. Additionally, the authors proposed to better understand whether need thwarting further impacted ill- and well-being. The participants completed the Psychological Need Satisfaction in Exercise Scale (PNSE), a modified version of the Psychological Need Thwarting Scale (PNTS), a modified version of the Subjective Vitality Scale (SVS), and the Positive and Negative Affect Schedule (PANAS). Psychological need satisfaction in exercise did lowly predict vitality ($r = .36$), positive affect ($r = .40$), and negative affect ($r = .35$). All three innate psychological needs had small and significant correlations with vitality and positive affect. However, only autonomy significantly correlated with negative affect ($r = .34$). Need thwarting did not significantly contribute to scores of subjective vitality or positive affect, but did contribute significantly to negative affect. Negative affect was related to autonomy thwarting ($r = .28$), competence thwarting ($r = .36$), and relatedness thwarting ($r = .26$). This article suggests that need satisfaction could play a role in well-being, but that need thwarting should also be considered.

Duncan et al. (2010) studied a similar population to assess self-determined motivation in regular exercisers. They examined 468 males and 612 females who were self-reported regular exercisers. They analyzed relationships between exercise motivation and exercise frequency, intensity, and time. Regular exercise was defined as at least two exercise sessions, of any kind, per week for the past six months; no session duration criteria was specified. Assessment of exercise was self-reported using the Leisure Time Exercise Questionnaire. Mean frequency was 4.20 (*SD* = 1.84) exercise sessions per week for men and 3.97 (*SD* = 1.70) exercise sessions per week for women. Mean duration was 70.0 (*SD* = 29.8) minutes per session for men and 65.2 (26.8) minutes per session for women. In addition to self-reported physical activity, the

Behavioral Regulation in Exercise Questionnaire-revised version 2 (BREQ-2R) was completed by participants to assess motivation regulation. Participants also provided demographic information.

Duncan et al. (2010) found strong correlations between identified and integrated regulation for both males ($r = .74$) and females ($r = .78$). Exercise frequency was more strongly related to integrated ($r = .41$) and identified ($r = .42$) regulations than the other forms of motivation. Exercise duration was more moderately correlated with integrated ($r = .30$) and identified regulation ($r = .29$) than other forms of motivation. Also, exercise intensity, although not highly correlated to any motive, was correlated more highly to intrinsic motivation (females. $r = .25$; males, $r = .20$) than to the other behavioral regulations. Regression analysis revealed that integrated regulation and identified regulation were the strongest predictors of exercise frequency for males ($\beta = 0.20$ and $\beta = 0.25$) and females ($\beta = 0.39$ and $\beta = 0.15$). Only integrated regulation was a significant predictor of exercise duration ($\beta = 0.19$). Introjected regulation was the only significant predictor of exercise intensity ($\beta = 0.11$), suggesting that feelings of guilt or obligation may drive intensity. Since introjected regulation for a task is not indicative of persistence, health professionals may need to carefully frame recommendations for intensity to encourage more self-determined motivation. Results also suggest that practitioners encouraging integrated and identified regulation could be important in helping individuals achieve recommended levels of physical activity. It is not surprising that intrinsic motivation did not reveal stronger predictions and relationships. Self-determination theory (Deci and Ryan, 2000) proposes that tasks that are not innately enjoyable are less likely to be regulated by intrinsic motivation. Instead, in these cases, integrated and identified regulations may encourage adequately persisting in the behavior.

Wilson et al. (2004) evaluated self-determination theory's position that feelings of autonomy towards exercise are associated with more self-determined motivation for exercise. They evaluated the theory with 276 (178 women) undergraduate students, given course credit for participation. The participants self-reported that they exercised on a weekly basis, had a BMI less than 24.9, and ranged in age from 18-48 years. An extended version of the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2) was used to assess exercise regulation. It measured external, introjected, identified, and intrinsic regulation of exercise behavior as well as amotivation. The questions used a 5-point Likert-type scale ranging from "not true for me" to "very true for me". Exercise time was measured using a modified Weekly Leisure Time Exercise Questionnaire (LTEQ). Exercise was self-reported to assess mild, moderate, and strenuous exercise of at least 20 minutes per session, during a typical week. Intention to exercise was measured from three previously studied items. The items assessed exercise plans over the next four months for general and specific intention. Effort and importance were assessed using a modified effort and importance subscale, specific to exercise (adapted from Ryan's Intrinsic Motivation Inventory). Collection of data took place in small groups, the same researcher was responsible for all data collection and survey packet order was randomized to reduce any confounding order effects.

Results of the Wilson et al. (2004) study indicated that the regular exercisers were more intrinsically ($M = 2.65$, $SD = 1.02$ for women and $M = 2.76$, $SD = 0.96$ for men) than extrinsically ($M = 0.58$ for women, $SD = 0.70$ and $M = 0.65$, $SD = 0.68$ for men) motivated for exercising. The results of the study supported self-determination theory's stand that more autonomous exercise regulation would predict more beneficial motivational consequences. Exercise intention was strongly correlated with identified regulation ($r = .74$ for men, $r = .67$ for women) and moderately correlated with intrinsic regulation ($r = .55$ for men, $r = .61$ for women). Physical activity behavior, measured through self-report questionnaire, was lowly correlated with identified regulation ($r = .37$ for men, $r = .46$ for women) and intrinsic regulation ($r = .27$ for men, $r = .35$ for women). Though correlations were low, they were lower and nonsignificant among the other types of regulation. Regression analysis indicated that identified regulation significantly predicted exercise behavior ($\beta = 0.61$ for men, $\beta = 0.35$ for men).

Another study comparing exercise regulation and exercise behavior assessed exercise objectively with accelerometers, instead of using questionnaires. Sebire, Standage, and Vansteenkiste (2011) assessed exercise goal content and exercise motivation using questionnaires and objectively measured physical activity using accelerometers and a log of major activities. Participants ($N = 107$) completed the questionnaires and had at least five days of valid accelerometer data to be included in the analysis. The sample mean age was 38.8 years ($SD = 11.5$). Autonomous motivation was significantly but lowly correlated with average time in moderate to vigorous physical activity ($r = .25$), average daily time in moderate to vigorous physical activity in bouts greater than 10 minutes ($r = .26$), and number of days meeting the ACSM/AHA guidelines ($r = .28$). Guidelines were defined as: 30 minutes of moderate to vigorous physical activity accumulated during a day, in bouts of at least 10 minutes. In regression analysis autonomous motivation significantly predicted minutes of moderate to vigorous physical activity greater than or equal to 10 minute bouts ($r = .24$). Autonomous motivation also significantly predicted days that ACSM/AHA guidelines were achieved ($r = .26$).

Ryan et al. (1997) conducted a cluster of studies to assess the effectiveness of intrinsic versus extrinsic motivation for exercise adherence. One part of the study used participants who were joining either aerobics or tae kwon do classes in a college setting. The class was voluntary and not for credit. Participants could attend up to several times per week. The authors compared adherence between the two classes, based on the hypothesis that those attending aerobics classes would be more extrinsically motivated and the tae kwon do participants more intrinsically motivated. They also hypothesized that those with higher body-related motives would have lower attendance and greater drop out. The participants ranged in age from 18 to 24 years, the aerobics participants were all female and the tae kwon do participants were 16 males and 8 females. The Motivation for Physical Activity Measure (MPAM) was administered. Adherence was tested by labeling individuals as “dropouts” if they attended no classes in the first two weeks. They rated attendance by the number of hours attended during the 10-week study. At baseline participants were given a questionnaire to assess demographics, physical activity background, and initial motives for exercise. Analysis of the participant’s MPAM scores showed that competence had a strong correlation with enjoyment motives (r = .74). Competence and enjoyment motives were significantly correlated with attendance (r = .45; r = .52) and dropout (r = -.36; r = -.43). In relation to drop out, tae kwon do participants were significantly less likely to drop out than the aerobics participants. The tae kwon do participants also attended significantly more total hours than the aerobics participants. These results support self-determination theory, suggesting that intrinsic motivation, or inherent enjoyment and interest, produce the greatest adherence to a behavior.

Study two of the cluster by Ryan et al. (1997) examined relationships between three factors: initial reasons for exercise, ongoing responses to exercise (especially enjoyment), and attendance/adherence. They hypothesized that those who received more enjoyment out of their workouts would have greater adherence and that social factors would also positively influence adherence as well. Participants were 155 individuals, 89 females and 46 males. Their mean age was 19.5 years (*SD* = 3.0) with an age range of 17-39 years. As in the first study, participants completed an initial MPAM, paid the exercise facility required membership fees, and signed in and out each time they attended. Participants completed a workout log/rating after each workout. They recorded their average work out length in minutes as well as their degree of enjoyment and challenge on a 7-point Likert-type scale. Participants took the revised MPAM (MPAM-R), at the conclusion of the study. Results showed that women were significantly more likely than men to workout for reasons associated with appearance and fitness. Attendance, for women and men, was significantly correlated with exercise motives for competence (r = .26), enjoyment (r = .19), social interaction (r = .21), and fitness (r = .17). Significant predictors of attendance were competence, enjoyment, and social motives for exercise. Correlations also revealed that competence had a weak, yet significant association with length of workout (r = .25) and was moderately associated with enjoyment (r = .39). Exercise enjoyment also had a weak, yet significant association with length of workout (r = .23). This study suggests that exercise motives associated with intrinsic motivation like enjoyment and competence are associated with adherence. This further supports the position of self-determination theory.

Lloyd and Little (2010) provided evidence to support self-determination theory through qualitative data from 20 participants. Their results led them to conclude that well-being can be improved through engaging in physical activity, when self-determination theory's three innate needs of competence, autonomy, and relatedness, are supported.

If self-determination theory is a theory that offers successful strategy for provoking self-determined motives for exercise, then it could be beneficial to apply it in physical activity and exercise class settings. Research shows success in the realm of physical activity and exercise instruction.

Self-Determination Theory in Physical Education Settings. Standage et al. (2005) tested self-determination theory in a physical education class setting. Participants ($N = 950$) were from four secondary schools in England and had a mean age of 12.1 years ($SD = 0.9$). Data were collected from students in classes taught by 21 different PE teachers. No experiment or intervention was implemented. Normal classroom conditions and teaching styles were assessed. Participants responded anonymously to an inventory that measured need support, need satisfaction, and motivation through a 7-point Likert scale ranging from 1-strongly disagree to 7-strongly agree. Other measures included concentration, positive and negative affect, and preference for challenging tasks.

Standage et al. (2005) indicated that need support in the classroom had a positive relationship with intrinsic motivation ($\beta = 0.68$) and introjected motivation ($\beta = 0.36$), but a negative one with external regulation ($\beta = -0.35$) and amotivation ($\beta = -0.50$). Also, need support satisfaction correlated with perceptions of autonomy support ($\beta = 0.64$), competence support ($\beta = 0.65$), and relatedness-support ($\beta = 0.69$) in the classrooms. Need support also had a positive effect, on concentration ($\beta = 0.52$), positive affect ($\beta = 0.62$), and preference for challenging tasks ($\beta = 0.28$). It had a negative effect on need support and feelings of unhappiness ($\beta = -0.34$). Because the extent to which a student reported need satisfaction positively impacted intrinsic motivation and positive motivational consequences for exercise, it is probably important that teachers create a need-supportive class environment in the context of physical education.

Zhang et al. (2011) took a similar approach to their study design. They assessed 286 middle school students in their physical education classes. Again, no intervention or condition was applied. Students were asked questions based on their class, as it was conducted normally. Their results were also supportive of self-determination theory and need-supportive teaching.

These results revealed that perceived need support had a significant effect on perceived need satisfaction ($\beta = 0.89$) and perceived need satisfaction had a significant effect on intrinsic motivation ($\beta = 0.75$). In turn, intrinsic motivation had a significant impact on physical activity within and beyond school ($\beta = 0.43$) as measured by the Physical Activity Questionnaire for Older Children (PAQ-C). These results also strongly support the benefits of need-supportive teaching styles in the context of physical education to encourage regularly engaging in physical activity.

Ntoumanis (2005) conducted a study among physical education classes to assess many factors. He revealed that the physical education teacher's need support predicted students' need satisfaction ($r = .86$) which, in turn, predicted the students' self-determination index ($r = .69$). Self-determination index predicted concentration ($r = .60$) and intention ($r = .74$), among other things. This study suggests that teachers can teach physical education with need support that translates into need satisfaction for the student. It also suggests that the class environment the teacher creates can influence self-determined motivation that can positively impact intention and concentration.

Ferrer-Caja and Weiss (2000) studied a sample of 407 physical education high school students. Their findings were similar to others, previously mentioned. Their results revealed that perceived competence in the class predicted intrinsic motivation for females ($r = .30$) and males ($r = .28$). Intrinsic motivation predicted choice of challenging tasks, effort, and persistence in the physical education class in females ($r = .37$) and males ($r = .29$).

Hagger et al. (2003) assessed whether student perception of autonomy support in their physical education classes promoted leisure time physical activity intention and engagement. Perceived autonomy support of the students in the physical education class had a significant and low correlation with physical activity behavior (*r* = .16) outside of the class setting. Perceived autonomy support in physical education had a low correlation with identified regulation in physical education (*r* = .38) and intrinsic motivation in physical education (*r* = .33). Intentions to be physically active, assessed by a theory of planned behavior questionnaire, had the strongest correlation to physical activity behavior, yet it was still only approaching a moderate level (*r* = .48).

However, if teachers are encouraged to create a need-supportive class for interventions, it is also important that students feel the class is such. Taylor and Ntoumanis (2007) measured teachers' perceptions of student self-determination, the teachers' own self-determination, and the teachers' self-reported use of three motivational strategies in the classroom: autonomy support, structure, and involvement. Students' perception of need satisfaction and their reported self-determination were measured and compared to determine the relationships with the teachers' measures.

Taylor and Ntoumanis (2007) studied 787 PE students (399 boys, 371 girls and 17 unspecified) with an age range of 11-16 years (Mean of 12.81 years, *SD* = 1.42 years) and 51 PE teachers (25 male, 26 female) with an age range of 22 - 57 years (Mean of 29.6 years, *SD* = 7.56 years) from 13 schools in England. To measure the teachers' use of autonomy support, structure, and involvement, the teachers self-evaluated by using a shortened version of the Teacher as Social Context Questionnaire. To measure the students' perception of the teacher's use of these strategies, students were asked to evaluate their teacher's use of autonomy support, structure, and involvement using a shortened version of the Teacher as Social Context Questionnaire. The teachers' self-determination to teach the PE class was measured using the Situational Motivation Scale. Teachers evaluated their students' self-determination in their class, specifically, by answering “Student X takes part in PE classes ______” with choices that corresponded to each of the self-determination theory regulations for motivation. The students’ perception of need satisfaction (degree of satisfaction of three psychological needs—autonomy, competence, and relatedness) was measured using 16 items taken from need-specific validated measures. Students’ self-determination was measured through a motivational regulations questionnaire.

As hypothesized by Taylor and Ntoumanis (2007), the teachers’ perception of the class’s average self-determination significantly predicted the teachers’ self-reported use of autonomy support ($\beta = 0.39$), involvement ($\beta = 0.46$), and structure ($\beta = 0.07$) with those classes. When relationships were assessed, student self-determination predicted the student perception of autonomy support ($\beta = 0.19$), structure ($\beta = 0.22$), and involvement ($\beta = 0.22$) in the class. Therefore, student self-determination was related to the perception of the teachers’ use of those three styles. However, teachers’ self-reported use of autonomy support negatively predicted student self-determination ($\beta = -0.13$). Also, teacher self-determination and student self-determination were not significantly related ($\beta = 0.08$). Another interesting finding was that teacher perceptions of autonomy support and structure did not significantly predict students’ perception of autonomy support ($\beta = 0.12$) or structure ($\beta = -0.04$).

It is interesting that teachers’ perception of class average self-determination predicted the teachers’ reported use of autonomy support, involvement, and structure. However, the teachers’ reported use of autonomy support, involvement, and structure did not predict the students’ perception of the use of these strategies. This finding suggests that student perception is a valuable measure when assessing teacher use of motivational strategies. The finding that students’ perception of the level of autonomy support, structure, and involvement provided by the teacher positively predicted the students’ degree of self-determination can be considered for future educational study or intervention. In this study the degree to which the student perceived the use of motivational strategies was related to their self-determination. Therefore, how they felt about the teacher's strategies was related to how intrinsically motivated they were in the class. This finding proposes a challenge that even if teachers believe they teach with certain strategies, it does not necessarily transpose onto the student's attitude and experience in the class. Teacher focus should be on student perception and understanding how students perceive motivational strategies.

Reeve, Bolt, and Cai (1999) published a cluster of study findings that revealed some different results. In one study, preservice teachers were asked to role play as either a teacher or student. Those playing teacher roles were shown a puzzle which they would guide their hypothetical students to complete. Raters observed and assessed the teachers' conversation techniques and utterances. They also subjectively rated the teachers' interpersonal style and impressions. In a previous study, the teachers were surveyed on their perception of their autonomy supportive teaching style. The study revealed that teachers that self-reported that they were autonomy supportive were actually such in the simulated role play activity. Autonomy-supportive teaching was related to listening more ($r = .34$), resisting giving task solutions ($r = -.34$), giving fewer verbal commands ($r = -.29$), asking more questions about student desires ($r = .32$), responding more to student-generated questions ($r = .28$), and giving more perspective-taking statements ($r = .27$) than the controlling teachers. Autonomy-supportive teachers supported student intrinsic motivation and internalization. Their study suggests that teachers who believe they are autonomy supportive actually teach in a way that supports autonomy when rated by an observer. Assessing student perceptions and using direct observation of the teachers is necessary to ensure teachers use specified teaching strategies and then, that the students perceive the presence of the strategies.

Puente and Anshel (2010) tested student perception of instructor teaching style and student perception of the class as well as student motivation for exercise. Instructor perception of themselves or students was not measured in this study. One hundred thirty-five female and 103 male undergraduate students enrolled in a physical education class at their university (mean age of 20.4 years, $SD = 2.16$ years) volunteered to participate in the study in exchange for extra credit in the class. Numerous questionnaires were used to analyze students' perception of the instructor and the class. Results indicated that student perception of the instructor's teaching style significantly positively affected the student's perceived competence ($\gamma = 0.18$) and perceived autonomy ($\gamma = 0.31$). In turn, perceived competence and autonomy significantly predicted more self-determined motivation ($\beta = 0.19$; $\beta = 0.69$). Self-determined motivation significantly predicted enjoyment ($\beta = 0.47$), positive affect ($\beta = 0.33$), negative affect ($\beta = -0.18$), and exercise frequency ($\beta = 0.18$). These findings have implications for training teachers to use self-determination theory-based approaches in physical education settings to increase more self-determined motivation.

Shen et al. (2007) analyzed whether or not a students' perception of a physical education class's use of self-determination theory-based constructs like autonomy and competence influenced their leisure-time physical activity. Adolescents ($N = 653$) between the ages of 11 and 15 years completed questionnaires regarding their physical education classes and their own physical activity. Correlations between perceived autonomy in physical education and intention to partake in physical activity ($r = .21$), moderate and vigorous physical activity as measured by self-report ($r = .09$), and cardiorespiratory fitness as measured by the PACER ($r = .08$) were low to very low, even though they were statistically significant. Correlations between perceived competence in physical education and intention to partake in physical activity (r = .34), moderate and vigorous physical activity as measured by self-report (r = .24), and cardiorespiratory fitness as measured by the PACER (r = .21) were also significant and low. These significant, yet low, correlations warrant the continued study and assessment of self-determination theory.

The literature supports that self-determination theory may increase self-determined motives for physical activity through physical education or forms of physical activity class. If applying self-determination theory encourages positive motivational change and, therefore, positive behavior change, interventions that implement self-determination theory-based components could enhance student motivation. Using a self-determination theory-based strategy could provoke more self-determined motives for physical activity and greater physical activity adherence, even across time.

Through a review of literature, Ntoumanis and Standage (2009) made recommendations for using self-determination theory to improve the physical education class. Their recommendations are to educate physical education teachers on the practical and prudent importance of satisfying students' innate psychological needs in physical education and the usefulness of self-determination theory in helping the teachers reach students. The literature supports that activities not innately interesting can become more self-determined when the psychological needs are met. Though intrinsic motivation may never occur, persistence and other beneficial effects can occur when regulated by integrated motives. They also support autonomy-supportive teaching by providing rationale, acknowledging student feelings and opinion, and conveying choice instead of control. Their recommendations are based on literature reporting intervention studies.

Self-Determination Theory in Intervention Research. All of the self-determination theory studies discussed previously examined classes in their typical settings, without the use of intervention or any changes. However, it is important to determine if teachers can be trained to implement a need-supportive environment and adapt their classes to incorporate self-determination theory for physical activity participation. Edmunds et al. (2008) hypothesized that teaching style can be manipulated to provide autonomy support, structure, and interpersonal involvement in order to incorporate self-determination theory's three psychological needs for self-determined motives: autonomy, competence, and relatedness. They also hypothesized that participants receiving a self-determination theory-based teaching style would report more psychological need satisfaction and self-determined motivation as well as increased exercise-related engagement and positive affect due to the teacher's ability to incorporate self-determination theory-based teaching. Lastly, they hypothesized that the students' perception of the class's autonomy support, structure, and interpersonal involvement would predict their psychological need satisfaction, again, due to the teacher's ability to teach through self-determination theory components.

