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The relationship between intensity, frequency, duration, and location of physical activity and motivation: A Self-Determination Theory perspective

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The relationship between intensity, frequency, duration, and location of physical activity and motivation: A Self-Determination Theory perspective

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Abstract

INTRODUCTION: As the prevalence of physical inactivity and the health risks involved with it continues to increase, effective intervention approaches have become a necessity. According to Self-Determination Theory (SDT), adherence to physical activity could be improved by designing programs or interventions that target the more autonomous reasons for exercise. In previous research, the exercise variable is often only defined in terms of frequency, duration, and intensity, and differentiation between locations of exercise has been neglected. Environments with natural features have been shown to heighten physical and mental health benefits, which could have important implications for public and environmental health. Given the positive outcomes of green exercise, it would be advantageous to investigate whether different types of motivation exist for all outdoor and, more narrowly, nature-based physical activity compared to other types of physical activity.

METHODS: Alumni of a large Midwestern University were invited to participate via email. Those who agreed to participate completed an online survey that included assessments of physical activity behavior by the 7-Day Physical Activity Recall (7-Day PAR), motivation for physical activity by the Behavioral Regulations in Exercise Questionnaire (BREQ-2), stage of change, and demographic variables such as age, sex, height, weight, place of residence, ethnic group, and level of education.

RESULTS: The final sample consisted of 1,051 active adults (mean age 43.5 ± 11.1 years). No relationship was found between the percentage of physical activities that took place in nature and the BREQ-2 subscales. The percentage of physical activities that took place outdoors was negatively correlated with integrated ($r = -.12$, $p < 0.01$), identified ($r = -.11$, $p < 0.01$), and introjected regulation ($r = -.12$, $p < 0.01$), contrary to the hypothesis. However, among a

subsample of participants that were meeting the Physical Activity Guidelines for Americans (defined as a frequency ≥ 3x per week and intensity ≥ 600 MET-minutes; N = 849), the percentage of physical activities that took place in nature was found to be positively correlated with intrinsic motivation ($r = .08$, $p < 0.05$), integrated ($r = .08$, $p < 0.05$) and identified regulation ($r = .07$, $p < 0.05$). The percentage of physical activities that took place outdoors was negatively correlated with integrated ($r = -.11$, $p < 0.01$), identified ($r = -.10$, $p < 0.01$), and introjected regulation ($r = -.13$, $p < 0.01$). Consistent with previous research, there was a positive correlation between autonomous forms of motivation and exercise frequency, duration, and vigorous intensity activity. However, a negative correlation between moderate intensity activity and intrinsic motivation, integrated, identified, and introjected regulation was observed. Regression analyses revealed that introjected regulation was the strongest and only significant (yet negative) predictor of nature-based physical activity. Intrinsic motivation was a positive predictor of outdoor physical activity, while both integrated and introjected regulations were negative predictors.

CONCLUSION: The relationship between motivation and nature-based and outdoor physical activity is not clear, but it does appear that those who are physically active outdoors and in nature are less likely to be introjected, defined as performing the behavior out of guilt or shame. Intrinsic and other forms of autonomous motivation were associated with engagement in three or more days per week of vigorous intensity activity. Therefore, according to SDT, individuals whose physical activities have these characteristics may be more likely to adhere to their physical activity program. However, moderate intensity was negatively associated with the autonomous forms of motivation, which could have negative implications for physical activity adherence.

Chapter 1. Introduction

Regular participation in physical activity is known to have many health-related benefits for physical and mental well-being. Physical inactivity is an adjustable risk factor for chronic diseases such as diabetes, hypertension, certain forms of cancer, and cardiovascular disease (Warburton, Nicol, & Bredin, 2006). Nevertheless, regardless of the positive consequences of physical activity, less than half of American adults were active enough to achieve these health benefits in 2007 (Centers for Disease Control and Prevention, 2008). One aspect that may influence physical activity participation is the *type* of motivation for a particular activity (Duncan, Hall, Wilson, & Jenny, 2010).