To test their hypotheses, Edmunds et al. (2008) recruited participants from two exercise classes in a university setting. One class received a control treatment while the other, unknowingly, received self-determination theory-based instruction. Twenty-five students participated in the self-determination theory class (SDT) with a mean age of 21.3 years (*SD* = 3.8) and 31 students with a mean age of 21.4 years (*SD* = 6.7) participated in the control class. All participants were females and were either university students or employees. Each exercise class was led by the same trained instructor and both classes were exposed to the same 'cardio combo' class for 10 weeks.

Both classes received typical instruction during the first week of class. That same week they completed an initial questionnaire packet. It included questions assessing demographics, perceived autonomy support, structure, and interpersonal involvement provided by the instructor, psychological need satisfaction, motivational regulations, behavioral intention, and positive and negative affect. After week one, the SDT class was exposed to a trained teaching style to offer autonomy support, structure, and interpersonal involvement while the other class received conventional instruction. Ways in which the instructor created a need supportive environment included expressing genuine interest and care for students, creating opportunities for exercises to be chosen by students, minimizing the use of pressure, coercion and extrinsic rewards, providing clear expectations and informative feedback and acknowledging student feelings. Measures were taken again at five weeks and nine weeks. Two trained independent observers also rated autonomy support, structure, and interpersonal involvement provided by the instructor in week one.

The control group demonstrated a decline in autonomy support (week 1, $M = 5.90$, $SD = 1.17$; week 9, $M = 5.08$, $SD = 1.33$). This steady decline was significant ($\beta = -0.65$). The SDT class, on the other hand, demonstrated an increase in autonomy support (week 1, $M = 5.60$, $SD = 1.21$, week 9, $M = 6.33$, $SD = 0.40$), structure (week 1, $M = 4.98$, $SD = 1.45$; week 9, $M = 5.59$, $SD = 0.72$), and interpersonal involvement (week 1, $M = 4.97$, $SD = 1.44$; week 9, $M = 5.63$, $SD = 0.86$). The SDT class had significantly greater increases in relatedness ($\beta = 0.50$) and competence ($\beta = 0.66$) need satisfaction than the control group. Changes in motivational regulations did not differ significantly between the control and SDT group. Control group class students attended significantly less often than the SDT class students ($d = 0.54$). This study suggests that it is possible to train teachers to implement effective self-determination theory-based techniques that have positive perceptions by the students.

Aelterman et al. (2013) offered a need-supportive physical education teacher training to 35 physical education teachers. The researchers' objective was to develop a training program to effectively teach physical education teachers how to implement strategies to create a need-supportive class environment. After a literature review, a three part, half day training was developed. The three parts were (a) conducting a theoretical background to explain the theory and its importance, (b) overview of motivating teaching strategies to instruct teachers on how to implement the theory, and (c) application exercise to allow them to practice implementing the strategies. Study findings revealed that teachers valued the training, appreciated each part, but most valued the application exercises. This study suggests that interventions to help teachers teach with more need-supportive styles could be well received.

Tessier and Sarrazin (2008) conducted an autonomy-supportive training program for physical education teachers to assess the effects of the program on teacher behavior. This study design can provide evidence for the effectiveness of intervening on teaching style. Three physical education teachers, with 62 students, comprised the control group, while two teachers, with 34 students, comprised the experimental group. The teachers were assigned to their group randomly. The experimental group teachers attended a workshop on autonomy-support to learn about self-determination theory, the research supporting the theory, and application activities to help teachers practice implementing autonomy supportive teaching strategies. After this, workshop teachers implemented these strategies. After each lesson with the researcher, the teacher reviewed videos of themselves teaching to increase quality of autonomy-support. Together the teacher and researcher would determine ways the teacher could increase autonomy-support. They measured motivation toward physical education, degree of self-determination, and teachers' behavior with direct observation. The results revealed that teachers in the autonomy-supportive teaching group used significantly more autonomy supportive (β = 0.39) and neutral styles (β = 0.28) and praised their students more (β = 0.56) than the control group teachers. It seems promising that these teachers appeared to increase their autonomy-support in the classroom, which could in turn, increase student self-determined motivation for physical education. However, their sample was small and did not include training on limiting need thwarting or measures of need thwarting.

Cheon et al. (2012) conducted an experimental intervention with middle school and high school physical education classes. Nineteen physical education teachers and 1,158 students (1,025 in middle school and 133 in high school) were randomly assigned to either an intervention or control group. The intervention group teachers were trained through an autonomy-supportive intervention program to implement self-determination theory principles with their classes. Students were measured on several variables at baseline, midterm, and final. Measures included perceived autonomy-supportive teaching, autonomy need satisfaction, competence need satisfaction, relatedness need satisfaction, autonomous motivation, amotivation, and future intention toward physical activity. Teacher ability to implement the training and use autonomy-supportive teaching was measured by a trained observer.

Cheon et al. (2012) reported improvements in measures among the intervention group. The intervention condition significantly predicted psychological need satisfaction at midterm (β = 0.14) and final (β = 0.12). Autonomous motivation (more self-determined) increased from 5.26 to 5.74 in the intervention group but this increase was not significant. Results showed a significant decrease (4.83 to 3.62) in autonomous motivation in the control group. Intention for future physical activity significantly increased from 4.87 at midterm to 5.20 at final assessment in the intervention group, but did not change in the control group. Measures of direct observation suggested that teachers in the intervention group were successfully more autonomy-supportive than the control group teachers. Interrater reliability ranged from $r = .78\text{-}.92$, so ratings from the two observers were averaged. Four behaviors were observed: extrinsic versus intrinsic motivational sources, use of controlling language, using rationale, and response to negative affect. These four observed behaviors differed significantly between the intervention teachers and control teachers. The average effect size of differences in observed behaviors between intervention and control was 1.49. The authors concluded that the teaching style intervention was successful at improving need support and motivation for physical activity among students. This study supports the practicality of teaching style interventions and their potential effect on student improvements.

Self-determination theory has also been used in interventions to study its influence on motivation for exercise and physical activity as part of a weight loss study. Silva et al. (2010) analyzed the impact of a self-determination theory-based intervention on self-regulatory variables, as well as its impact on physical activity/exercise, weight, and body composition. They conducted a one-year behavior change intervention with a two-year follow-up without intervention, for overweight/obese premenopausal women. The 239 women who participated were randomly assigned to one of two groups: a self-determination theory-based group designed to promote autonomous forms of exercise regulation and intrinsic motivation, or the control group that received a general health education program. The groups received an equal amount of face-to-face programming/treatment and participants were not different in baseline measurements. The experimental group, which received the self-determination theory-based program, was led in a way that was intentional about creating an autonomy-supportive environment by having established ways to conduct sessions as well as established structure for the content of sessions. The overall theme for creating autonomy-support was to promote an internal perceived locus of causality for the participants. Strategies used to accomplish this included (a) using language like “may” and “could” instead of “should” and “must”, (b) providing opportunities for choice while minimizing demands and extrinsic rewards, (c) providing options and variety, (d) giving rationale for a behavior as well as the outcome of the behavior, (e) encouraging melding of the lifestyle behaviors with personal values and goals, and (f) giving positive informative feedback. Several measurements were assessed for both groups. Measures included weight and body composition, self-reported physical activity through a 7-day physical activity recall, and physical activity through an objective measure of steps per day. Types of motivation or regulation for exercise, intrinsic motivation for exercise, exercise motives, and several other measures were also collected.

Results revealed that individuals in the intervention group saw significant improvements in all areas, as compared to the control group. The intervention group had significantly greater physical activity than the control group. The intervention group accumulated 2,049 more steps per day (SD = 571) and 138 more minutes of moderate to vigorous physical activity per week (SD = 26) than the control group. The intervention group had significantly more weight loss than the control group. The control group lost 1.74 % body weight in 12 months and the intervention group lost 7.29 % body weight in 12 months. Improvements in body composition were significantly greater among the intervention group compared to the control group. The control group reduced their body fat percentage by 2.5 % in 12 months, while the intervention group reduced their body fat percentage by 6.9 % by the end of the 12 months. The intervention group had significantly more autonomous forms of motivation than the control group. Intrinsic motivation was greater in the intervention group (*M* = 24.0, *SD* = 3.9) than the control group (*M* = 18.9, *SD* = 5.6). This difference was significant and had a large effect size of 1.08. Integrated regulation was greater in the intervention group (*M* = 26.1, *SD* = 2.0) than the control group (*M* = 22.7, *SD* = 4.5). This difference was significant and had a large effect size of 1.05. This study demonstrated the positive effect of implementing a successful self-determination theory-based intervention. It also demonstrated the ability to develop effective programs and skills to do so.

Teixeira et al. (2006) implemented an intervention to increase physical activity and improve other measures to promote weight loss as well. Their intervention was designed to increase autonomy and competence. Details of how this was pursued were not provided in the study publication. Meetings were held weekly for 150 minutes. Participants (*N* = 136) met in groups of about 25 with the intervention team. Participants were encouraged to make small changes in their eating and physical activity lifestyle to promote adherence for the long term. At the end of the intervention, participants reported more self-determined motivation in exercise with a moderate effect (effect size = 0.55). At the 16 month follow-up, percent weight change had the highest, yet still low correlation with self-determined motivation in exercise (*r* = -.29). Specifically, exercise interest and enjoyment (intrinsic motivation) had the highest correlations with weight change of the self-determination regulations (*r* = -.45). These findings suggest that intervening using self-determination theory may foster sustainable lifestyle changes.

Silva et al. (2011) assessed a one year intervention for women between the ages of 25 and 50 years that also targeted weight loss. The intervention was designed to encourage more self-determined motivation in exercise. Following the intervention, the intervention group had significantly greater weight loss and significantly more moderate and vigorous physical activity than the control group. One year later, at the two year follow-up, the intervention group maintained statistically significant differences from the control group. Two years later, at the three-year follow-up, the intervention group continued to have significantly greater weight loss maintenance and higher levels of exercise than the control group. Perceived need support had an effect on autonomous self-regulation at two-year follow-up (effect ratio = 1.00), moderate and vigorous exercise at two-year follow-up (effect ratio = 1.00), and weight change percentage at three-year follow-up (effect ratio = 0.22). This study is encouraging in that it points to a potential theory to base intervention strategies for long-term physical activity adherence.

The literature supports the use of self-determination theory-based teaching and leadership in the contexts of physical activity and education instruction and interventions. The literature supports the use of the theory concepts to increase self-determined motivation for physical activity and exercise adherence.

Technology to Motivate Physical Activity

Another avenue to potentially impact self-determined motivation for exercise and exercise behavior is using objective physical activity measuring devices, like "movement technology". Technology is available to help individuals measure their physical activity and may offer motivation for obtaining a desired level of physical activity. Pedometers offer easy to understand, immediate physical activity feedback that is specific to the individual wearing the device. They can be helpful in goal setting, and can be used in theory-based interventions, especially if self-monitoring, feedback, and goal-setting are components (Tudor-Locke & Lutes, 2009). Pedometers, devices that count steps taken throughout the day, have been studied for their potential motivational qualities. Croteau (2004a) conducted a preliminary study on a pedometer-based intervention and its effect on total daily steps. The author recruited 37 volunteers (29 women, 8 men) who were college employees. Height and weight measurements were taken at baseline to determine body mass index and to place participants into a body mass index status group. Physical activity was measured before and immediately following the intervention by sealed pedometers and two self-report surveys.

The eight-week intervention began with a counseling session that included goal setting. Suggested goals were dependent upon participants' baseline pedometer measurements. Those with 8,000-10,000 steps per day at baseline were encouraged to set a goal of increasing their steps by 5% every 2 weeks and those with less than 8,000 steps per day at baseline were encouraged to a set of a goal of increasing their steps by 10% every 2 weeks. Participants with over 10,000 steps were encouraged to maintain their steps. These goals were encouraged to guide participants to achieve an average of 10,000 steps per day, or more, by the end of the intervention period. After goal setting, the intervention included unsealed pedometer use for 8 weeks, self-monitoring of daily pedometer steps, strategies to increase steps, and follow-up through weekly emails with reminders, motivational tips, and educational information (Croteau, 2004b).

Croteau (2004a) found that the average daily steps increased significantly from baseline to after the program with a mean of 8,565 steps at baseline and 10,538 steps after the program. When the participants were separated by BMI status, normal weight participants increased steps by 16.4%, overweight participants increased steps by 24.0%, and obese participants increased steps by 34.3%.

In another publication, Croteau (2004b) assessed the selected strategies for increasing steps on pedometer step counts in the same intervention. Eleven different strategies were used among the participants. Participants who increased their steps per day by at least 5,000 steps selected to park farther away, walk after work, walk at work, and walk their dogs. The group with a 1% to 5% increase in steps per day was the only group to select the strategy of doing a cardiovascular workout at a fitness center to increase steps.

Results demonstrated that a pedometer-based intervention with little contact and self-management was effective at encouraging participants to increase their steps per day. The study results suggest that similar interventions might be most beneficial for those with the lowest levels of physical activity and higher levels of body mass index as supported by other intervention research (Thomas & Williams, 2006). The results of the Croteau (2004b) study suggest that the strategies used to increase steps could impact meeting goals, but more extensive data should be collected on larger populations. This study has limitations due to the homogeneity of study participants and the specificity of the environment. Also, increases could be due to aspects of the intervention (weekly emails and goal setting) as opposed to the use of pedometers alone.

Another pedometer intervention study assessed the effect of pedometer use on low-active adolescent girls. Schofield et al. (2005) studied 85 participants with a mean age of 15.8 (*SD* = 0.1). They were assigned to either a control group, pedometer group, or minutes group and were then split into small groups. All groups met once per week for about 30 minutes and all participants were given a personal logbook that included a 12-week log as well as information to help them be more active. The pedometer group was given a log with step count recommendations and directions on step counts during meetings. The minutes group was given a log with recommended physical activity minutes and the group was given direction on minutes of activity during their meetings. All participants were encouraged to increase their daily physical activity. Measurements were taken at baseline, end of intervention phase (6 weeks), and at follow-up (completion of maintenance phase-12 weeks). Measurements included body mass index, waist circumference, blood pressure, Rockport fitness walking test, pedometer steps for a 4-day period, and self-reported physical activity. Results indicated that the pedometer group increased average weekly steps from 30,004 at baseline to 40,992 at week 12, while the minutes group increased steps from 24,497 to 32,939. The control group had an average of 33,598 steps at baseline and 34,221 at week 12, which was not a significant increase. Therefore, both the pedometer and minutes groups increased physical activity as measured by pedometers. However, during the 12 weeks, the most marked increase in steps was seen in the pedometer group between baseline and 6 weeks (30,004 to 37,352 steps) as opposed to the minutes group (24,497 to 29,939 steps). These data point to a potential plateau of pedometer mediated improvements in physical activity. Measuring physical activity at midterm and final during interventions over six weeks should be considered.

Shore et al. (2013) studied sixth grade students to assess a physical activity intervention using pedometers. The study took place in physical education classes and lasted six weeks. The intervention group (n = 46) received two verbal cues per day to obtain 10,000 steps and 3,200 steps during their physical education class. They receive a 10-lesson curriculum aimed at physical activity promotion and utilizing pedometer-based activities. The control group (n = 46) class was conducted as usual. The control group curriculum focused more on team sports and athletic skill. They were encouraged to accumulate 2,000 steps during their physical education class but this was part of the school's original curriculum. Participants recorded their steps during their computer class. They were supervised for accuracy of steps recorded and reset their pedometers for the next 24-hour period of recording during their computer time. Following the six week treatment period, the intervention group had a significant increase in daily steps, compared to the control group (steps per day, pre-post mean difference = 2,307, SD = 679). This suggests that the verbal cues and curriculum treatments were influential parts of this pedometer intervention.

Van Dyck et al. (2013) evaluated a pedometer intervention with a different type of population. Their studied population was 92 people with type II diabetes (Mean age = 62 ± 9 years). The intervention group ($n = 60$) had one face-to-face session, used pedometers to monitor physical activity, and received seven telephone calls designed to promote physical activity through motivational interviewing. The control group ($n = 32$) received usual care. The intervention lasted 24 weeks and included a one-year follow-up after the conclusion of the intervention. At the end of the intervention there was a significant difference of 3,820 in daily step counts between the intervention and control groups. At one year follow-up the intervention group still had significantly more steps per day than the control group (2,767 steps per day). This study also supports the use of pedometers for physical activity promotion.

A pedometer intervention with college students was conducted by Jackson and Howton (2008). Three hundred twenty-six students, enrolled in a required fitness course, took part in the "Pedometer Project" intervention to increase physical activity on campus. The sample was 70% female and 22% of the sample was deemed "ethnic minorities". The mean age was 24.3 years ($SD = 7.8$). The students purchased their own pedometers and were asked to wear them for at least 5 days a week, for 12 weeks. Baseline pedometer steps were collected during week one when students had been given no instructions about step recommendations. After baseline measures were collected, students were given suggestions for number of pedometer steps to accrue each day. They were also instructed on behavior change strategies, including goal setting, to help them increase their daily step counts. Keeping a daily pedometer log and completing a demographic questionnaire for the intervention was part of their course grade. Using self-reported height and weight, body mass index was classified and students were grouped into underweight (BMI < 20 kg/m^2), normal weight (BMI of 20-24.9 kg/m^2), overweight (BMI of 25-29.9 kg/m^2), or obese (BMI ≥ 30 kg/m^2) groups. The intervention results revealed that average daily pedometer steps increased significantly from week one (7,000 steps, *SD* = not reported) to week six (8,600 steps, *SD* = not reported). The average daily pedometer steps continued to increase significantly from week six to week twelve (9,600 steps, *SD* = not reported). No significant difference in step change was found between body mass index groups except the underweight group had significantly lower average daily pedometer steps than the normal weight group. The results suggest that pedometer interventions may motivate an increase in physical activity among college students. It also suggests that despite body mass index, improvements in physical activity can be achieved.

However, some studies do reveal that physical activity pedometer interventions may not be motivationally consistent. Ho et al. (2013) assessed the effect of the use of a pedometer on moderate and vigorous physical activity in adolescents. Three hundred ninety boys and five hundred two girls (Mean age = 14.5 years, *SD* = 0.5 years) were assessed. All of the participants were instructed to wear an Actiheart, a heart rate and uniaxial accelerometry measuring device, for four consecutive days. Three hundred seventy-six of the participants were instructed to also wear a pedometer for four consecutive days, at the same time they wore the Actiheart. Results revealed that only the girls who wore the pedometers had significantly higher accelerometer counts per minute than the girls who did not wear the pedometers. The girls that wore the pedometers accrued 5.1 counts per minute more than the girls that did not wear the pedometers. Boys that wore the pedometers did not have significant activity differences from the boys that did not wear the pedometers. Though counts per minute were significantly different between the girl groups, moderate to vigorous physical activity was not. This suggests that the extra steps the pedometer wearing girls accrued were of light intensity. Results revealed that pedometers, if effective at promoting physical activity, may only encourage light physical activity. Another finding in this study was that activity differences between weekdays and weekend days were significant for both boys and girls. Boys accrued 16.6 fewer minutes of moderate to vigorous physical activity on the weekend days, compared to weekdays and girls accrued 10.0 fewer minutes of moderate and vigorous physical activity on the weekend days, compared to weekdays. This finding suggests that pedometer use alone may not change physical activity behavior or motivation.

Eastep et al. (2004) split 26 volunteer participants (Mean age = 39 years, *SD* = 12.5) of a "Walking for Fitness" class into two groups. Group 1 received an unsealed pedometer for the first three weeks and then a sealed pedometer that had been wrapped and "camouflaged" to not look like the original pedometer for the second three weeks of the study. Group 2 received the same conditions but in the opposite order. The participants were not given any instructions or recommendations regarding the pedometer, other than how to wear it. The researchers told the participants that they were wearing the devices only to assess the two different forms of physical activity measuring devices in terms of how cumbersome and intrusive they were. The class as a whole was encouraged to increase the amount of walking done outside of the class, but with no directions on steps or specific recommendations. Even though the researchers hypothesized that step counts would be greater for unsealed pedometer wearers, the results showed that whether or not the pedometer could be opened for feedback, step counts were not affected. In fact, overall physical activity declined during the 6 weeks, for both groups. Mean steps for group one were 64,298 steps (*SD* = 24,372) at week one and were 58,204 steps (*SD* = 27,310) at week six. Mean steps for group two were 63,897 steps (*SD* = 22,044) at week one and 50,593 steps (*SD* = 19,137) at week six. Only two participants mentioned that the pedometers motivated them to be more active. This study suggests that a pedometer, apart from any suggestions, directions, or additional intervention components, may not be a successful motivational tool.

Bravata et al. (2007) reviewed 26 studies, eight of which were randomized control trial studies. All of these eight studies reviewed included an intervention group that wore unsealed pedometers and were encouraged to view and log their step counts. They also included a control group that wore sealed pedometers. The interventions reviewed lasted three to 104 weeks (M = 18 ± 24 weeks). On average, participants in the reviewed studies that were part of the pedometer intervention increased physical activity by 2,491 steps more than the control group participants. The authors found that goal setting and activity logging could be determining factors to motivate individuals to increase physical activity.

New “movement technology”, like the Fitbit is quickly emerging. These types of devices may be a potential physical activity motivator in the college-age population, in the place of pedometers. This “movement technology” includes measures of activity such as steps, calories burned, distance traveled, and amounts of moderate and vigorous physical activity. The measures on the Fitbit flex device can be synced wirelessly through Bluetooth® to be seen on mobile devices, tablets and computers whenever desired. The device has features to give wearers an instant indication of the progress towards certain levels of physical activity. Data are electronically uploaded, stored, and displayed in graphs, tables, and figures. Electronic reward badges are made available when goals are met. To date, a literature search did not reveal any research on the motivational properties and effectiveness of the Fitbit and revealed only a few studies published on any Fitbit devices and none on the Fitbit Flex (wrist worn) specifically.

Takacs et al. (2013) assessed the reliability and validity of the step counting measure on the hip worn Fitbit device with 30 adults using a treadmill at 5 different speeds. Participants wore three Fitbit devices and the step output on the Fitbits was compared to observer step counts. There were no significant differences between Fitbit step counts and observer step counts and inter-device reliability was high. Though this device has not been studied extensively, since it includes instant measures of steps, it can be compared to the use of pedometers. However, "movement technology" should be used to assess its distinct effect on change in self-determined motivation for physical activity and influence on physical activity behavior that may be different from intervention pedometer use. No literature on the Fitbit Flex device was found. Other studies have assessed the accuracy of other Fitbit devices (Fulk et al., 2013; Lee, Kim, & Welk, 2014; Sasaki et al., 2014).

Gilson et al. (2013) assessed a worksite intervention that allowed employees to electronically log their pedometer steps, keep track of their data, and receive encouragement. Intervention components were similar to features of the Fitbit website. The assessment of the Walk@Work study revealed statistically significant differences in step counts from pre- to post-intervention. The group with less than 5,000 steps per day at baseline significantly increased their steps by 1,837 per day). The group with between 5,000 and 7,499 steps per day at baseline significantly increased their steps by 1,464 per day and the group with 5,000 to 9,999 steps per day at baseline significantly increased their steps by 929 per day. The greatest increase in step counts was seen in the lowest baseline activity groups. This study suggests promise in the potential impact of using Fitbits to motivate individuals to be more active.

Summary

The review of literature indicates that physical activity declines markedly during the college-age years (Caspersen et al., 2000) and that the college-age population is not sufficiently physically active (Mack, Wilson, Lightheart, Oster, & Gunnell, 2009). Interventions that report little success within this population encourage the need for more research to assess better ways to promote physically active behavior among the college-age participants (Sailors et al., 2010; Sallis et al., 1998).

The review of literature supports one potential avenue, self-determination theory-based intervention. This theory-based approach can be applied in the context of college physical activity courses and yield positive results. Literature supports the potential beneficial results for increasing physical activity and more self-determined motives for physical activity (Edmunds et al., 2008; Silva et al., 2008). Intervening in the college physical activity course to create a need-supportive class environment can provoke more physical activity and self-determined motivation for physical activity. Teaching with intentionality to increase autonomy, competence, and relatedness support has successfully increased physical activity and self-determined motivation in other settings (Standage et al., 2005; Zhang et al., 2011) and may be applicable in the college physical activity class.

The literature is inconsistent on the extent to which pedometers based interventions are effective at motivating change, but pedometers could be another avenue to promote changes in physical activity adherence and motivation among college-age participants. Some research does suggest that the use of pedometers in interventions has the potential for lasting behavior change (Van Dyck et al., 2013). Though similar to pedometers, new devices, termed movement technology in this review, have additional features and designs. They should be studied for their motivational qualities as they could result in distinctly different effects on outcome variables.

The pedometer interventions that report increases in physical activity are coupled with an additional intervention component such as goal setting (Croteau, 2004b; Gilson et al., 2013; Scofield et al., 2004). Pairing the two intervention ideas supported by research, need-supportive teaching and using movement technology, may increase physical activity levels. This may yield results distinct from assessing need-supportive teaching and the use of movement technology in intervention separately. Expanding research to thoroughly assess two intervention strategies that may provoke increases in physical activity and self-determined motivation for exercise can reveal future directions for promoting physical activity among the college-age population.

Chapter 3: Methods

Participants

Participants were recruited from a required Lifetime Physical Activity and Fitness course at a large university in eastern North Carolina. The mission of the Lifetime Physical Activity and Fitness Program is to empower all students to sustain regular, lifelong physical activity as a foundation for a healthy, productive, and fulfilling life. The course is taught by graduate students in a Department of Kinesiology who undergo training through a one day orientation and weekly seminars. They are further led and supervised by university staff and professors. The course is supplemented with a customized textbook written by departmental faculty.

All procedures were approved by the University Institutional Review Board (see Appendix A). Informed consent was obtained electronically from all participants in the full study and via written consent from all participants in the substudy (see Appendix C).

Approximately 1,600 university students enrolled in the course were recruited for this study. Students completed online questionnaires as a homework assignment in their course. The students were assured their responses would not be shared with their instructor and that their instructor would only be notified to confirm completion of questionnaires. As part of the online questionnaire, students were asked for consent to use their responses for research (see Appendix C). Students under the age of 18 were excluded from analysis due to their inability to give consent for the use of their data. Students over the age 24 were also excluded from the analysis to be consistent with CDC age classifications. This was done for comparison between CDC physical activity prevalence data and that found in the current study sample. The students were in a class with conventional teaching styles or in a class taught by an instructor trained in need-supportive teaching styles. The intervention took place during the spring semester of 2014.

For a substudy sample, 160 students were recruited from all of the courses, including both teaching conditions. Students were excluded from participation in the substudy if they had prior experience with the course (e.g., withdrew a previous semester, failed the course previously, etc.). Student participants in the substudy were volunteers from the course. At the start of the semester, students were asked to complete a form denoting their interest in participation by wearing a pedometer for one week, three times across the semester. They were also asked to express their interest in wearing a Fitbit throughout the semester. The form stated that they would be offered 10 extra credit points on their final test on completion of full participation in the study. The participants were clearly informed that their participation, or lack thereof, would have no negative or positive effect on their grade beyond the extra credit points. They were also given alternative opportunities to receive extra credit in the course. Forms were separated by instructors and 10 students were randomly selected from each instructor. Of these 10, 5 were randomly assigned to the Fitbit group (with movement technology) and 5 to the no Fitbit group (without movement technology). See Figure 2.

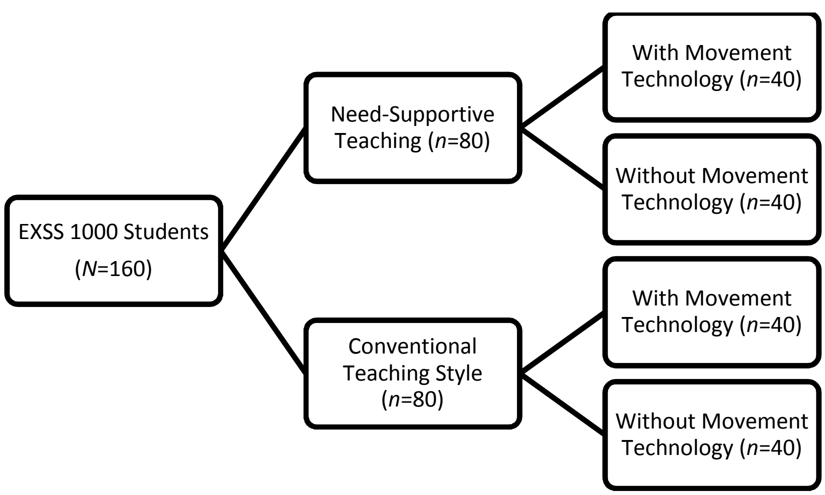

Figure 2. Participant recruitment scheme for movement technology sub-study

Measures

Measures taken at baseline, midterm, and post-intervention for the full sample included self-report physical activity, physical activity Stage of Change, need satisfaction, motivation, and enjoyment. Additionally, objectively measured physical activity was assessed via pedometer at three time points throughout the semester in the substudy sample. As recommended by Taylor and Ntoumanis (2007), student perception of need support in the class was measured post-intervention. Figure 3 shows study measures and data collection times. All questionnaires were given electronically through the university Qualtrics system. Students received information about how to complete questionnaires and open dates from their course syllabus, course schedule, and instructor reminders. Students were notified that their questionnaire responses would not be available to their instructors. A separate questionnaire link was created for each instructor to ensure that results were separated by instructor. Instructors were notified that their link was unique and not to be shared with other instructors. Each instructor was given a list of students who participated at each time point. No other information was given to the instructors.

Physical Activity. Physical activity was measured via self-report for all students and through pedometers for the substudy sample. Three self-report measures were taken on all students including the 30-Day Physical Activity Recall, the 8-Response Physical Activity Self-Report Measure, and the International Physical Activity Questionnaire. The 30-Day Physical Activity Recall (30-Day PAR; Baumgartner, Jackson, Mahar, & Rowe, 2006) requires students to select their level of physical activity over the previous 30 days based on a zero to seven specified scale (see Appendix C). Subjective physical activity was also measured via the 8-response physical activity self-report measure (PA-8). The measure asks students to make one selection that best represents their physical activity level based on a 1 to 8 scale (see Appendix

C). Selection of 5 or greater signifies a physical activity level sufficient to meet recommendations (Pate et al., 1995). The measure has evidence of reliability and validity (Jackson, Morrow, Bowles, FitzGerald, & Blair, 2007). The self-administered International Physical Activity Questionnaire-short form (IPAQ) was also used to assess self-reported physical activity (see Appendix C). The IPAQ has evidence of reliability and validity for large scale studies of diverse populations (Craig et al., 2003) and with college students (Dinger, Behrens, & Han, 2006). Responses on the IPAQ were used to get estimates of time spent in moderate to vigorous physical activity as well as metabolic equivalent (MET) minutes per week. The published IPAQ scoring protocol and data cleaning guidelines were used (Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ)-Short and Long Forms, 2005).

In the substudy, physical activity was measured objectively with a New Lifestyles NL-800 or NL-1000 pedometer. Pedometers were sealed with zip ties and students were instructed to keep the seal intact. Students were instructed to wear the pedometer at the waist, in line with the midline of the knee, for all waking hours for 7 consecutive days. Students collected their pedometers from their instructor and returned their pedometers to their instructors one week later. Those that wore pedometers also completed pedometer logs denoting the time the pedometer was put on and taken off. They also recorded any activity done while not wearing the pedometer (e.g., swimming). Valid step days were considered days of at least 1,000 steps as supported by previous research (Rowe, Mahar, Raedeke, & Lore, 2004). Students who did not accumulate at least 1,000 steps at least three days during the data collection time were removed from analysis. Tudor-Locke et al. (2005) and Felton, Tudor-Locke, and Burkett (2006) found intra-class correlations of .86 to .97 for any three day combination of their seven day pedometer data collection with adults and college students, supporting the three day criteria.

Stage of Change. A short, four-item questionnaire was used asking about current physical activity, activity over the past six months, and physical activity intention in the next six months to assess Stage of Change (See Appendix C). The questionnaire has validity evidence supporting its use (Marcus et al., 1992).

Motivation. Motivation to be active was assessed using the Behavioral Regulation in Exercise Questionnaire-Modified (BREQ-2R). The questionnaire asks respondents to answer questions regarding reasons behind why they do or do not engage in physical activity. Wilson et al. (2012) used the previously validated BREQ and BREQ-2, but also incorporated the BREQ-2R. The BREQ-2R is an updated measure of motivation for physical activity that includes measures for integrated regulation for exercise. They found integrated regulation to be a prominent regulator for activity. Wilson, Rodgers, Loitz, and Scime (2006) provided evidence of the validity and reliability of the new version BREQ-2R. The questionnaire includes 23 questions that follow a 5-point Likert-type format ranging from “not true for me” to “very true for me” (See Appendix C). Any use of the word “exercise” was replaced with “physical activity” to be consistent across all variables. Mean subscale scores were calculated using questionnaire responses. Relative Autonomy Index is a composite score that determines to what degree the respondent’s motivation for a behavior is self-determined. Higher scores represent more self-determined motives for engaging in a behavior. Relative Autonomy Index was also calculated using the formula by Vallerand, Pelletier, and Koestner (2008): ∑[(amotivation * -3) + (external regulation * -2) + (introjected regulation * -1) + (identified regulation * 1) + (integrated regulation * 2) + (intrinsic regulation * 3)].

Physical Activity Need Satisfaction. The degree to which basic psychological needs for competence, autonomy, and relatedness were satisfied in general exercise contexts was assessed. The Psychological Need Satisfaction in Exercise (PNSE) Scale was used (Wilson, Rodgers, & Rodgers, 2006). Wilson, Rodgers, and Rodgers (2006) provided validity evidence for this scale. The scale includes 18 6-point Likert-type questions to assess perceived satisfaction of autonomy, relatedness, and competence in exercise (See Appendix C). Any use of the word “exercise” was replaced with “physical activity” to be consistent across all variables.

Physical Activity Enjoyment. Physical Activity enjoyment was assessed using a shortened, five-item version of the Exercise Enjoyment Scale (Kendzierski & DeCarlo, 1991; Raedeke & Amorose, 2013). Participants were asked to rate how they felt about physical activity. The questions use a 7-point bipolar scale that includes like and dislike, enjoy and hate, boring and interesting, pleasurable and unpleasureable, and fun and not fun (See Appendix C). Any use of the word “exercise” was replaced with “physical activity” to be consistent across all variables.

Perception of Need Support. Perception of need support in the class was measured using a 24-item questionnaire validated by Standage et al. (2005) (See Appendix C). Their questionnaire included a physical education modified version of the 15-item Learning Climate Questionnaire to assess autonomy support. To assess competence and relatedness support they included an additional 9 items. All questionnaires were modified to reflect consistency in terminology. All references to “exercise” were changed to “physical activity”.

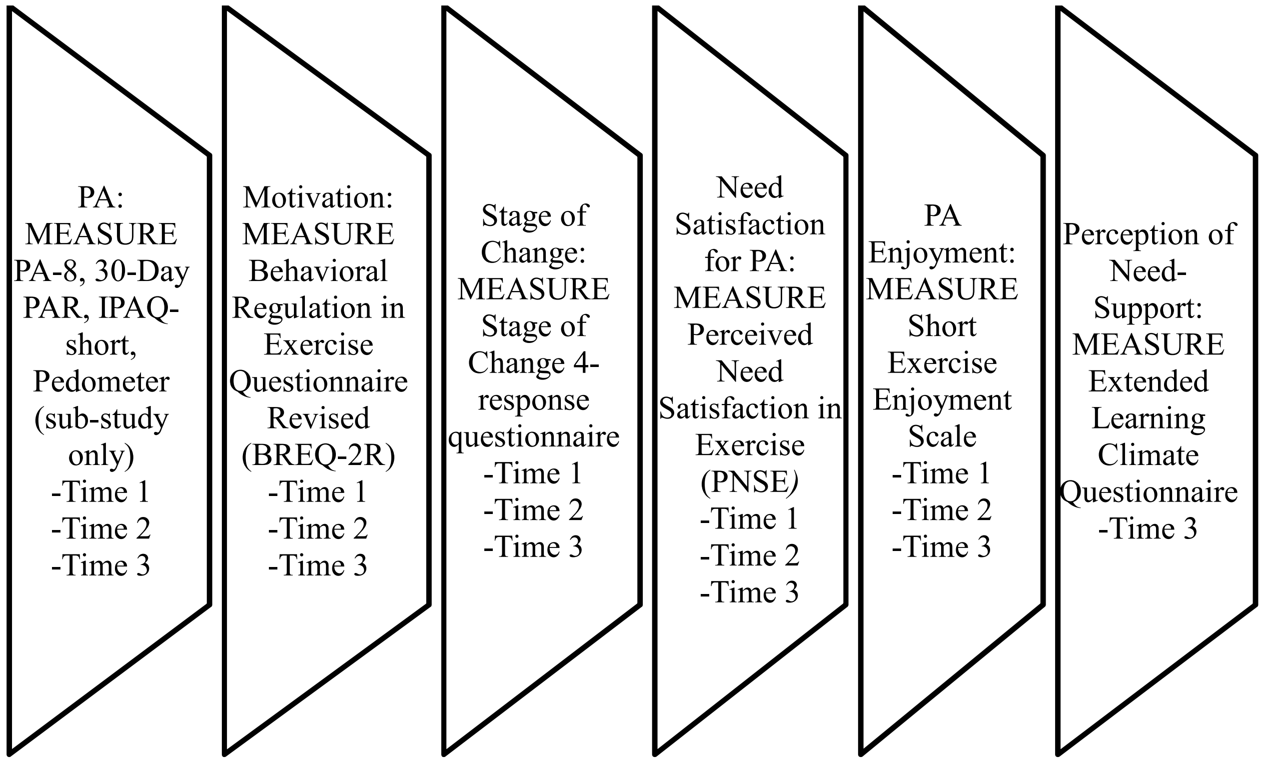

Figure 3: Study measures

Procedures

The 14 course instructors were randomly assigned to either need-supportive or conventional (control group) teaching, controlling for experience (number of semesters teaching the EXSS 1000 course). All instructors were given the opportunity to express disinterest in participating in the need-supportive intervention. All of the instructors expressed interest and willingness to participate. Both teaching style groups underwent the same training prior to the start of the semester led by the program director. To prevent cross-contamination, instructors of the conventional teaching condition were asked to not mimic or discuss other instructor techniques and to teach as usual. The instructors in the need-supportive teaching condition were instructed to not discuss intervention strategies or methodology with any of the conventional teaching condition instructors. The need-supportive teaching condition instructors were also asked to avoid co-teaching with instructors in the conventional teaching condition and to avoid having conventional teaching condition instructors substitute teach for them.

Instructors selected to lead the need-supportive classes participated in a 1-hour training program in addition to the general instructor training prior to the start of the semester. During this additional training, they were educated on self-determination theory and need-support. Supporting research was presented to them to increase buy-in and support for the intervention. During the initial training, and throughout the intervention, the instructors were educated and equipped to use a teaching style that incorporates the three psychological needs of the self-determination theory: autonomy, competence, and relatedness support. Recommendations for facilitating a class environment that encourages more self-determined motivation presented by Niemiec and Ryan (2009) were used, along with other techniques to support the innate needs within a physical activity class environment. Suggestions for autonomy support included, but were not limited to: limiting evaluative pressure, limiting coercion, and increasing the students' perceptions that they are making choices. Providing rationale for the meaningfulness of activities was also encouraged. Suggestions for competence support included, but were not limited to: creating optimally challenging tasks, while also giving students the resources and feedback they need to succeed. This feedback was directed to accentuate the students' success and soften evaluation. Suggestions for relatedness support included, but were not limited to: the teacher being sincere and evoking value of the student. True care and respect for the students with a warm and kind nature was encouraged. Physical education, exercise leadership, and teaching strategies supported by Silva et al. (2008), Reeve and Jang (2006), and Ryan and Deci (2000b) were used by the need-supportive teaching group throughout the intervention. A list of general strategies used by the instructors is provided in Appendix D.

At the end of the initial training, the instructors in the need-supportive teaching condition agreed upon a set of standard need-supportive goals for each week. These are listed on the goal setting worksheet in Appendix D. As part of the initial training, the instructors were encouraged to begin brainstorming specific ways they could implement need-support during the first week of classes. They set specific and individual goals for themselves using the goal setting worksheet (Appendix D).

Class tasks, directions, and assignments were also framed with need-supportive intentionality in the intervention group. During the initial training, the instructors role played by discussing how to deliver the course syllabus with need-supportive framing. Instructors planned and executed need-supportive framing throughout the intervention. This approach was utilized to foster students having an intrinsic goal of completing the task and following directions, as opposed to an extrinsic goal (Deci & Ryan, 2000). According to Vansteenkiste et al. (2009), intrinsic goal pursuit provokes higher well-being and lower ill-being, better physical health, and better relationships when compared to extrinsic goal pursuit. Therefore, goal and task framing can be important. Intrinsic goal setting focuses on attention on the task, yet extrinsic goal setting shifts focus to some external indicator of success. An extrinsic goal framing would be: you should seek to do well on all of these assignments because it is necessary to make a good grade in the class. An intrinsic goal framing might be: these assignments can help you better understand and enjoy physical activity. Extrinsic goal setting can thwart need satisfaction and lead to discouraging deep learning and individual directed persistence.

Both teaching style groups participated in weekly seminars for instruction enhancement, accountability, and responsibility clarification; however, the groups met separately. Seminars were 50-60 minutes each week. The conventional teaching style group had a conventional seminar meeting each week, led by the program director. The need-supportive teaching style group seminar focused on intervention implementation, and assessment and setting goals for intervention implementation each week. This seminar was led by the primary researcher at the same time as the conventional teaching group, but in a different location. The need-supportive seminar was led with a need-supportive approach (supported by the literature) to enhance the need-supportiveness of the teachers. The need-supportive seminar followed the same format each week. It began with announcements and was followed by self-assessment of need-supportive goals setting the previous week during seminar. Instructors used the goal evaluation worksheet to organize their assessment (see Appendix D). Then, instructors shared things they felt went well or were particularly challenging over the previous week. During this time, open discussion was encouraged and instructors would discuss how to prevent or overcome the mentioned challenges in the future. After this a helpful resource was presented to the instructors. These varied each week. An example was small talk strategies to help instructors implement their goal of arriving to the class setting early to engage students in conversation (to support relatedness). Open discussion began again after the helpful resource presentation. During this open discussion, instructors discussed lessons they had in the coming week. They discussed the logistics of the lessons to ensure that all instructors felt competence. They also discussed ideas for how to be need-supportive during specific lessons. After discussion, instructors set their specific goals for the week using the goal setting worksheet in Appendix D.

Each week need-supportive teachers submitted a list of specific need-supportive strategies they had used in their classes over the previous week. They also submitted a list of the goals they were planning to set for the following week. These were submitted electronically to the primary researcher, were compiled, and then distributed to all need-supportive instructors electronically and in hard copy format.

The students in the movement technology groups used a new product that is available to the general public that may serve as a motivational tool for the college population. This product is comparable to a pedometer, but its additional features and style may have a different impact on motivation for physical activity. Fitbit® Flex (Fitbit) devices use a triaxial accelerometer, measure activity throughout the day, and are worn around the wrist. They can be adjusted to a size that best suits the individual wearing the device. A lithium polymer battery keeps the Fitbit Flex charged. The battery is recharged using an included USB cable. Battery life is approximately five days. The Fitbit Flex contains a vibration motor, which elicits vibration for alarms that are set and when goals are achieved. Activity data can be instantly synced and viewed on a preferred device (phone, tablet, computer) using Bluetooth® technology. Measures of activity include: steps, distance, calories burned, and very active minutes. The device website and application stores all activity data and additional measures such as caloric balance. Students had access to the website (www.fitbit.com), website tools, smartphone application, and the device software used for customization, syncing data, and goal setting. To date, a literature search by the researcher revealed no studies on the device.

Instructors were given instructions to remind students to complete questionnaires. Instructions specified that instructors would not have access to student responses. Instructors were also given instructions to recruit participants to the substudy as well. Interest forms were made available to all students and they were returned to the instructor. Students specified if they were interested. Of the forms returned from students who expressed interest, students over the age of 24 were excluded and students who had previously taken the course were excluded. Each instructor had 10 students randomly selected to participate. Of those 10, five were selected to wear the Fitbit and five were selected to not wear the Fitbit. Selected students were notified of their selection by the primary researcher and given an opportunity to withdraw their name from interest. Those who remained interested were given consent forms and consent forms were collected by their instructor, prior to their participation. Students in the Fitbit group signed up for a time to visit the Student Recreation Center to pick up their device. They were given information about what pieces the Fitbit contained and how to store the device and its parts. They were not given further instruction, but were told to treat the device as if they had purchased it for themselves at a store, and to discover the device set-up and features for themselves. Students were all given the same instructional and informational sheet. It provided minimal instruction and information about how to fully participate in the research. The students were instructed to contact the primary researcher, not the instructor, to ask questions or share concerns about the Fitbit.

Implementation assessment and fidelity of the need-supportive teaching intervention was assessed in two ways. Instructors documented the ways in which they were need-supportive each week during their weekly end-of-week seminar using the goal evaluation worksheet mentioned previous (see Appendix D). As part of the assessment, on the worksheet they also rated their autonomy support, competence support, relatedness support, and need thwarting each week on a 1-7 scale. Secondly, some instructors were randomly observed by one to two trained observers. Half of the observers were blind to the intervention strategies and instructor grouping, and half of the observers were not blind. Our initial methodology was to pair all observations with one blind and one not blind observer and to assess interrater reliability. However, scheduling conflicts with observers hindered pairing all observations. Instructors were scored on their degree of autonomy, competence, and relatedness support (need-supportive techniques) in contrast to their degree of autonomy, competence, and relatedness thwarting. A scoring sheet was created for the purposes of this evaluation based on previous research (See Appendix D, Haerens et al., 2013). Observers attended a one-hour training session. The observation protocol and scoring was presented by the primary researcher (see Appendix D). Examples of scoring were provided and observers conducted one practice observation.

Baseline questionnaire measures for all groups were taken during the first week of classes. The teaching intervention treatment began in the need-supportive teaching style groups when instructors had first interactions with their students. All classes met for approximately 100 minutes each week. Unit concepts were the same across all groups. Midterm measurements were taken at week 6 and final measures were taken at week 12. Figure 4 is a visual representation of data collection timing. Objective physical activity was assessed during the third and fourth week of classes. Objective physical activity was delayed and extended due to a winter storm that led to cancelled classes. The movement technology intervention treatment began during the third and fourth week of classes. The movement technology intervention lasted 10 weeks. Time 2 pedometer data collection took place midway through the intervention. Time 3 pedometer data collection took place at the end of the semester and after Fitbit devices had been collected from students. Figure 4 is a visual representation of data collection timing.

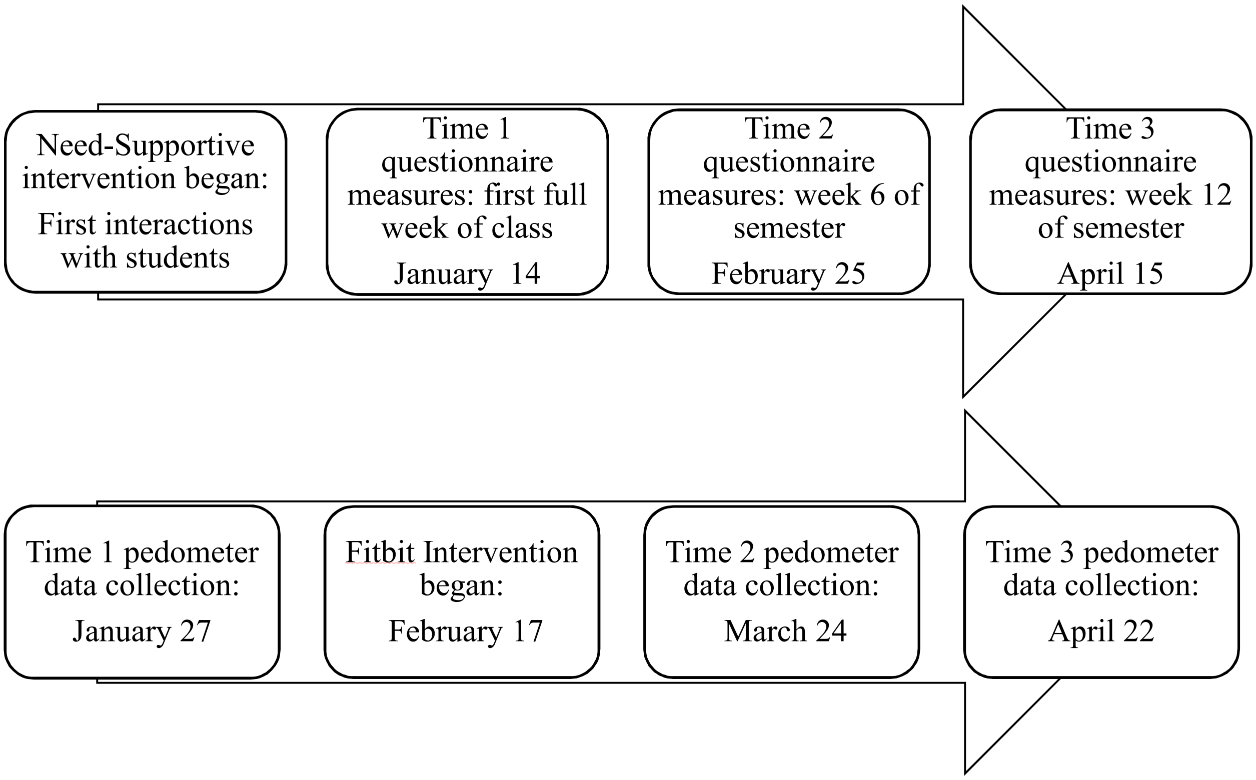

Figure 4. Intervention timelines

Statistical Analyses

Descriptive statistics were calculated by teaching condition at each time point. Internal consistency reliability estimates for all subscales of the BREQ-2R and PNSE were estimated with alpha reliability coefficients. Pearson correlations among BREQ-2R subscales were calculated to examine the associations among subscales. Multiple 3 (time) x 2 (teaching condition) mixed effects ANOVAs were used for statistical analysis of the data in the main study. Several 2 (time 1 and time 3) x 2 (Fitbit group) mixed effects ANOVAs were used for statistical analysis of the substudy data. A 2 (time 1 and time 3) x 2 (teaching condition) x 2 (Fitbit group) mixed effects ANOVA was used for statistical analysis of the objectively measured physical activity data. All significance tests were conducted at a nominal value of p = .05. Between-group and between-time effects were also calculated using Cohen's delta (d).

Chapter 4: Results

Main Study Descriptive Statistics

During the spring semester of 2014, 1,605 students completed study questionnaires. Five students were excluded from analysis due to an inability to give independent consent (age < 18 years). Students over the age of 24 years were also removed from the analyses (n = 34). Students who completed a questionnaire more than once had their second questionnaire completion removed from analysis (time 1 = 13, time 2 = 9, time 3 = 82). The remaining students (N = 1,505) had a mean age of 19.4 ± 1.4 years. Response rates for survey questions varied slightly and are specified below.

As shown in Table 1, the number of male and female participants in each teaching condition was not statistically different (p = .84). Likewise, similar numbers (p = .14) of students from various class standings in each teaching condition completed the questionnaires.

Table 1
Number and Percent of Participants per Teaching Condition by Sex and Class Standing

	Teaching Condition			
	Conventional n = 775		Need-Supportive n = 730	
Gender	n	Percent	n	Percent
Male	282	36%	262	36%
Female	493	64%	468	64%
Class Standing				
Freshman	334	43%	309	42%
Sophomore	207	27%	228	31%
Junior	115	15%	105	15%
Senior	115	15%	83	11%
Other	3	< 1%	5	1%

Table 2 presents descriptive statistics for the self-reported physical activity measures. In both teaching conditions, self-reported physical activity for the PA-8 and 30-Day PAR increased slightly between the first two time points and decreased slightly between the last two time points, although it did not return to baseline. All PA-8 and 30-Day PAR mean scores considered insufficiently active.

Per the IPAQ scoring protocol, 50 responses were deleted due to computing errors, 10 were deleted due to invalid text entry, and 56 were deleted due to activity time reports of over 24 hours. If a question had matching hours and minutes (e.g., 1 hour and 60 minutes) answers (n = 1,108), only one response was retained as this was judged to be a response error. Responses were truncated to four hours if greater than four hours and less than 24 hours of activity were reported (n = 761). If a respondent provided a range of time he or she engaged in any type of physical activity, the median was taken (n = 39). Responses were converted to minutes spent in moderate, vigorous, and walking physical activity. These data were then converted to Metabolic Equivalent (MET) minutes per week. IPAQ questionnaire data (see Table 2) are reported as average moderate-to-vigorous physical activity minutes per week (MVPA/week) and MET-minutes per week (MET-minutes/week). In the original IPAQ validation study, Craig et al. (2003) reported a median of 2,514 MET-minutes/week for 1,974 adults. More comparable to our study values, Lee et al. (2011) reported mean values of 4,250 ± 5,054 MET-minutes/week for a sample of 1,270 adults (*M* age = 42.9 ± 14.4 years). Average MET-minutes/week for participants in the current study appears to be substantially higher than reported in previous studies, which may be partially due to the younger age group in the current study and partially due to over-reporting of physical activity by the current sample. Dinger, Behrens, and Han (2006) assessed physical activity in a sample of 123 college students (*M* age = 20.8 ± 14.4 years) with the IPAQ. Though their mean age was comparable to our sample, they reported a mean total MVPA of 233.1 ± 130.7

min/week. Their reported physical activity levels were much lower than those calculated for the present study.

Table 2
Self-reported Physical Activity (*M* ± *SD*) for each Teaching Condition at each Time Point of Questionnaire Data Collection

	Teaching Condition	
Physical Activity Questionnaire	Conventional	Need-Supportive
PA-8	*n = 674*	*n = 625*
Time 1	4.9 ± 1.9	5.1 ± 1.9
Time 2	5.3 ± 1.8	5.4 ± 1.8
Time 3	5.2 ± 1.9	5.3 ± 1.8
30-Day PAR	*n = 675*	*n = 626*
Time 1	3.6 ± 2.3	3.8 ± 2.2
Time 2	4.2 ± 2.1	4.5 ± 2.0
Time 3	4.1 ± 2.0	4.3 ± 2.0
IPAQ-MVPA (min/week)	*n* = 177	*n* = 175
Time 1	744.5 ± 578.1	698.0 ± 518.7
Time 2	730.8 ± 557.5	790.6 ± 515.3
Time 3	740.9 ± 562.6	773.2 ± 520.2
IPAQ-Total MET-minutes/week	*n* = 253	*n* = 250
Time 1	5,510.0 ± 4,022.3	5,596.1 ± 3,903.9
Time 2	5,703.3 ± 3,974.5	6,172.5 ± 3,783.0
Time 3	5,933.6 ± 4,198.1	5,999.7 ± 3,941.5

Note: PA-8 is the 8-item physical activity measure; 30-Day PAR is the 30-Day Physical Activity Recall; IPAQ is the International Physical Activity Questionnaire-short form; MVPA is moderate-to-vigorous physical activity; MET is Metabolic Equivalent.

Table 3 presents descriptive statistics for the BREQ-2R Relative Autonomy Index (RAI) and subscales for each teaching condition, at each time point. Differences across the three time points were small and were similar between teaching conditions at time 1. RAI scores ranged from -13.3 to 24.0, but the mean for our sample was much smaller and the standard deviation much greater than those (*M* = 15.5 ± 4.4) reported by Wilson, Sabiston, Mack, and Blanchard (2012) in a sample of 236 Canadian college students (*M* age = 20.0 ± 1.9 years). The subscale values are comparable to those found by Duncan et al. (2010) in a large sample of young adults (N = 1,055, M age = 24.0 ± 9.6 years) who were self-reported regular exercisers. As expected for a sample of regular exercisers, respondents reported higher intrinsic regulation (M = 3.1 ± 0.8), integrated regulation (M = 2.7 ± 1.0), and identified regulation (M = 3.2 ± 0.7) than the current sample. Their respondents also reported lower introjected regulation (M = 1.8 ± 1.1), external regulation (M = 0.8 ± 0.5), and amotivation (M = 0.2 ± 0.4) than the current sample. Overall, in the current study, trivial changes were noted across time for most BREQ-2R subscale scores; however, increases in external regulation and amotivation, which are less self-determined classifications of motivation were seen.

Table 3
BREQ-2R Scores (*M* ± *SD*) at each Time Point of Questionnaire Data Collection for each Teaching Condition

	Teaching Condition	
	Conventional	Need-Supportive
Relative Autonomy Index	*n = 659*	*n = 620*
Time 1	10.3 ± 6.9	10.8 ± 6.7
Time 2	10.2 ± 6.7	10.9 ± 6.7
Time 3	8.9 ± 7.2	9.3 ± 7.0
Intrinsic Regulation	*n = 674*	*n = 625*
Time 1	2.7 ± 1.0	2.7 ± 1.0
Time 2	2.6 ± 0.9	2.9 ± 0.9
Time 3	2.6 ± 0.9	2.8 ± 0.9
Integrated Regulation	*n = 673*	*n = 625*
Time 1	2.2 ± 1.2	2.3 ± 1.1
Time 2	2.4 ± 1.1	2.5 ± 1.1
Time 3	2.3 ± 1.1	2.4 ± 1.0
Identified Regulation	*n = 674*	*n = 625*
Time 1	2.7 ± 0.9	2.8 ± 0.9
Time 2	2.8 ± 0.9	2.9 ± 0.8
Time 3	2.7 ± 0.9	2.8 ± 0.8
Introjected Regulation	*n =659*	*n =620*
Time 1	2.0 ± 1.2	2.0 ± 1.1
Time 2	2.1 ± 1.1	2.1 ± 1.1
Time 3	2.0 ± 1.1	2.1 ± 1.1
External Regulation	*n = 674*	*n = 625*
Time 1	0.9 ± 0.9	0.8 ± 0.9
Time 2	1.0 ± 0.9	1.0 ± 1.0
Time 3	1.1 ± 1.0	1.8 ± 1.0
Amotivation	*n = 673*	*n = 625*
Time 1	0.4 ± 0.6	0.3 ± 0.6
Time 2	0.5 ± 0.8	0.5 ± 0.8
Time 3	0.7 ± 1.0	0.7 ± 1.0

Note: BREQ-2R is Behavior Regulation Exercise Questionnaire-Revised.

Descriptive statistics for scores on perceptions of need satisfaction in physical activity, for both teaching conditions, at each time point are included in Table 4. The scores were high across teaching condition and time. They changed little across time, for both teaching conditions.

The scores were similar to those reported by Wilson et al. (2006) who sampled 426 undergraduate students.

Descriptive statistics for the Modified Short Exercise Enjoyment Measure are also presented in Table 4. Means for each teaching condition were high (Means > 5.2 on a 7-point scale).

Table 4
Perceived Need Satisfaction for Physical Activity and Physical Activity Enjoyment (*M* ± *SD*) at each Time Point of Questionnaire Data Collection for each Teaching Condition

	Teaching Condition	
Modified PNSE Subscales	Conventional	Need-Supportive
Perceived Competence	*n = 675*	*n = 625*
Time 1	4.4 ± 1.2	4.5 ± 1.1
Time 2	4.5 ± 1.0	4.7 ± 1.0
Time 3	4.5 ± 1.1	4.7 ± 1.0
Perceived Autonomy	*n = 675*	*n = 625*
Time 1	5.0 ± 1.0	5.0 ± 1.0
Time 2	5.0 ± 1.0	5.0 ± 1.0
Time 3	5.0 ± 1.0	5.0 ± 1.0
Perceived Relatedness	*n = 675*	*n = 625*
Time 1	4.3 ± 1.2	4.3 ± 1.2
Time 2	4.3 ± 1.1	4.5 ± 1.1
Time 3	4.3 ± 1.2	4.4 ± 1.1
Enjoyment Scale	*n = 675*	*n = 626*
Time 1	5.4 ± 1.3	5.6 ± 1.3
Time 2	5.5 ± 1.2	5.7 ± 1.1
Time 3	5.3 ± 1.3	5.5 ± 1.2

Note: PNSE is Perceived Need Satisfaction in Exercise Scale.

The percentage of students classified into each Stage of Change, at each time point, is presented in Table 5. More than 50% of participants were classified into the Maintenance Stage at each time point for each teaching condition. A similar percentage of participants in the two teaching conditions were classified in each Stage of Change at Time 1.

Table 5
Percent of Participants in each Stage of Change for each Time Point

	Teaching Condition					
	Conventional $n = 675$			Need-Supportive $n = 629$		
Stage of Change Classification	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3
Precontemplation	1	2	1	0	0	1
Contemplation	24	14	17	23	12	15
Preparation	9	8	6	9	6	6
Action	14	20	11	14	19	14
Maintenance	52	56	65	54	63	64

Descriptive statistics for student perceptions of their instructor's need-support (Table 6) were collected from 1,420 students. Means for each teaching condition were high (means for all subscales > 5.5 on a 7-point scale).

Direct observations were conducted on six need-supportive teachers and five conventional teachers. Descriptive statistics for subscale measures and the overall need-support measure are provided in Table 6. Teachers in the conventional teaching condition received lower scores on all subscales than the need-supportive teachers. Both teaching condition means were considered need-supportive (score > 4). Of the 19 direct observations, only 14 were able to be paired for reliability due to observer availability and scheduling. Of those 14 observations, 77% of the items were consistently classified by the two observers.

Table 6
Student Perceptions and Direct Observation of Need-Support (*M* ± *SD*) by Teaching Condition

Student Perceptions of Need-Support				
Teaching Condition	Perceived Autonomy	Perceived Competence	Perceived Relatedness	Perceived Need Support
Conventional (*n* = 719)	5.6 ± 1.4	5.6 ± 1.5	5.8 ± 1.5	5.7 ± 1.5
Need-Supportive (*n* = 701)	5.8 ± 1.4	5.9 ± 1.5	6.0 ± 1.5	5.9 ± 1.5

Direct Observation of Need-Support				
Teaching Condition	Autonomy Support	Competence Support	Relatedness Support	Overall Need Support
Conventional (*n* = 9)	4.7 ± 1.3	4.4 ± 1.4	4.9 ± 1.2	4.5 ± 1.1
Need-Supportive (*n* = 10)	5.7 ± 0.9	5.5 ± 1.2	6.4 ± 0.5	5.8 ± 0.8

Main Study Questionnaire Reliability and Validity

Internal consistency reliability estimates for the psychosocial questionnaires are provided in Table 7. Alpha reliability coefficients (α) for each questionnaire scale or subscale were high, ranging from .78 to .95.

Table 7
Descriptive Statistics and Reliability Estimates for the BREQ-2R Subscales, PNSE Subscales, Enjoyment, and Student Perception Subscale at each Time Point

	Time 1 *n* = 1,520			Time 2 *n* = 1,440			Time 3 *n* = 1,532		
BREQ-2R	*M*	*SD*	α	*M*	*SD*	α	*M*	*SD*	α
Intrinsic Regulation Subscale (4 items)	2.7	1.0	.91	2.8	0.9	.91	2.7	0.9	.91
Integrated Regulation Subscale (4 items)	2.2	1.1	.91	2.4	1.1	.90	2.4	1.0	.90
Identified Regulation Subscale (4 items)	2.7	0.9	.80	2.9	0.8	.78	2.7	0.8	.80
Introjected Regulation Subscale (3 items)	2.0	1.2	.83	2.1	1.1	.84	2.0	2.0	.86
External Regulation Subscale (4 items)	0.9	0.9	.85	1.0	0.9	.87	1.1	1.0	.88
Amotivation Subscale (4 items)	0.4	0.7	.87	0.5	0.8	.88	.70	0.9	.91
	Time 1 *n* = 1,520			Time 2 *n* = 1,440			Time 3 *n* = 1,532		
PNSE	*M*	*SD*	α	*M*	*SD*	α	*M*	*SD*	α
Perceived Autonomy Subscale (6 items)	5.0	1.0	.94	5.0	1.0	.95	4.9	1.0	.96
Perceived Competence Subscale (6 items)	4.4	1.1	.94	4.6	1.1	.94	4.6	1.1	.95
Perceived Relatedness Subscale (6 items)	4.3	1.2	.93	4.4	1.1	.94	4.4	1.1	.95
	Time 1 *n* = 1,520			Time 2 *n* = 1,440			Time 3 *n* = 1,532		
Enjoyment Scale	*M*	*SD*	α	*M*	*SD*	α	*M*	*SD*	α
Enjoyment (5 items)	5.5	1.3	.93	5.6	1.2	.92	5.4	1.2	.92
							Time 3 *n* = 1,532		
Student Perception of Need-Support							*M*	*SD*	α
Perceived Autonomy Subscale (15 items)							5.7	1.4	.95
Perceived Competence Subscale (4 items)							5.7	1.5	.90
Perceived Relatedness Subscale (5 items)							5.9	1.5	.94

Notes: BREQ-2R is Behavioral Regulation in Exercise Questionnaire-Revised; PNSE is Perceived Need Satisfaction in Exercise Questionnaire

Table 8 presents BREQ-2R subscale correlations at time 1. The correlations followed the expected pattern with subscales close to one another on the self-determination theory continuum correlated more strongly than subscales that are farther from one another. Subscales on opposite ends of the self-determination theory continuum correlated weakly or negatively. Similar patterns of correlations were found at time 2 and time 3 (shown in Appendix D). This pattern of correlations supports the theory that the subscales are measuring dimensions along the continuum theorized under self-determination theory.

Table 8
BREQ-2R Subscale Correlations

	1	2	3	4	5	6
Time 1						
1. Intrinsic Regulation	1.00					
2. Integrated Regulation	.78	1.00				
3. Identified Regulation	.75	.80	1.00			
4. Introjected Regulation	.36	.48	.55	1.00		
5. External Regulation	-.14	-.02	-.04	.29	1.00	
6. Amotivation	-.32	-.21	-.35	-.07	.37	1.00

Notes: BREQ-2R is Behavioral Regulations in Exercise Questionnaire-Revised; all correlations are significant ($p < .001$).

Main Study Intervention Evaluation

Physical Activity. A 2 x 3 (teaching condition x time) mixed ANOVA was conducted to examine the effects of teaching condition across three time periods. In large samples, mean differences can be statistically significant even if they are not meaningful. Interpretation of the results will therefore focus on the sizes of the mean differences expressed as Cohen's delta (*d*). For the 30-Day PAR, the interaction effect ($p = .71$) and teaching condition effect ($p = .09$) were not statistically significant and the overall mean difference between teaching conditions was negligible ($d = -0.09$). The time effect was statistically significant ($p < .05$). Mean 30-Day PAR increased significantly from time 1 to time 2 ($d = 0.29$), then decreased significantly from time 2 to time 3 (d = -0.23). From time 1 to time 3, mean 30-Day PAR increased significantly but negligibly (d = 0.07).

Results were similar for the PA-8 physical activity scale. The interaction effect (p = .92) and teaching condition effect (p = .08) were not significant and the mean difference between teaching conditions was small (d = -0.10). The time effect was significant ($p < .05$). Mean PA-8 increased from time 1 to time 2 (d = 0.19), then decreased significantly but negligibly from time 2 to time 3 (d = -0.06). From time 1 to time 3, mean PA-8 increased significantly (d = 0.14).

For the IPAQ estimate of MVPA, the interaction effect (p = .15), teaching condition (p = .75), and time effect (p = .31) were not significant and the mean difference between teaching conditions was negligible (d = 0.03). Mean IPAQ MVPA increased negligibly from time 1 to time 2 (d = 0.07), and changes from time 2 to time 3 (d = -0.01) and from time 1 to time 3 (d = 0.07) were negligible.

For the IPAQ estimate of MET-minutes/week, the interaction effect (p = .37) and teaching condition effect (p = .49) were not significant and the mean difference between teaching conditions was negligible (d = -0.05). The time effect was significant ($p < .05$). Mean IPAQ MET-minutes/week increased minimally from time 1 to time 2 (d = 0.10), but no change was noted from time 2 to time 3 (d = -0.01). MET-minutes/week increased minimally from time 1 to time 3 (d = 0.10).

BREQ-2R. Results from the 2 x 3 mixed ANOVA showed that for the RAI the interaction effect (p = .63) was not significant. The teaching condition effect was not significant (p = .91) and the mean difference between teaching conditions was negligible (d = 0.07). The time effect was significant ($p < .05$). Mean RAI did not change from time 1 to time 2 (d = -0.00), then decreased from time 2 to time 3 (d = -0.21). From time 1 to time 3, mean RAI had a small decrease (d = -0.22).

For intrinsic regulation, the interaction effect was not significant (p = .23). The teaching condition effect was significant ($p < .05$), but the mean difference between teaching conditions was small (d = -0.14). The time effect was significant ($p < .05$). Mean intrinsic regulation increased significantly from time 1 to time 2 (d = 0.14), then decreased from time 2 to time 3 (d = -0.15). From time 1 to time 3, mean intrinsic regulation did not change significantly (d = 0.01).

For integrated regulation, the interaction effect (p = .07) and teaching condition effect were not significant (p = .07). The mean difference between teaching conditions was small (d = -.11). The time effect was significant ($p < .05$). Mean integrated regulation increased significantly from time 1 to time 2 (d = 0.16). The change from time 2 to time 3 was not significant (d = -0.04). Mean integrated regulation increased significantly from time 1 to time 3, but the change was small (d = 0.13).

For identified regulation, the interaction effect (p = .44) and teaching condition effect were not significant (p = .12). The mean difference between teaching conditions was negligible (d = 0.08). The time effect was significant ($p < .05$). Mean identified regulation increased significantly from time 1 to time 2 (d = 0.13) and then decreased significantly from time 2 to time 3 (d = -0.14). From time 1 to time 3, identified regulation decreased, but the decrease was negligible and nonsignificant ($d < 0.01$).

For introjected regulation, the interaction effect (p = .55) and teaching condition effect (p = .85) were not significant. The mean difference between teaching conditions was negligible (d = -0.01). The time effect was significant ($p < .05$). Mean introjected regulation increased significantly from time 1 to time 2 ($d = 0.15$), then decreased significantly from time 2 to time 3 ($d = -0.09$). From time 1 to time 3, introjected regulation increased negligibly ($d = 0.06$).

For external regulation, the interaction effect ($p = .28$) and teaching condition effect were not significant ($p = .83$). The mean difference between teaching conditions was negligible ($d = -0.01$). The time effect was significant ($p < .05$). Mean external regulation increased significantly from time 1 to time 2 ($d = 0.16$), and continued to increase from time 2 to time 3 ($d = 0.14$). The significant increase in external regulation from time 1 to time 3 was small to medium ($d = 0.31$).

For amotivation, the interaction effect ($p = .40$) and teaching condition effect were not significant ($p = .66$). The mean difference between teaching conditions was negligible ($d = 0.02$). The time effect was significant ($p < .05$). Mean amotivation increased significantly from time 1 to time 2 ($d = 0.14$), and continued to increase from time 2 to time 3 ($d = 0.22$). The increase in amotivation from time 1 to time 3 was significant and small to medium ($d = 0.36$).

PNSE. For perceived competence satisfaction, the interaction effect ($p = .08$) was not significant. The teaching condition effect ($p < .05$) and the time effect ($p < .05$) were significant. The mean difference between teaching conditions was small ($d = 0.11$). Mean perception of competence satisfaction increased significantly from time 1 to time 2 ($d = 0.17$), then did not change from time 2 to time 3 ($d = -0.05$). From time 1 to time 3, mean perception of competence satisfaction increased significantly ($d = 0.13$).

For perceived autonomy satisfaction, the interaction effect ($p = .29$) and teaching condition effect ($p = .32$) were not significant. The mean difference between teaching conditions was negligible ($d = 0.05$). The time effect ($p < .05$) was significant. Change in the mean perception of autonomy satisfaction from time 1 to time 2 was negligible ($d = 0.06$). From time 2 to time 3, a small decrease in autonomy satisfaction was seen (*d* = -0.13). From time 1 to time 3, the change in the mean perception of autonomy satisfaction was negligible (*d* = -0.06).

For perceived relatedness satisfaction, the interaction effect (*p* = .32) and teaching condition effect (*p* = .06) were not significant and the mean difference between teaching conditions was negligible (*d* = 0.09). The time effect was significant ($p < .05$). Mean perception of relatedness satisfaction increased significantly from time 1 to time 2 (*d* = 0.13), then did not change from time 2 to time 3 (*d* = -0.05). From time 1 to time 3, mean perception of relatedness satisfaction increased significantly, but negligibly (*d* = 0.08).

Enjoyment. Results from the 2 x 3 mixed ANOVA showed that for physical activity enjoyment the interaction effect (*p* = .85) was not significant. The teaching condition effect was significant (*p* = .01). The mean difference between teaching conditions was small (*d* = 0.14). The time effect was statistically significant ($p < .05$). The mean change in physical activity enjoyment from time 1 to time 2 was negligible (*d* = 0.09). The mean change from time 2 to time 3 was small (*d* = -0.13). From time 1 to time 3, change in mean physical activity enjoyment was negligible (*d* = 0.04).

Stage of Change. Table 9 shows the percentage of students that experienced a shift in their Stage of Change from time 1 to time 3. The number of stage changes represents how many shifts from stage to stage occurred and in which direction. The majority of students in both groups experienced no shifts in the Stage of Change. Though some percentage differences between teaching conditions exist, they were small.

Table 9
Percentage of Stage of Change Differences from Time 1 to Time 3

Number of stage changes	Teaching Condition Conventional *n* = 738	 Need-Supportive *n* = 717
-4	0.3	0.4
-3	2	4
-2	4	4
-1	5	7
0	60	58
+1	13	11
+2	7	9
+3	7	7
+4	0.1	0.8

Student Perceptions of Need-Supportive Teaching. Results from an independent samples *t*-test indicated that students in the need-supportive teaching condition classes reported significantly ($p < .05$) higher levels of perceived autonomy support ($M = 5.8 \pm 1.4$, $n = 700$) compared to the students in the conventional teaching condition classes ($M = 5.6 \pm 1.4$, $n = 719$). The mean difference of 0.20 was small ($d = 0.14$). Students in the need-supportive teaching condition classes also reported significantly ($p < .05$) higher levels of perceived competence support ($M = 5.9 \pm 1.6$) compared to students in the conventional teaching condition classes ($M = 5.6 \pm 1.5$). The mean difference of 0.30 was small ($d = 0.19$). Students in the need-supportive teaching condition classes reported higher levels of perceived relatedness support ($M = 6.0 \pm 1.5$) compared to the students in the conventional teaching condition classes ($M = 5.8 \pm 1.5$). However, this difference was small ($d = 0.13$) and not significant ($p = .08$).

Direct Observation of Need-Supportive Teaching. Direct observation scores were significantly different between teaching conditions. Need-supportive teachers had higher scores ($p < .05$) on all subscales than teachers in the conventional teaching condition. The need-supportive teaching condition had higher scores on observed competence support (*M* = 5.5 ± 1.4) than the convention teaching condition (*M* = 4.2 ± 1.3). The difference was large (*d* = 0.96). The need-supportive teaching condition had higher scores on observed autonomy support (*M* = 5.7 ± 1.1) than the convention teaching condition (*M* = 4.7 ± 1.5). The difference was medium to large (*d* = 0.77). The need-supportive teaching condition had higher scores on observed relatedness support (*M* = 6.4 ± 0.9) than the convention teaching condition (*M* = 4.9 ± 1.3). The difference was large (*d* = 1.63). The difference between need-supportive teachers and conventional teachers on overall need support was large (*d* = 1.30).

Substudy Results

From the sample of participants that volunteered for the substudy, originally 160 students were selected to participate. Participants in the substudy were requested to wear a pedometer for one week, three times during the semester. An equal number of males (*n* = 5) and females (*n* = 5) were randomly selected from the classes taught by each instructor. An additional 39 students were selected to replace students who initially expressed interest in participating in the substudy, but did not participate. Of the students selected to participate, 80 were randomly assigned to wear a Fitbit during the semester and 80 were randomly assigned to the comparison group (not to wear Fitbit). An equal number of students were assigned to the Fitbit and no Fitbit groups per instructor. Of the 80 students selected to wear a Fitbit, 68 picked up the Fitbit.

Students were excluded from analysis if they had less than three days with over 1,000 steps at each time point. Of the 160 students selected to wear pedometers three times during the semester (including the Fitbit group), 61 participated in the pedometer data collection at each time point (*M* age = 19.5 ± 1.3 years). Because of the limited number of participants that wore the pedometers at all three time points, the analyses for the substudy were conducted on participants who met the pedometer inclusion criteria at time 1 and time 3 ($n = 75$, *M* age = 19.4 ± 1.2 years). The students in the final sample included 27 from the conventional teaching condition (15 wore Fitbits and 12 did not) and 48 from the need-supportive teaching condition (19 wore Fitbits and 29 did not). Of those that met pedometer inclusion criteria, 73 completed questionnaires at time 1 and time 3 (see Figure 5).

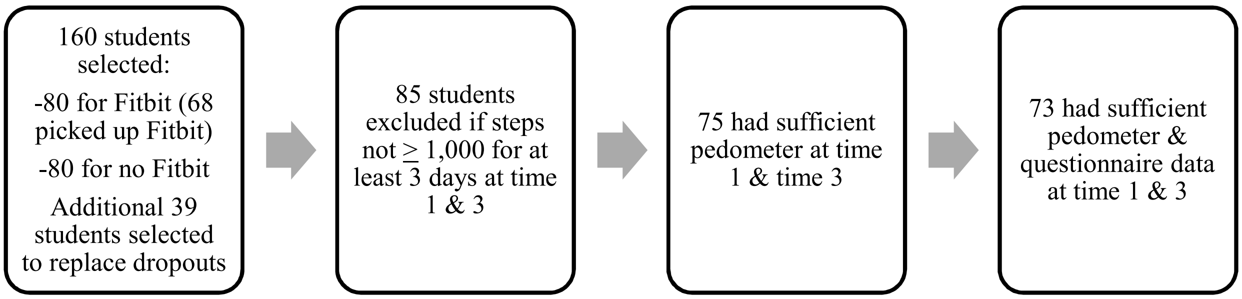

Figure 5. Participant inclusion flow chart

The number of male and female participants was similar across Fitbit groups ($p > .05$). The percentage of students from each class standing across Fitbit groups did not significantly differ ($p > .05$). Table 10 presents the number and percentage of male and female students as well as the number and percentage of students in the various class standings.

Table 10
Number and Percent of Participants per Teaching Condition and Fitbit Group by Sex and Class Standing

	Conventional Teaching Condition, *n* = 27				Need-Supportive Teaching Condition, *n* = 48			
	Fitbit		No Fitbit		Fitbit		No Fitbit	
Gender	*n*	%	*n*	%	*n*	%	*n*	%
Male	6	22	4	15	6	13	16	33
Female	9	33	8	30	13	27	13	27
Class Standing	*n*	%	*n*	%	*n*	%	*n*	%
Freshman	7	26	7	26	3	6	11	23
Sophomore	6	22	2	7	12	25	8	17
Junior	2	7	2	7	2	4	5	11
Senior	0	0	1	4	1	2	4	8
Other	0	0	0	0	1	2	1	2

Results for the full sample and substudy sample indicated no significant differences between teaching conditions on any variable. Therefore, teaching condition was eliminated from the analyses and analyses for the substudy focused on the Fitbit versus no Fitbit groups from time 1 to time 3.

Self-reported Physical Activity. Data for self-reported physical activity measures among the substudy sample are provided in Table 11. IPAQ scores were not analyzed for the substudy because of the limited amount of usable data for the substudy sample.

Table 11
Self-reported Physical Activity for Students in Fitbit/Pedometer Substudy at each Time Point of Questionnaire Data Collection

Questionnaire	Fitbit Group	
PA-8	Fitbit *n = 32*	No Fitbit *n = 41*
Time 1	5.1 ± 2.0	5.8 ± 2.0
Time 3	5.5 ± 1.5	5.7 ± 1.9
30-Day PAR	Fitbit *n = 32*	No Fitbit *n = 41*
Time 1	3.9 ± 2.0	4.6 ± 2.1
Time 3	4.6 ± 1.9	4.6 ± 2.0

Note: PA-8 is the 8-item physical activity measure; 30-Day PAR is the 30-Day Physical Activity Recall.

For the 30-Day PAR, results from the 2 x 2 mixed effects ANOVA showed that the interaction effect (p = .07) and Fitbit group effect (p = .38) were not significant. The overall mean difference between Fitbit and no Fitbit groups was small (d = -0.19). The time effect was significant (p < .05). The mean increase in 30-Day PAR from time 1 to time 3 was small (d = 0.15). The effect size of the differences between changes in 30-Day PAR scores from time 1 to time 3 for the Fitbit and no Fitbit groups was calculated (see Table 12). The effect size of the differences between changes in 30-Day PAR scores for the Fitbit group versus the no Fitbit group was small to medium. Figure 6 presents these differences in change scores for the Fitbit groups.

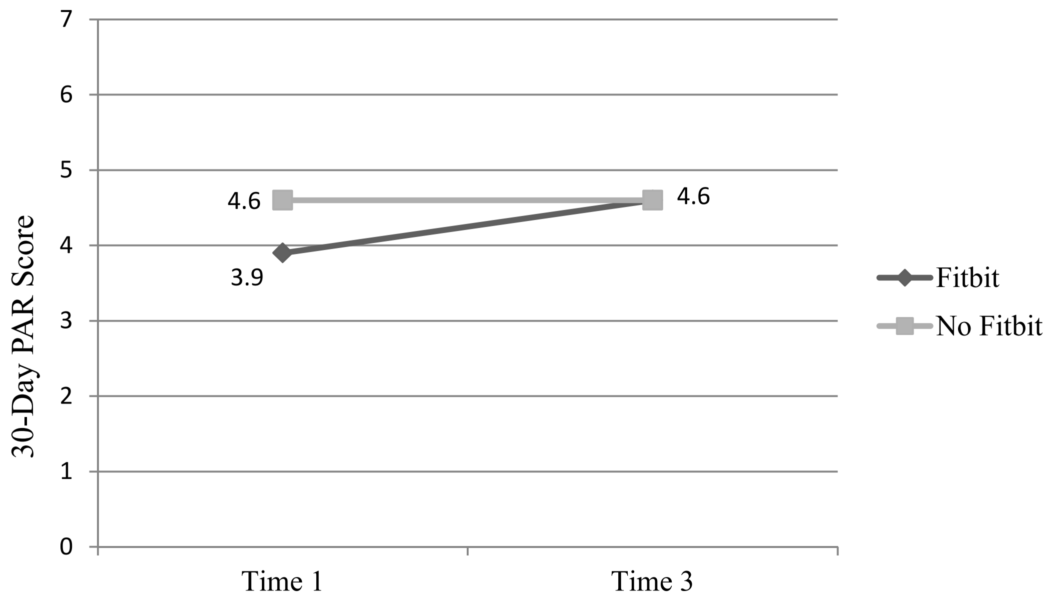

Figure 6. Change in 30-Day PAR for the Fitbit and no Fitbit groups

Similar results were found for PA-8 scores. For the PA-8, the interaction effect (p = .19), time effect (p = .35), and Fitbit group effect (p = .21) were not significant. The overall mean difference between Fitbit and no Fitbit groups was small (d = -0.27). The mean increase in PA-8 from time 1 to time 3 was negligible (d = -0.08). The effect size of the differences between change in PA-8 scores from time 1 to time 3 for the Fitbit and no Fitbit groups was calculated (see Table 12). The effect size of the differences between changes in PA-8 scores for the Fitbit group versus the no Fitbit group was small. Figure 7 presents these differences in change scores for the Fitbit groups.

Table 12
Mean Differences between Time 1 to Time 3 Differences, *p*-values, and Effect Size Estimates of Mean Difference between Fitbit and No Fitbit Groups

	Mean Difference	*p*-value	*d*
30-Day PAR	0.63	.07	0.32
PA-8	0.51	.19	0.28
BREQ-2R			
Relative Autonomy Index	1.54	.21	0.16
Intrinsic Regulation	0.28	.11	0.33
Integrated Regulation	0.01	.97	0.01
Identified Regulation	0.03	.84	0.04
Introjected Regulation	0.17	.43	0.11
External Regulation	0.09	.56	0.11
Amotivation	-0.10	.56	0.15
PNSE			
Perceived Competence	-0.03	.89	0.03
Perceived Autonomy	0.01	.97	0.01
Perceived Relatedness	0.17	.43	0.16
Enjoyment	0.19	.88	0.03
Steps per Day	356	.98	0.16

Note: 30-Day PAR is the 30-Day Physical Activity Recall; PA-8 is the 8-item physical activity measure; BREQ-2R is the Behavioral Regulation in Exercise Questionnaire-Revised; PNSE is the Perceived Need Satisfaction in Exercise Questionnaire.

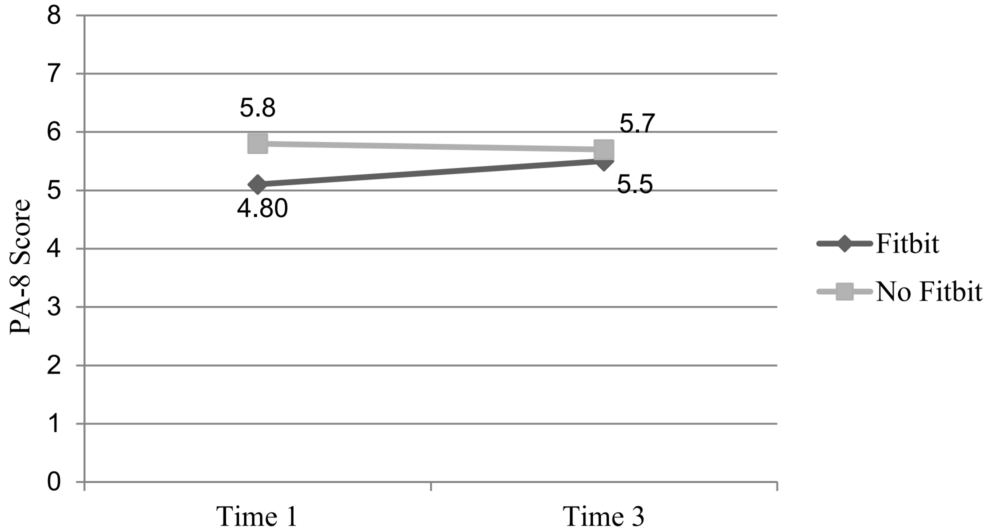

Figure 7. Change in PA-8 scores for the Fitbit and no Fitbit groups

BREQ-2R. Data for BREQ-2R measures for the substudy sample are provided in Table 13. The Relative Autonomy Index and each subscale score are included.

Table 13
BREQ-2R Motivation Scores at Time Point 1 and 3 of Questionnaire Data Collection

	Fitbit Group	
	Fitbit *n = 32*	No Fitbit *n =41*
Relative Autonomy Index		
Time 1	13.2 ± 6.3	12.1 ± 6.4
Time 3	13.5 ± 6.0	10.8 ± 7.0
Intrinsic Regulation		
Time 1	3.0 ± 0.8	2.8 ± 1.0
Time 3	3.3 ± 0.8	2.8 ± 0.9
Integrated Regulation		
Time 1	2.4 ± 1.0	2.4 ± 1.0
Time 3	2.7 ± 0.9	2.7 ± 1.1
Identified Regulation		
Time 1	3.1 ± 0.7	2.9 ± 0.8
Time 3	3.1 ± 0.7	3.0 ± 0.7
Introjected Regulation		
Time 1	1.9 ± 1.1	1.9 ± 1.2
Time 3	1.9 ± 1.0	2.1 ± 1.2
External Regulation		
Time 1	0.6 ± 0.7	0.8 ± 0.9
Time 3	0.9 ± 0.8	1.2 ± 1.0
Amotivation		
Time 1	0.1 ± 0.3	0.2 ± 0.5
Time 3	0.4 ± 0.7	0.5 ± 0.9

Note: Behavioral Regulations in Exercise Questionnaire, Revised 2 (BREQ-2R)

For the RAI, results from the mixed effects ANOVA showed that the interaction effect (p = .21), time effect (p = .36), and Fitbit group effect (p = .18) were not significant. The overall mean difference between Fitbit and no Fitbit groups was medium (d = 0.55). The mean decrease in RAI from time 1 to time 3 was negligible (d = -0.10). The Fitbit group increased from time 1 to time 3 while the no Fitbit group decreased from time 1 to time 3. The effect size of the differences between changes in RAI from time 1 to time 3 for the Fitbit and no Fitbit groups was small (see Table 12).

Results for intrinsic regulation from the mixed effects ANOVA showed that the interaction effect (p = .11), time effect (p = .11), and Fitbit group effect (p = .15) were not significant. The overall mean difference between Fitbit and no Fitbit groups was small to medium (d = 0.32). The mean increase in intrinsic regulation from time 1 to time 3 was small (d = 0.14). The Fitbit group increased from time 1 to time 3 while the no Fitbit group did not change. The effect size of the differences between changes in intrinsic regulation from time 1 to time 3 for the Fitbit and no Fitbit groups was small to medium (see Table 12). Figure 8 presents these differences in change scores between Fitbit groups.

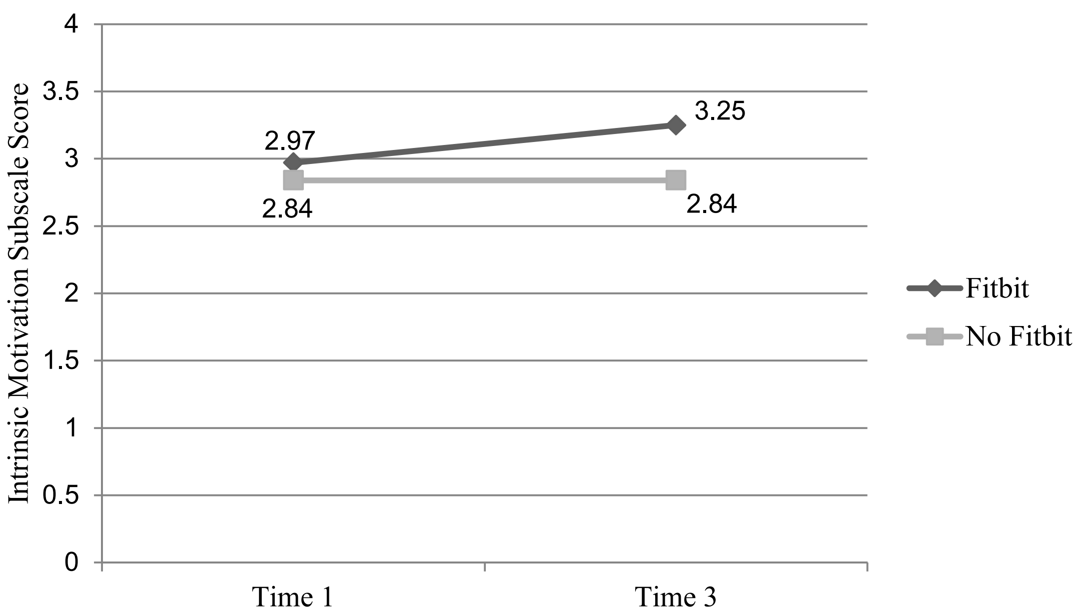

Figure 8. Change in Intrinsic Regulation for Fitbit and no Fitbit groups

For integrated regulation, the interaction effect (p = .97) and Fitbit group effect (p = .99) were not significant. No difference was noted between Fitbit and no Fitbit groups (d = 0.00). The time effect ($p < .05$) was significant. Mean integrated regulation had a small increase from time 1 to time 3 (d = 0.25). Both the Fitbit and no Fitbit group increased from time 1 to time 3. The effect size of the differences between changes in integrated regulation for the Fitbit versus the no Fitbit groups was negligible (see Table 12).

For identified regulation, the interaction effect (*p* = .84), time effect (*p* = .33), and Fitbit group effect (*p* = .43) were not significant. The overall mean difference between Fitbit and no Fitbit groups was small (*d* = 0.17). Mean identified regulation had a small increase from time 1 to time 3 (*d* = 0.10). The Fitbit group did not change from time 1 to time 3 while the no Fitbit group increased slightly. The effect size of the differences between changes in integrated regulation for the Fitbit group versus the no Fitbit group was negligible (see Table 12).

For introjected regulation, the interaction effect (*p* = .43), time effect (*p* = .24), and Fitbit group effect (*p* = .53) were not significant. The overall mean difference between Fitbit and no Fitbit groups was small (*d* = 0.14). Mean introjected regulation had a small increase from time 1 to time 3 (*d* = 0.12). The Fitbit group did not change from time 1 to time 3 while the no Fitbit group increased from time 1 to time 3. The effect size of the differences between changes in introjected regulation for the Fitbit group versus the no Fitbit group was small (see Table 12).

For external regulation, the interaction effect (*p* = .57) and Fitbit group effect (*p* = .24) were not significant. The overall mean difference between Fitbit and no Fitbit groups was small (*d* = 0.26). The time effect was significant ($p < .05$). Mean external regulation had a small to medium increase from time 1 to time 3 (*d* = 0.41). The Fitbit group increased from time 1 to time 3. The no Fitbit group increased slightly more than the Fitbit group from time 1 to time 3. The effect size of the differences between changes in external regulation for the Fitbit group versus the no Fitbit group was negligible (see Table 12).

For amotivation, the interaction effect (*p* = .56) and Fitbit group effect (*p* = .33) were not significant. There was a small overall mean difference between Fitbit and no Fitbit groups (*d* = -0.21). The time effect was significant ($p < .05$). Mean amotivation had a small to medium increase from time 1 to time 3 (*d* = 0.41). Both the Fitbit and no Fitbit group increased the same amount from time 1 to time 3. The effect size of the differences between changes in amotivation for the Fitbit group versus the no Fitbit group was small (see Table 12).

PNSE. Data for Perception of Need Satisfaction in Physical Activity measures among the substudy sample are provided in Table 14. For perception of competence satisfaction for physical activity, the interaction effect (p = .89), time effect (p = .06), and Fitbit group effect (p = .93) were not significant. The overall mean difference between Fitbit and no Fitbit groups was negligible (d = 0.02). Mean competence satisfaction had a small increase from time 1 to time 3 (d = 0.18). Both the Fitbit and no Fitbit group increased the same amount from time 1 to time 3. The effect size of the differences between changes in competence satisfaction for the Fitbit group versus the no Fitbit group was negligible (see Table 12).

For perception of autonomy satisfaction for physical activity, the interaction effect (p = .97), time effect (p = .93), and Fitbit group effect (p = .51) were not significant. The overall mean difference between Fitbit and no Fitbit groups was small (d = 0.14). Mean autonomy satisfaction did not change from time 1 to time 3 (d = 0.00). Neither the Fitbit nor no Fitbit group changed from time 1 to time 3.

For perception of relatedness satisfaction for physical activity, the interaction effect (p = .43), time effect (p = .89), and Fitbit group effect (p = .89) were not significant. The overall mean difference between Fitbit and no Fitbit groups was negligible (d = -0.03). Mean relatedness satisfaction decreased negligibly from time 1 to time 3 (d = -0.02). The Fitbit group did not change from time 1 to time 3 while the no Fitbit group decreased. The effect size of the differences between changes in relatedness satisfaction for the Fitbit group versus the no Fitbit group was small (see Table 12).

Enjoyment. Data for the Enjoyment measures among the substudy sample are also provided in Table 14. Results from the 2 x 2 mixed ANOVA for physical activity enjoyment showed that the interaction effect (p = .88), time effect (p = .72), and Fitbit group effect (p = .34) were not significant. The overall mean difference between Fitbit and no Fitbit groups was small (d = 0.20). Mean enjoyment decreased negligibly from time 1 to time 3 (d = 0.04). The Fitbit group decreased from time 1 to time 3 while the no Fitbit group did not change. The effect size of the differences between changes in enjoyment for the Fitbit group versus the no Fitbit group was negligible (see Table 12).

Table 14
Perceived Need Satisfaction for Physical Activity and Physical Activity Enjoyment

	Fitbit Group	
PNSE	Fitbit *n = 32*	No Fitbit *n = 41*
Perceived Competence		
Time 1	4.7 ± 1.0	4.7 ± 1.0
Time 3	4.9 ± 0.9	4.9 ± 1.1
Perceived Autonomy		
Time 1	5.3 ± 0.8	5.2 ± 0.8
Time 3	5.3 ± 0.8	5.2 ± 1.0
Perceived Relatedness		
Time 1	4.5 ± 0.9	4.6 ± 1.0
Time 3	4.5 ± 1.3	4.5 ± 1.2
Enjoyment		
Time 1	5.9 ± 1.0	5.6 ± 1.4
Time 3	5.8 ± 0.9	5.6 ± 1.3

Note: Perceived Need Satisfaction in Exercise-Modified (PNSE-Modified)

Stage of Change. Table 15 presents the percentage of students classified into each of the Stages of Change at each time point according to whether they were in the Fitbit or no Fitbit group. Most students self-reported that they were in the maintenance Stage of Change at both time points.

Table 15
Percent of Participants in each Stage of Change for each Time Point for Substudy

	Time 1		Time 3	
Stage of Change Classification	Fitbit *n = 27*	No Fitbit *n = 35*	Fitbit *n = 25*	No Fitbit *n = 35*
Precontemplation	0	0	0	0
Contemplation	19	17	12	14
Preparation	0	6	4	6
Action	22	11	12	3
Maintenance	59	66	72	77

The number of students in the substudy groups that exhibited a shift in their Stage of Change from time 1 to time 3 is presented in Table 16. The highest percentage of students experienced no stage changes.

Table 16
Percentage of Stage of Change Differences from Time 1 to Time 3 for Substudy

	Fitbit Group	
Number of stage changes	Fitbit $n = 32$	No Fitbit $n = 43$
-4	0	0
-3	0	2
-2	6	2
-1	9	5
0	63	70
+1	16	9
+2	0	0
+3	6	12
+4	0	0

Objectively Measured Physical Activity. For the full study, objectively measured physical activity (pedometer steps per day) was not assessed. Therefore, Table 17 presents pedometer steps per day for teaching condition and Fitbit groups. The low step counts that were found among our sample are similar to those found by Jackson and Howton (2010) among college students at the start of a pedometer intervention (*M* = 7,013 steps/day, *M* age = 24.3 ± 7.8 years). Because the effect of teaching condition on objectively measured physical activity was not evaluated in the full study, a 2 x 2 x 2 mixed ANOVA, with teaching condition, Fitbit group, and time effects was conducted for the substudy results. The three-way interaction was not significant ($p = .24$). Evaluation of these analyses will focus on the two-way interactions.

Table 17
Average Steps per day for Substudy

	Teaching Condition			
	Conventional		Need-Supportive	
	Fitbit *n = 15*	No Fitbit *n = 12*	Fitbit *n = 19*	No Fitbit *n = 29*
Time 1	6,082 ± 2,199	5,296 ± 2,345	6,385 ± 2,290	7,023 ± 2,574
Time 3	6,426 ± 1,466	6,264 ± 2,433	5,927 ± 2,043	5,972 ± 2,065

The teaching condition by Fitbit group interaction ($p = .38$) and the Fitbit group by time interaction ($p = .98$) effects were not significant. The teaching condition by time interaction was significant ($p < .05$). The time effect ($p = .86$) and Fitbit group effect ($p = .89$) were not significant. The overall mean difference between Fitbit and no Fitbit groups was negligible ($d = -0.03$). Mean steps per day decreased slightly from time 1 to time 3 ($d = -0.14$). Participants in the Fitbit group had a decrease in steps from time 1 to time 3 (104 steps). The no Fitbit group had a decrease in steps from time 1 to time 3 but it was larger than the Fitbit group (460 steps). Participants in the conventional teaching condition had an increase in objectively measured physical activity of 621 steps per day from time 1 to time 3. Participants in the need-supportive teaching condition had a decrease of 816 steps per day from time 1 to time 3. The difference in step counts between teaching conditions from time 1 to time 3 was 1,437 steps per day. This difference in steps per day from time 1 to time 3 between teaching conditions was medium to large ($d = 0.66$).

Chapter 5: Discussion

The main purpose of this study was to examine the effect of need-supportive class environments and conventional class environments, with and without the use of movement technology, on changes in self-determined motivation for physical activity and physical activity level, among college students. A secondary purpose was to examine changes in enjoyment and Stage of Change for physical activity. To address these purposes, the study was designed as a main study that included 1,505 participants and a substudy. The substudy incorporated wearing a commercially available activity monitor and objective assessment of physical activity. This section will first discuss the findings of the main study, followed by a discussion of findings from the substudy.

Main Study

Because college-age individuals are at a pivotal age for risk of the development of a physically inactive lifestyle (Caspersen et al., 2010; Huang et al., 2010; Irwin, 2004; Kwan et al., 2012; Mack et al., 2009), assessing the effectiveness of a theory-based teaching environment can have important implications. Examination of changes over time between the need-supportive and the conventional class conditions revealed no meaningful differences on any measure.

The current study trained teachers in the intervention group to create a need-supportive class environment. However, the conventional class environments used for comparison, that received no intervention training, were also deemed need-supportive. This was reflected by self-reported high levels of need-support in the conventional class condition. The finding of no meaningful differences on any measures between teaching conditions might be expected because student perceptions of need-support were similar, and high, in both teaching conditions.

The self-determination theory-based intervention to create a need-supportive class environment began with an hour long training session and subsequent weekly one hour seminars, as planned, using need-supportive strategies. Teachers expressed enjoyment and appreciation for the intervention and communicated success in implementing strategies. Each week teachers shared what went well and what was challenging and were given a helpful resource to implement the intervention. Teachers began creatively thinking of ways to implement the intervention and shared them with the others in the intervention, without expectation to do so. Intervention teachers committed to not share intervention information with conventional teachers. The conventional teachers also committed to not replicate anything they observed the need-supportive teachers doing with their classes. Results from direct observation of the intervention teachers, weekly self-report ratings of need-support, and student perceptions of need support indicated successful implementation of the intervention. These results showed that a need-supportive class environment was created. Successful implementation of self-determination theory based leadership for physical activity intervention has been demonstrated in several studies (Edmunds et al., 2008; Fortier et al., 2012; Silva et al., 2010). No literature was discovered that used a need-supportive intervention in college physical activity classes.

Results from the Student Perception of Need Support Questionnaire indicated no differences in student perceived need-support from their instructor between the two teaching conditions. All mean scores on this questionnaire were high and may have reached a ceiling. Standage et al. (2005), who used this questionnaire to assess student perception of need-support, reported lower scores on all subscales than the scores reported in the current study. Results suggest that teachers in the conventional teaching condition in the current study were perceived as need-supportive by their students, even though no intervention was implemented in this group.

Six of the seven teachers in the conventional teaching condition had been exposed to self-determination theory and need-support in two semester-long graduate level courses. This exposure to self-determination theory may have contributed to their use of need-support in the conventional setting.

International Physical Activity Questionnaire (IPAQ) data suggested that, on average, the students engaged in over 100 minutes of moderate to vigorous physical activity (MVPA) each day and over 5,000 MET-minutes per week. These values seem improbable and are not consistent with the other self-report physical activity measures, the 30-Day Physical Activity Recall (30-Day PAR) and PA-8. The 30-Day PAR and PA-8 averages at each time point were classified as insufficiently active or just barely sufficiently active. After following the IPAQ scoring protocol we were only left with sufficient data for 33% of our sample. The IPAQ mean data suggests the study sample was extremely active, well beyond just meeting guidelines to be classified as sufficiently active. Craig et al. (2003) reported a median of 2,514 MET-minutes per week. This was much lower than the current study median of 4,320 MET-minutes per week. Though research on the IPAQ shows some support for its validity with several populations and even among American college students, the results with the current study sample seem inaccurate. The seemingly inflated results of the current study decrease confidence in the measure and its use to represent a true reflection of the sample's physical activity. Lee et al. (2011) who reported comparable IPAQ results (MVPA) to the current study concluded that there is weak validity evidence for the IPAQ. They reported close to 159 minutes of MVPA from their sample. IPAQ self-report physical activity was over 231% more than that measured by accelerometer. Even though data from the current study revealed some differences in IPAQ score changes from time 1 to time 2 across teaching conditions, these differences may be hard to interpret due to high values for physical activity resulting from the IPAQ. The need-supportive teaching condition had a significantly greater increase in MET-minutes per week than the conventional teaching condition from time 1 to time 2, with a small effect size of 0.20. The high MVPA values that suggest the students engaged in over 100 minutes of moderate to vigorous physical activity, on average, each day gives little confidence in the IPAQ results for the current study and their implications. We administered the IPAQ through an online questionnaire system. Whether this type of protocol further limits the validity and reliability of the IPAQ may need to be considered. Most publications, to date, used a paper form of this questionnaire. Questionnaires are now easily administered online, therefore, for future research the reliability and validity of the IPAQ answered online needs to be assessed.

Though PA-8 and 30-Day PAR scores significantly increased across time in the full sample, this increase represented a negligible or small effect. The PA-8 and 30-Day PAR score changes did not differ across teaching conditions. This may be as expected because the student perception of need-support from teachers was similar across teaching conditions. The PA-8 questionnaire can be used to classify respondents as sufficiently active or insufficiently active. If respondents select a 5 or greater on the PA-8 question, they are self-reporting that they meet physical activity guidelines. For the entire sample, 53% of students were classified as sufficiently active at time 1, 63% were classified as sufficiently active at time 2, and 61% were classified as sufficiently active at time 3, according to the PA-8. These were similar to the percentage of students that were classified in the maintenance stage of change. The percentages for activity classification are slightly higher than CDC physical activity prevalence data. The CDC found 50.4% of North Carolina young adults in this age bracket (18-24 years) self-reported that they were sufficiently active. Results from the current study are more similar to the national CDC data than the North Carolina data. The CDC found that, nationally, 59% of young adults, aged 18 to 24 years, self-reported that they were sufficiently active. In the original development and validity study for the PA-8, Jackson et al. (2007) found a similar percent of 58.5% classified as sufficiently active in an adult sample. Though overall changes across time were small for the current study sample, based on the PA-8, 242 students moved from an insufficiently active classification score to a sufficiently active classification score from time 1 to time 3. Therefore, approximately 16% of the current study sample became sufficiently active during the course of the semester.

Though students becoming sufficiently active could be attributed to their enrollment in the physical activity course during the semester, other confounders could have been at play, like a season effect. Students started the semester having just returned from a winter break and to cold outdoor temperatures (*M* temperature = 33°F, Low = 5°F) and inches of frozen precipitation. Literature suggests this can have both no effect and little effect on physical activity (Dasgupta et al., 2010; Williams & French, 2014), but can also be a barrier to physical activity (Tucker & Gilliland, 2007). Throughout the course of the semester temperatures warmed and time 2 questionnaire data were collected one week prior to spring break (*M* temperature = 47°F, Low = 26°F). Time 3 questionnaire data collection took place at the end of the semester when temperatures were warmer (*M* temperature = 65°F, Low = 41°F), but the pressure of exams and final projects may be heightened, leading to a decrease in activity levels (Baghurst & Kelley, 2014).

Changes across time seen in BREQ-2R subscales for the entire sample were negligible. This was surprising because students expressed perception of need-support in their courses. Previous self-determination theory literature supports that perception of need-support facilitates an increase in more self-determined forms of motivation (Silva et al., 2010; Standage et al., 2005; Zhang et al., 2011). Therefore, it would be expected that increases in intrinsic regulation, integrated regulation, and identified regulation would be more marked than what was found in the current study. However, subscale scores were relatively high at time 1, especially for intrinsic and identified regulation. The high scores on the BREQ-2R subscales at time 1 may have limited the ability to detect an effect of need-supportive classes on motivation scores.

Previous research shows that perception of need-support positively impacts need satisfaction. In addition, high need-satisfaction leads to more self-determined forms of motivation for physical activity, which in turn leads to an increase in physical activity engagement (Zhang et al., 2011). The current study sample reflects this trend. Though psychological variable scores were already high at time 1, small increases in need satisfaction (PNSE) and BREQ-2R scores were seen from time 1 to time 2. From time 1 to time 2, small increases in self-reported physical activity were noted as well. However, the small increases in more extrinsic forms of motivation that were seen from time 1 to time 2 are not supported by the theory. Self-determination theory would propose that these forms of motivation would decrease if need satisfaction increased.

Results from the current study revealed significant, though low, correlations between perception of overall need support and identified regulation ($r = .34$), integrated regulation ($r = .23$), and intrinsic regulation ($r = .34$). Correlations between perception of need support and introjected regulation were trivial ($r = .11$), and were negative with external regulation ($r = -.17$) and amotivation ($r = -.35$). As expected, based on self-determination theory, motivational subscales were more highly correlated with need satisfaction than with need support. In the current study, the correlations between need satisfaction and identified regulation ($r = .69$), integrated regulation (*r* = .63), and intrinsic regulation (*r* = .70) were moderately high. As self-determination theory would support, significant correlations were found between self-reported physical activity measures and identified regulation (*r* = .48), integrated regulation (*r* = .57), and intrinsic regulation (*r* = .45).

Surprisingly, introjected regulation and amotivation significantly increased across time in the current study. This is inconsistent with the finding of no change in mean scores on perception of need satisfaction and physical activity enjoyment, which would be expected to decrease when introjected regulation and amotivation increase. It is possible that the increase in stress as examinations before spring break (time 2) and as the semester comes to an end (time 3) may explain this (Baghurst & Kelley, 2014), although stress was not assessed in the current study. The increases in introjected regulation and amotivation over the course of the semester should be considered for developing the most effective strategies to prevent increases in less self-determined forms of motivation.

Though data from the current study showed no change in enjoyment from time 1 to time 3, these scores were high at all three time points and suggest the sample already enjoyed physical activity at time 1. Such high scores on this measure may have reached a ceiling effect. In support of self-determination theory, enjoyment scores were highly correlated with intrinsic motivation (*r* = .75). Self-reported physical activity measures were moderately correlated with enjoyment (*r* = .48-.51). Self-determination theory proposes that those who intrinsically enjoy physical activity will be more active. Moore et al. (2009) used a longer version of the enjoyment scale with children and reported a lower correlation (*r* = .16) with self-reported physical activity than was found in the current study.

As can be expected, in the current study Stage of Change data were similar to PA-8 data. Stage of Change and PA-8 were moderately to highly correlated ($r = .60$). The PA-8 was developed based on the Stages of Change (Jackson et al., 2007). The highest percentage of the current study sample reported maintenance Stage of Change and remained there throughout the course of the semester. Pinto and Marcus (1995) found comparable Stage of Change numbers in their sample of college students. Research suggests that college-aged students are at a pivotal time in their life that can lead to inadequately active lifestyles as adults (Caspersen et al., 2010; Huang et al., 2010; Irwin, 2004; Kwan et al., 2012; Mack et al., 2009). Considering the 18% of students classified in the contemplation and the 15% classified in the preparation stage in the current study, special stage specific consideration should be given to the design of courses to move these students into the action stage and maintenance stage. Different approaches to physical activity promotion may need to be considered for students classified in the action and maintenance stages compared to students who are classified in lower Stages of Change. Special attention should be given to designing course content to equip students to prevent regression into a lower Stage of Change.

Substudy

In opposition to the current study hypothesis, objectively measured physical activity decreased in the need-supportive teaching condition compared to the conventional teaching condition, from time 1 to time 3. The current study results were inconsistent with results reported by Silva et al. (2010), who reported greater increases in pedometer steps for their need-supportive intervention group compared to their control group. Much of the literature has not employed objective measures of physical activity in self-determination theory based interventions. In order to assess true changes in behavior, objective measures should complement self-report and psychological questionnaires, as in the current study design.

The hypothesis that participants who wore Fitbits would exhibit a greater increase in physical activity than those who did not wear Fitbits was supported, but only to a small degree. The increases in self-reported physical activity from time 1 to time 3 for participants who wore Fitbits were small. Though the Fitbit group had a decrease in objective physical activity from time 1 to time 3, it was less of a decrease than the no Fitbit group. The difference in changes in self-reported and objectively measured physical activity for the Fitbit and no Fitbit groups from time 1 to time 3 was also small. In a review by Bravata et al. (2007), results from eight randomized controlled trials showed that pedometer user groups increased physical activity by 2,491 steps more than control groups. In the current study, those who wore the Fitbit only decreased physical activity by 356 steps less than those in the no Fitbit group. Though the current study self-report physical activity data supported the hypothesis, Fitbit use only slightly increased perception of physical activity. Also, though the current study objectively measured physical activity data did not support the hypothesis, extraneous variables not measured may have provoked a decrease in physical activity for all participants (school workload, stress). Wearing the Fitbit may have prevented further decrease in physical activity.

Most previous activity monitor intervention research has focused on the use of pedometers. The literature exhibits mixed results on the motivational quality of pedometer use (Croteau, 2004a; Eastep et al., 2004; Fitzsimons, Baker, Gray, Nimmo, & Mutrie, 2012). Fitbit devices are different from pedometers in that they have built-in features intended to motivate the individual who wears it. It is important to know if the built-in features of the Fitbit have a motivational impact beyond those of the ability to simply monitor steps. The lack of large differences in pedometer steps per day between Fitbit and no Fitbit groups in the current study is comparable to the results reported by Eastep et al. (2004), who found that just giving someone a pedometer, without further intervention, did not increase physical activity. However, the literature supports the effectiveness of pedometer interventions that include additional components, such as encouraging emails, reminders, and goal setting (Bravata et al., 2007; Croteau, 2004a; Gilson et al., 2013; Fitzsimons et al., 2012). Students were asked to set up and wear the Fitbit as if they had bought it for themselves. How students wore the device was likely how people use the device in real life. Though the features of the Fitbit are comparable to the additional components in some of the effective pedometer interventions, they may not have the same impact. To date, a literature search did not reveal any research on the motivational properties and effectiveness of the Fitbit. The current literature regarding commercially available activity monitors assesses the accuracy of Fitbit devices (Fulk et al., 2013; Lee, Kim, & Welk, 2014; Sasaki et al., 2014; Takacs et al., 2013).

In the current study, participants who wore the Fitbit did have a small, greater increase in one self-determined form of motivation, intrinsic regulation, than those that did not wear the Fitbit. This only partially supports the current study hypothesis that students who wore the Fitbit would exhibit greater increases in more self-determined forms of motivation than those who did not wear it. The changes in the other forms of more self-determined motivation did not differ more than trivially between Fitbit and no Fitbit groups. Self-determination theory proposes that individuals with more self-determined forms of motivation are more likely to continue engaging in the motivated behavior. Because intrinsic regulation is the highest form of self-determined motivation, increases in this regulation are desired. It may be that using new technology with many features and tracking mechanisms makes physical activity inherently more appealing and pleasurable. Further research should be conducted to assess the reproducibility of these results and what aspects of the devices influence intrinsic regulation.

The other psychological variables changed only slightly from time 1 to time 3 for Fitbit wearers versus no Fitbit wearers. Because many of the variables were related to intrinsic regulation, similar results were expected for those variables. However, even the difference in physical activity enjoyment between Fitbit and no Fitbit wearers was only negligible. Because enjoyment is a characteristic of intrinsic regulation, the lack of difference between Fitbit and no Fitbit wearers for physical activity enjoyment was unexpected.

The current study had several limitations. Though random assignment of instructors was used, a sample of conventional teachers that did not create a need-supportive class environment was not available. Teachers in the need-supportive teaching condition may have become more need-supportive than they were previously. The teaching intervention may have impacted their teaching style and, in turn, the students. However, no measures were taken prior to the intervention to truly assess whether or not this did occur. Because questionnaires were part of a class assignment, some students may have completed them quickly and mindlessly knowing that the only requirement for their grades was completion of the questionnaires. Pedometer compliance was weak and may not have given a full representation of students' objectively measured physical activity across teaching conditions and Fitbit groups. Another limitation of the study was weather. The beginning of the semester was marked with several snow and ice days that caused cancellation of classes and may have caused misrepresentative levels physical activity in the sample because the weather conditions were uncharacteristic of the location in which the study was conducted.

The strengths of the current study included the number of students surveyed at all three time points during the semester. Other strengths of the study included the ability to provide an intervention designed to provide a need-supportive environment to a randomly selected group of classes in a university basic instruction program and the ability to gather data through questionnaire class assignments. Conducting the interventions in a field setting and collecting objectively measured physical activity on a substudy sample of students were also strengths.

Data revealed several important take-away messages that should be considered. Though we sought to develop a strong study design, the current study teaching group assignment led to a lack of true disparity between teaching conditions. That is, both teaching conditions appeared to provide need-supportive environments for the students. Though the need-supportive teaching condition had higher scores for student perception of need-support and direct observation of need-support; both condition's scores were classified as need-supportive. However, further research should be conducted that employs class environments that are truly distinct. It may be best to compare a need-supportive class environment to a class environment structured to be more controlling with limited student input, although this may not always represent true teaching conditions. The IPAQ was not an effective tool to measure MVPA or MET-minutes per week in the current sample of college students. The reliability and validity of the IPAQ, particularly when administered online and with college-age individuals should be considered. High values for the psychological variables were also seen in the current study sample. Though we had high mean scores on more self-determined forms of motivation, a high percentage of students in the maintenance Stage of Change, high mean scores on physical activity enjoyment, and high mean scores on need satisfaction for physical activity, the current study sample's self-reported physical activity was not high (excluding IPAQ data). Previous research suggests that high scores on these psychological variables would predict higher levels of physical activity. This was not the case in the current study, suggesting that some other variable that we did not measure may be stronger than self-determined motivation, enjoyment, need satisfaction, and Stage of Change, in predicting actual physical activity behavior. It is also possible that these psychological variable mean values may have been so high as to limit the ability to see changes. Though the use of novel movement technology in college physical activity courses could be appealing to the student population, meager increases in physical activity may not help college students adopt adequately active lifestyles for a lifetime. Increases in intrinsic regulation for physical activity among Fitbit wearers could help students adopt active lifestyles. Further research should be employed to assess the effect of wearing a Fitbit on physical activity motivation and behavior. Further intervention research should also be conducted in the college physical activity class environment to guide programming that will optimally facilitate students to choose a lifestyle of physical activity for a lifetime.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
4N-70 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914**· Fax **252-744-2284**· **www.ecu.edu/irb**

Notification of Initial Approval: Expedited

From: Social/Behavioral IRB
To: Lindsey Nanney
CC: Matthew Mahar
Date: 1/21/2014
Re: UMCIRB 13-002613
Movement Technology in Undergraduate Physical Activity and Fitness Classes

I am pleased to inform you that your Expedited Application was approved. Approval of the study and any consent form(s) is for the period of 1/21/2014 to 1/20/2015. The research study is eligible for review under expedited category #4, 7. The Chairperson (or designee) deemed this study no more than minimal risk.

Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The Investigator must adhere to all reporting requirements for this study.

Approved consent documents with the IRB approval date stamped on the document should be used to consent participants (consent documents with the IRB approval date stamp are found under the Documents tab in the study workspace).

The approval includes the following items:

Name	Description
30-Day Physical Activity Recall	Surveys and Questionnaires
Enjoyment questionnaire	Surveys and Questionnaires
IPAQ Short Version	Surveys and Questionnaires
LN Informed Consent v1.doc	Consent Forms
LN Thesis Proposal Revised 12-12-13.docx	Study Protocol or Grant Application

Motivation to be active-BREQ-2R	Surveys and Questionnaires
Need Satisfaction for Exercise PNSE	Surveys and Questionnaires
Need Support in PE	Surveys and Questionnaires
PA 8	Surveys and Questionnaires
Stages of Change for Exercise	Surveys and Questionnaires
Survey-Consent-Letter-Template-for-Expedited-Research-12-20-13.doc	Consent Forms

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

IRB00000705 East Carolina U IRB #1 (Biomedical) IORG0000418
IRB00003781 East Carolina U IRB #2 (Behavioral/SS) IORG0000418

APPENDIX B

INFORMED CONSENT

Main Study Consent via Online Survey:

Dear EXSS 1000 Student,

I am a Graduate Student at East Carolina University in the Kinesiology department. I am asking you to take part in my research study entitled, "Movement Technology in Undergraduate Physical Activity and Fitness Classes".

The purpose of this research is to better understand what may or may not motivate college students to be physically active. By doing this research, I hope to learn optimal ways to teach classes such as EXSS 1000 that will promote physically active lifestyles among students. Your participation is voluntary.

You are being invited to take part in this research because you are a student in EXSS 1000 and I value your input. Your involvement in this study will take no additional time other than what you would normally do for the EXSS 1000 class. You will complete questionnaires at three different times during the semester as part of your course credit. For my study, I would like your permission to use your responses for research purposes and to contact you by email in the future to invite your participation in other studies.

You are being asked to carefully complete your class required online questionnaires. You will answer several questions about your thoughts on physical activity, your physical activity instruction and your physical activity habits. You will answer these questions three times throughout the semester, always via an online survey. You will also be asked to provide your name and email address. This will be used to match your answers at the three different time points and to notify your teacher of your full participation so you receive course credit.

Because this research is overseen by the ECU Institutional Review Board, some of its members or staff may need to review my research data. Your identity will be evident to those individuals who see this information. However, I will take precautions to ensure that anyone not authorized to see your identity will not be given access.

If you have questions about your rights as someone taking part in research, you may call the UMCIRB Office at phone number 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of UMCIRB Office, at 252-744-1971.

You do not have to take part in this research, and you can stop at any time. If you decide you are willing to take part in this study by granting me access to your answers, check the YES, I

AGREE TO ALLOW USE OF MY RESPONSES FOR RESEARCH PURPOSES box on the next page of this survey. Those who participate in the study, by granting me access to their answers, will receive 1 EXTRA CREDIT point in EXSS 1000. If you are not willing to have your responses used for research, check the NO, I DO NOT AGREE TO ALLOW THE USE OF MY DATA FOR RESEARCH PURPOSES box.

Thank you for taking the time to complete this survey.

Sincerely,

Lindsey Nanney

Substudy Consent Form:

Study ID:UMCIRB 13-002613 Date Approved: 1/21/2014 Expiration Date: 1/20/2015

East Carolina University

Informed Consent to Participate in Research

Information to consider before taking part in research that has no more than minimal risk.

Title of Research Study: Movement Technology in Undergraduate Physical Activity and Fitness Classes
Principal Investigator: Lindsey Nanney
Institution/Department or Division: East Carolina University, Department of Kinesiology, Activity Promotion Lab
Address: 101 Minges Coliseum
Telephone #: 328-1996

Researchers at East Carolina University (ECU) study problems in society, health problems, environmental problems, behavior problems and the human condition. Our goal is to try to find ways to improve the lives of you and others. To do this, we need the help of volunteers who are willing to take part in research.

Why is this research being done?

The purpose of this research is to better understand effective ways to teach EXSS 1000 so students optimally benefit from the course. The decision to take part in this research is yours to make. By doing this research, we hope to learn ways to enhance EXSS 1000 and positively impact future students in the course.

Why am I being invited to take part in this research?

You are being invited to take part in this research study because you are enrolled in EXSS 1000 and have expressed interested in wearing a Fitbit activity band. If you volunteer to take part in this research, you will be one of about 160 people to do so.

Are there reasons I should not take part in this research?

You should not volunteer for this study if you withdraw from EXSS 1000, have previously taken EXSS 1000 or are unwilling to wear an activity band for the Spring 2014 semester.

What other choices do I have if I do not take part in this research?

You can choose not to participate.

Where is the research going to take place and how long will it last?

The research procedures will be conducted at the Student Recreation Center and in Christenbury Gym as part of your EXSS 1000 class. This study will take place during the Spring semester, from January 20th to April 21st. If you are in the group that wears the Fitbit activity band, the activity band should be worn throughout the semester.

What will I be asked to do?

If you are in the group that wears the activity band, you are being asked to do the following: Create an account of the Fitbit website; and wear an activity band from the week of January 20th to the week of April 21st; charge the activity band and upload your activity data to your account on the website. In addition, you will be asked to wear a pedometer for 6 consecutive days at three different times during the semester. The pedometer should be worn during all waking hours, when possible. You will be asked to keep a log of when the pedometer was put on and taken off and of activities done when the pedometer was not worn, other than sleeping and bathing.

If you are not in the group that wears a Fitbit activity band, you will be asked to wear a pedometer for 6 consecutive days at three different times during the semester. The pedometer should be worn during all waking hours, when possible. You will be asked to keep a log of when the pedometer was put on and taken off and of activities done when the pedometer was not worn, other than sleeping and bathing.

What possible harms or discomforts might I experience if I take part in the research?
It has been determined that the risks associated with this research are no more than what you would experience in everyday life.

What are the possible benefits I may experience from taking part in this research?
We do not know if you will get any benefits by taking part in this study. This research might help us learn more about monitoring physical activity using newer technology. There may be no personal benefit from your participation, but the information gained by doing this research may help others in the future.

Will I be paid for taking part in this research?
We will not be able to pay you for the time you volunteer while being in this study.

What will it cost me to take part in this research?
It will not cost you any money to be part of the research.

Who will know that I took part in this research and learn personal information about me?
To do this research, ECU and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. With your permission, these people may use your private information to do this research:

- The University & Medical Center Institutional Review Board (UMCIRB) and its staff, who have responsibility for overseeing your welfare during this research, and other ECU staff who oversee this research.
- Your EXSS 1000 instructor, who will only know if you participated or not. No information, other than your participation, will be shared with him or her.

How will you keep the information you collect about me secure? How long will you keep it?
Data will be kept on a password protected computer in our laboratory and will be saved for six years. Your information may be stripped of identifiers and used in future research without anyone knowing it is information from you. None of your individual data, with your name attached, will be shared with others.

What if I decide I do not want to continue in this research?
If you decide you no longer want to be in this research after it has already started, you may stop at any time. You will not be penalized or criticized for stopping. You will not lose any benefits that you should normally receive.

Who should I contact if I have questions?
The people conducting this study will be available to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator, Lindsey Nanney, at 252-328-1996 (days, between 8:00 am and 5:00 pm).

If you have questions about your rights as someone taking part in research, you may call the Office for Human Research Integrity (OHRI) at phone number 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of the OHRI, at 252-744-1971

I have decided I want to take part in this research. What should I do now?
The person obtaining informed consent will ask you to read the following and if you agree, you should sign this form:

- I have read all of the above information.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I know that I can stop taking part in this study at any time.
- By signing this informed consent form, I am not giving up any of my rights.
- I have been given a copy of this consent document, and it is mine to keep.

____

Participant's Name (PRINT) **Signature** **Date**

Person Obtaining Informed Consent: I have conducted the initial informed consent process. I have orally reviewed the contents of the consent document with the person who has signed above, and answered all of the person's questions about the research.

____

Person Obtaining Consent (PRINT) **Signature** **Date**

APPENDIX C

QUESTIONNAIRES

1. Exercise Regulations Questionnaire: BREQ-2R
2. Exercise Enjoyment Questionnaire
3. Perception of Need Satisfaction for Exercise Questionnaire: PNSE
4. Perception of Need Support in EXSS 1000
5. 30-day Physical Activity Recall
6. 8-Item Self Report Physical Activity Questionnaire: PA-8
7. International Physical Activity Questionnaire—Short Form: IPAQ
8. The Stages of Change Questionnaire

EXERCISE REGULATIONS QUESTIONNAIRE (BREQ-2R)

We are interested in the reasons underlying peoples' decisions to engage, or not engage 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
1	I do physical activity because other people say I should	0	1	2	3	4
2	I feel guilty when I don't do physical activity	0	1	2	3	4
3	I value the benefits of physical activity	0	1	2	3	4
4	I do physical activity because it's fun	0	1	2	3	4
5	I do physical activity because it is consistent with life goals	0	1	2	3	4
6	I don't see why I should have to do physical activity	0	1	2	3	4
7	I take part in physical activity because my friends/family/partner say I should	0	1	2	3	4
8	I feel ashamed when I miss a physical activity session	0	1	2	3	4
9	It's important to me to do physical activity regularly	0	1	2	3	4
10	I enjoy my physical activity sessions	0	1	2	3	4
11	I can't see why I should bother to do physical activity	0	1	2	3	4
12	I consider physical activity to be part of my identity	0	1	2	3	4

		Not true for me		Sometimes true for me		Very true for me
13	I do physical activity because others will not be pleased with me if I don't	0	1	2	3	4
14	I feel like a failure when I haven't done physical activity in a while	0	1	2	3	4
15	I don't see the point in doing physical activity	0	1	2	3	4
16	I think it is important to make the effort to do physical activity regularly	0	1	2	3	4
17	I find physical activity a pleasurable activity	0	1	2	3	4
18	I consider physical activity a fundamental part of who I am	0	1	2	3	4
19	I feel under pressure from my friends/family to do physical activity	0	1	2	3	4
20	I think doing physical activity is a waste of time	0	1	2	3	4
21	I get restless if I don't do physical activity regularly	0	1	2	3	4
22	I get pleasure and satisfaction from participating in physical activity	0	1	2	3	4
23	I consider physical activity consistent with my values	0	1	2	3	4

EXERCISE ENJOYMENT QUESTIONNAIRE

Rate each of the following items based on your opinion of physical activity.

1. I enjoy it	1	2	3	4	5	6	7	I hate it
2. I feel bored	1	2	3	4	5	6	7	I feel interested
3. I dislike it	1	2	3	4	5	6	7	I like it
4. I find it pleasurable	1	2	3	4	5	6	7	I find it unpleasurable
5. It is no fun at all	1	2	3	4	5	6	7	It is a lot of fun

PERCEPTION OF NEED SATISFACTION FOR EXERCISE QUESTIONNAIRE

The following statements represent different experiences people have when they do physical activity. Please answer the following questions by considering how YOU TYPICALLY feel while you are engaging in physical activity.

	False	Mostly False	More false than true	More true than false	Mostly True	True
1. I feel that I am able to complete physical activities that are personally challenging	1	2	3	4	5	6
2. I feel attached to my physical activity companions because they accept me for who I am	1	2	3	4	5	6
3. I feel like I share a common bond with people who are important to me when we engage in physical activity together	1	2	3	4	5	6
4. I feel confident I can do even the most challenging physical activities	1	2	3	4	5	6
5. I feel a sense of camaraderie with my physical activity companions because we exercise for the same reasons	1	2	3	4	5	6
6. I feel confident in my ability to perform physical activities that personally challenge me	1	2	3	4	5	6
7. I feel close to my physical activity companions who appreciate how difficult physical activity can be	1	2	3	4	5	6
8. I feel free to engage in physical activity in my own way	1	2	3	4	5	6
9. I feel free to make my own physical activity program decisions	1	2	3	4	5	6
10. I feel capable of completing physical activities that are challenging to me	1	2	3	4	5	6
11. I feel like I am in charge of my physical activity program decisions	1	2	3	4	5	6
12. I feel like I am capable of doing even the most challenging physical activities	1	2	3	4	5	6
13. I feel like I have a say in choosing the physical activities that I do	1	2	3	4	5	6
14. I feel connected to the people who I interact with while we engage in physical activity together	1	2	3	4	5	6
15. I feel good about the way I am able to complete challenging physical activities	1	2	3	4	5	6
16. I feel like I get along well with other people who I interact with while we engage in physical activity together	1	2	3	4	5	6
17. I feel free to choose which physical activities I participate in	1	2	3	4	5	6
18. I feel like I am the one who decides what physical activities I do	1	2	3	4	5	6

STUDENT PERCEPTION OF NEED SUPPORT IN EXSS 1000 QUESTIONNAIRE

Instructors have different styles in dealing with students, and we would like to know more about how you have felt about your encounters with your instructor. Your responses are confidential. Please be honest and candid.								
	In this class…	*Strongly Disagree*			*Neutral*			*Strongly Agree*
1.	I feel that my EXSS 1000 instructor provides choices and options.	1	2	3	4	5	6	7
2.	I feel that my EXSS 1000 instructor makes me feel like I am good at physical activity/exercise.	1	2	3	4	5	6	7
3.	I feel understood by my EXSS 1000 instructor.	1	2	3	4	5	6	7
4.	We are able to be open with my EXSS 1000 instructor during class.	1	2	3	4	5	6	7
5.	I feel that my EXSS 1000 instructor shows confidence in my ability to do well.	1	2	3	4	5	6	7
6.	I feel that my EXSS 1000 instructor is interested in us as students.	1	2	3	4	5	6	7
7.	I feel that my EXSS 1000 instructor helps us to improve.	1	2	3	4	5	6	7
8.	I feel that my EXSS 1000 instructor accepts me.	1	2	3	4	5	6	7
9.	I feel that our EXSS 1000 instructor makes sure we really understand the goals of the lesson and what we need to do.	1	2	3	4	5	6	7
10.	I feel that our EXSS 1000 instructor encourages us to ask questions.	1	2	3	4	5	6	7
11.	I feel that our EXSS 1000 instructor supports us.	1	2	3	4	5	6	7
12.	I feel a lot of trust in our EXSS 1000 instructor.	1	2	3	4	5	6	7
13.	I feel that our EXSS 1000 instructor likes us to do well.	1	2	3	4	5	6	7
14.	I feel that our EXSS 1000 instructor has respect for us.	1	2	3	4	5	6	7
15.	I feel that our EXSS 1000 instructor encourages us to work together in class.	1	2	3	4	5	6	7
16.	I feel that our EXSS 1000 instructor answers questions fully and carefully.	1	2	3	4	5	6	7
17.	I feel that our EXSS 1000 instructor handles our emotions very well.	1	2	3	4	5	6	7
18.	I feel that our EXSS 1000 instructor cares about us as people.	1	2	3	4	5	6	7
19.	I don't feel very good about the way the	1	2	3	4	5	6	7

	EXSS 1000 instructor talks to us.							
20.	I feel that our EXSS 1000 instructor tries to understand how we see things before suggesting new ways to do things.	1	2	3	4	5	6	7
21.	I feel able to share my feelings with our EXSS 1000 instructor.	1	2	3	4	5	6	7
22.	I feel that our EXSS 1000 instructor listens to how we would like to do things.	1	2	3	4	5	6	7
23.	I feel that our EXSS 1000 instructor makes us feel like we are able to do the activities in class.	1	2	3	4	5	6	7
24.	I feel that our EXSS 1000 instructor is friendly towards us.	1	2	3	4	5	6	7

30-DAY PHYSICAL ACTIVITY RECALL

Use the appropriate number (0 to 7) that best describes your general activity level over the previous month

Do not participate regularly in programmed recreation, sport, or heavy physical activity.

0 – Avoid walking or exertion, e.g., always use elevator, ride whenever possible instead of walking.

1 – Walk for pleasure, routinely use stairs, occasionally exercise sufficiently to cause heavy breathing or perspiration.

Participate regularly in recreation or work requiring modest physical activity, such as gymnastics, horseback riding, calisthenics, table tennis, softball, baseball, weight lifting, yard work.

2 – Spend 10 to 60 minutes per week in these types of physical activity.

3 – Spend over 1 hour per week in these types of physical activity.

Participate regularly in heavy physical exercise, e.g. running or jogging, swimming, cycling, rowing, jumping rope or engaging in vigorous aerobic activity type exercise such as tennis, basketball, soccer, or other similar sports activities.

4 – Run less than 1 mile per week or spend less than 30 minutes per week in comparable physical activity.

5 – Run 1 to 5 miles per week or spend 30 to 60 minutes per week in comparable physical activity.

6 – Run 5 to 10 miles per week or spend 1 to 3 hours per week in comparable physical activity.

7 – Run over 10 miles per week or spend over 3 hours per week in comparable physical activity.

8-ITEM SELF REPORT PHYSICAL ACTIVITY QUESTIONNAIRE

We would like to know more about your physical activity habits. Select one of the eight choices below that best represents your current physical activity level.

Vigorous physical activity includes activities like jogging, running, fast cycling, aerobics, swimming laps, singles tennis, and racquetball. Count any activity that makes you work as hard as jogging and lasts at least 20 minutes at a time. These types of activities usually increase your heart rate, make you sweat, and make you feel out of breath don't count weight lifting).

Moderate physical activity includes activities such as brisk walking, gardening, slow cycling, dancing, doubles tennis, or hard work around the house. Count any activity that makes you work as hard as brisk walking in bouts of at least 8–10 minutes accumulating to at least 30 minutes a day

1. I do not exercise/walk regularly now and I do not intend to start in the near future.
2. I do not exercise/walk regularly but I have been thinking of starting.
3. I am trying to start to exercise or walk or I exercise/walk infrequently.
4. I am doing vigorous physical activity less than three times per week or moderate physical activity less than five times per week.
5. I have been doing moderate physical activity that accumulates to at least 30 minutes per day at least 5 days per week for 1-6 months.
6. I have been doing moderate physical activity that accumulates to at least 30 minutes per day at least 5 days per week for 7 or more months.
7. I have been doing vigorous physical activity at least 20 min a day 3-5 days per week for 1-6 months.
8. I have been doing vigorous physical activity at least 20 minutes a day 3-5 days per week for 7 or more months.

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE—SHORT FORM

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

    _____ **days per week**

    ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

    _____ **hours per day**
    _____ **minutes per day**

    ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

    _____ **days per week**

    ☐ No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**
_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**
_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**
_____ **minutes per day**

☐ Don't know/Not sure

THE STAGES OF CHANGE QUESTIONNAIRE

Physical activity includes activities such as brisk walking, jogging, cycling, swimming, or any other activity, such as gardening, in which the exertion makes you feel warmer or slightly out of breath.

	No	Yes
1. I am currently physically active	0	1
2. I intend to become more physically active in the next 6 months	0	1

For activity to be *regular*, it must add up to a *total* of 30 minutes or more per day and be done at least 5 days per week. For example, you could take one 30-minute walk or take three 10-minute walks.

	No	Yes
3. I currently engage in regular physical activity	0	1
4. I have been regularly physically active for the past 6 months	0	1

APPENDIX D

TEACHING INTERVENTION SUPPLEMENTS

1. Direct Observation Protocol
2. Direct Observation Guide
3. Direct Observation Scoring Sheet
4. Need-Supportive Teaching Resource: Strategies Stemming from CARE
5. Weekly Goal Setting and Evaluation Worksheet

EXSS 1000 Direct Observation Protocol Spring 2014

Pre-observation:

- Attend training
- Commit to times of paired observation
    - Record instructor name and class location
- Keep observation schedule and instructors confidential
- Arrive to the Student Recreation Center 10 minutes before the class begins
- Visit Grace Anne's office
    - Retrieve clipboard and observation sheet

During observation:

- Arrive to the class location 5 minutes before the class begins
- Sit in discrete areas, separate from the other observer
- Independently observe the teacher's style
- Observe the class for the entire class period (50 minutes)
- Feel free to make notes and markings on observation sheet to help with final selections
- Complete the observation sheet during the class by selecting a number for each area

Post observation:

- Leave completed observation sheet in designated folder in Grace Anne's office
- Keep observations confidential among other observers and among instructors

Observation guide:

Observation ratings follow a spectrum

1 is not “bad”, 7 is not “good”

Select the number that best represents the degree to which an instructor’s teaching style favors a particular end of the spectrum

1—The instructor’s style exhibits **ONLY** the approach on this side of the scale.

2—The instructor’s style exhibits **MOSTLY** the approach on this side of the scale. (1-2 occurrences of the approach on the opposite side of the scale are observed).

3—The instructor’s style exhibits **MORE** of the approach on this side of the scale than the other.

4—The instructor’s style exhibits an **EQUAL** amount of approaches on both sides of the scale OR exhibits a lack of both OR exhibits a neutral approach.

5—The instructor’s style exhibits **MORE** of the approach on this side of the scale than the other.

6—The instructor’s style exhibits **MOSTLY** the approach on this side of the scale (1-2 occurrences of the approach on the opposite side of the scale are observed).

7—The instructor’s style exhibits **ONLY** the approach on this side of the scale.

Direction Observation Scoring

Instructor Name: ______________________ *Date/Time of class:* ______________________ *Observer Name:* ______________________

Relies on Extrinsic Sources of Motivation *Offers incentives, consequences *Utters directives *Seeks compliance	1	2	3	***4***	5	6	7	**Nurtures Inner Motivational Resources** *Tries to enhance interest, enjoyment, curiosity *Appeals to a sense of challenge *Creates opportunities for choice, initiative
Relies on Controlling Language *Is controlling, coercive, intrusive *Says: "should", "must", "have to" *Is pressuring, rigid, ego-involving, no nonsense	1	2	3	***4***	5	6	7	**Relies on Informational Language** *Is informational, flexible, responsive *Says: "you may" or "you might" want to… *Is noncontrolling, nonpressuring
Neglects to Provide Explanatory Rationales *Does not say "because", "so" or "the reason is…" *Neglects to identify the value, meaning, use, benefit or importance of a task/request	1	2	3	***4***	5	6	7	**Provides Explanatory Rationales** *Says: "because", "so" or "the reason is" *Identifies/points out the value, meaning, use, benefit, or importance of a task/request
Counters & Tries to Change Negative Affect *Counters students' expressions of negative affect or signals of task/request resistance *Communicates that negative affect, resistance, or complaints are not ok, are unacceptable, or are something to be changed/fixed	1	2	3	***4***	5	6	7	**Acknowledges & Accepts Negative Affect** *Listens openly, non-defensively, carefully, understandingly to students' expressions of negative affect & to signals of task/request resistance *Accepts negative affect and resistance as ok, communicates that complaints are ok
Neglects to Provide Adequate Instruction *Does not give instruction for all levels of students *Uses unclear or confusing instruction *Neglects to give modifications for those of lower or higher fitness/skill level	1	2	3	***4***	5	6	7	**Provides Adequate Instruction** *Gives thorough instruction for students of all levels, providing frequent instruction and demonstration *Clearly states instructions and expectations *Provides modifications for those of lower or higher fitness/skill level

Uses Only Evaluative Feedback *Uses feedback that may encourage students to feel inadequate/incapable *Provides feedback that is only evaluative	**1 2 3 *4* 5 6 7**	**Provides encouraging feedback** *Uses future oriented instructional feedback that is encouraging rather than pointing out mistakes *Rewards effort and personal accomplishments
Allows Negative Student Interaction *Does not correct student interactions that may lead a student to feel "unliked"/"unaccepted" *Allows students interactions to be negative	**1 2 3 *4* 5 6 7**	**Encourages Student Interaction** *Provides opportunites for students to interact or work with one another positively *Encourages student discussions
Disconnected from Students *Is unfriendly, uncaring and/or disrespectful to one or more students *Demonstrates negative regard for one or more students *Shows lack of interest in interacting with students	**1 2 3 *4* 5 6 7**	**Connected with Students** *Conveys friendliness, care and respect for all students *Provides unconditional positive regard for all students *Expresses interest in interacting with students

Need-Supportive Teaching Resource: Strategies Stemming from CARE

Competence • Provide mastery experiences • Reward effort and personal accomplishments • Provide **specific and descriptive positive feedback** (instead of just "good job", specify what made it a good job) • Provide future oriented instructional feedback that is encouraging rather than pointing out mistakes • Use modifications and alternatives • Use frequent demonstrations and modeling • Create an optimal skill challenge balance • Use feedback that downplays evaluation & emphasizes students' effectance, providing relevant info on how to master the task • Clearly communicate guidelines & expectation • Offer sufficient guidance during the lesson & provide step-by-step directions and/or help • Avoid any demeaning evaluation or singling out students • Practice necessary skills
Autonomy • Involve participants in the design of classes or some aspects of class • Use autonomy supportive language versus telling participants what they should or should not do. Minimize pressure and control (instead of "you have to"…"you may want to") • Teach participants how to develop their own physical activity sessions • Take the perspective of the students by expressing empathy and through active listening • Maximize students' perception of voice and choice • Provide meaningful rationale so students understand why the lesson is taught or why certain techniques are encouraged • Acknowledge student feelings about tasks and topics (good and bad ones) • Provide structure (autonomy support is not permissiveness): clear expectations, guidance for students' activity, constructive feedback • Do NOT impose own perspective on students or attempt to make them change
Relatedness • Give opportunities for students to meet one another and interact socially (while still engaging in lesson/activity) • Incorporate partner and group activities (sometimes partners/groups they select—autonomy) • Integrate cooperative exercises • Develop group activities that create a sense of community • Students should feel teacher genuinely likes, respects and values them • Convey warmth, care and respect • Does NOT show indifference or a lack of interest in interacting with students • Provide unconditional positive regard which is non-contingent and non-judgmental • Recognize student interest/disinterest
Enjoyment • Assess students' likes and dislikes

• Incorporate variety • Develop creative, action packed activities that participants may find enjoyable • Create a stimulating environment (e.g., appropriate music) • Monitor how the students feel during class/exercise	
Self-Determination Theory Based Goal Framing	
Refer to intrinsic, rather than extrinsic goal benefits	Provide specific, not vague, goal and realistically & meaningfully connect the referenced intrinsic goal to the learning activity so learners accept promoted goal
No need to adjust goals teachers promote according to goals students pursue	All students benefit from intrinsic goal framing regardless of individual goal profiles
Employ autonomy-supportive, rather than controlling, communication style	Students benefit more when they feel free to pursue goals.
Refrain from extrinsic goal framing	Undermines learning and beneficial effects of intrinsic goal framing

Need-Thwarting

Below are feelings someone may express if they feel their needs are thwarted, as opposed to supported. Need-thwarting hinders the innate psychological needs.

Competence-Thwarting • I feel other people dislike me • I feel others can be dismissive of me • I feel I am rejected by those around me • I feel that other people are envious when I achieve success • I feel other people dislike me • I feel others can be dismissive of me • I feel I am rejected by those around me
Autonomy-Thwarting • I feel prevented from making choices with regard to the way I engage in physical activity • I feel pushed to behave in certain ways • I feel under pressure to agree with the physical activity regime I am provided • I feel forced to follow physical activity decisions made for me
Relatedness-Thwarting • There are situations where I am made to feel inadequate • I feel inadequate because I am not given opportunities to fulfill my potential • Situations occur in which I am made to feel incapable • There are times when I am told things that make me feel incompetent

Weekly Goal Setting and Evaluation

Goal Setting:

Below are my goals for being need-supportive the week of ____/_____/2014

The lessons I teach this week are: ____

Reminders: Be as specific as possible. Set goals that you can evaluate. Continue incorporating our standard goals.

Autonomy

- Give at least one opportunity for choice/expression of voice each class: ____ ____________
- Provide rationale: ____

Relatedness

- Arrive 10 minutes early for small talk
- Be positive, kind, friendly & respectful. Acknowledge their thoughts & feelings

Competence

- Offer clear directions
- How can I help my students feel competent during our activities this week? /How can I help my students feel competent about being regularly active?

____

Need-Thwarting

- Avoid firm, overly assertive instruction that may be perceived as controlling & unkind
- Avoid seeming unapproachable
- Avoid perceived intolerance toward certain skill levels, “bad students”, those that don’t engage in PA, etc.

Weekly Goal Setting and Evaluation

<u>Goal Evaluation</u>:

Below are my evaluations for being need-supportive the week of ____/_____/2014
The lessons I taught this week were: ____
Below evaluate the goals you set for yourself on the reserve side. And, rate how you general achieved supporting each psychological need.

Autonomy

Not Well **Very Well**
1 2 3 4 5 6 7

Relatedness

Not Well **Very Well**
1 2 3 4 5 6 7

Competence

Not Well **Very Well**
1 2 3 4 5 6 7

Avoiding Need-Thwarting

Not Well **Very Well**
1 2 3 4 5 6 7

APPENDIX E

ADDITIONAL TABLES AND FIGURES

BREQ-2R Subscale Correlations

	1	2	3	4	5	6
Time 2						
1. Intrinsic Regulation	1.00					
2. Integrated Regulation	.75	1.00				
3. Identified Regulation	.72	.77	1.00			
4. Introjected Regulation	.31	.46	.56	1.00		
5. External Regulation	-.14	.02	-.02	.35	1.00	
6. Amotivation	-.27	-.12	-.32	-.02	.45	1.00
Time 3						
1. Intrinsic Regulation	1.00					
2. Integrated Regulation	.77	1.00				
3. Identified Regulation	.78	.76	1.00			
4. Introjected Regulation	.35	.49	.54	1.00		
5. External Regulation	-.08	.08	-.02	.39	1.00	
6. Amotivation	-.27	-.10	-.34	.05	.56	1.00

Notes: BREQ-2R is Behavioral Regulations in Exercise Questionnaire-Revised; all correlations are significant (p < .001).