Self-Determination Theory (SDT; Deci & Ryan, 1985, 1995; Ryan & Deci, 2000) is a theory of human motivation, development, and wellness (Deci & Ryan, 2008). Previous theories of motivation have focused on the amount of motivation that individuals exhibit for certain behaviors, whereas Self-Determination Theory distinguishes between types of motivation (Deci & Ryan, 2008). Self-Determination Theory is an approach for understanding both initiation and persistence issues in physical activity given that it identifies the nature and function of motivation, as well as the conditions that support or hinder motivational development and well-being (Wilson, Mack, & Grattan, 2008).

Self-Determination Theory describes motivation on a continuum characterized by external, introjected, identified, and integrated regulations (Ryan & Deci, 2000). The continuum ranges from amotivation (lack of intention and motivation) to extrinsic motivation (performing an activity in order to attain an outcome) to intrinsic motivation (performing the activity for the inherent satisfaction of the activity itself). External, introjected, identified, and integrated

regulations are forms of extrinsic motivation. Externally regulated behaviors are performed to satisfy an external demand and those who convey introjected regulation behave in order to avoid guilt or to attain enhancements of ego. Identified regulation is comprised of a conscious value of the behavior, making it truly important to the individual (Ryan & Deci, 2000). Most similar to intrinsic motivation is integrated regulation, which is embracing the behavior because it has been fully incorporated into the self (Dyrlund & Wininger, 2006).

According to SDT, adherence to physical activity could be improved by designing programs or interventions that target the more autonomous reasons for exercise. Evidence supports this contention. For example, over the course of a structured cycling exercise program, Wilson, Rodgers, Blanchard, & Gessell (2003) observed increases in identified and intrinsic exercise regulations among the adhering participants. In another study with a female sample, those who exercised for identified or intrinsic reasons were more likely to report higher perceptions of their physical self-worth, while the participants relying exclusively on external regulations reported lower physical self-esteem (Wilson & Rodgers, 2002).

Although intrinsic motivation is considered optimal for long-term behavior, most researchers to date argue that intrinsic motivation is not as strongly associated with regular exercise as integrated and identified regulation are. Identified regulation was associated with positive motivational consequences in the form of more frequent exercise behavior, positive attitudes toward exercise, and overall physical fitness (Wilson et al., 2003). Edmunds, Ntoumanis, and Duda (2006) found that identified regulation significantly predicted strenuous exercise behavior, showing that the individuals place value on exercise and recognize its importance to health and wellness. Several authors have argued that it is unrealistic to think that

promoting intrinsic motivation for physical activity would be a successful strategy (Duncan, Hall, Wilson, & Jenny, 2010; Edmunds, Ntoumanis, & Duda, 2006; Wilson & Rodgers, 2002).

However, one of the problems with this conclusion is that the exercise variable is often only defined in terms of amount, duration, and intensity in these studies, and differentiation between type and location of exercise has been neglected. Research has demonstrated that some types of exercise are considered more enjoyable than others (Dyrlund & Wininger, 2006). Furthermore, location (i.e., natural environment versus indoors) appears to result in different psychological experiences of exercise (Focht, 2009; Kerr, et al., 2006; Ekkekakis, Hall, & Petruzzello, 2000), such as enjoyment and affect, which are considered components of intrinsic motivation.

Environments with natural features have been shown to heighten physical and mental health benefits, which could have important implications for public and environmental health. Pretty, Peacock, Sellens, South, and Griffin (2007) found that green exercise participation resulted in significant improvements in self-esteem and total mood disturbance. Similarly, Barton and Pretty (2010) showed that acute exposures to green exercise improved self-esteem and mood. Results from Ryan, Weinstein, Bernstein, Brown, Mistretta, and Gagne (2010) revealed that the participants who walked indoors experienced no change in vitality, and those who walked outdoors experienced an increase in vitality. A consumer outreach report identified that the majority of respondents agreed that participating in outdoor activities gives them a feeling of accomplishment, an escape from life's pressures, and a connection with themselves (Outdoor Industry Foundation, 2004), which may facilitate the internalization of those behaviors.

Given this evidence, it is plausible to suggest that individuals are motivated to spend time outdoors for intrinsic reasons (i.e., enjoyment) and is therefore reasonable to assume that outdoor

nature-based activity participation is largely self-determined. Given the positive physiological and psychological outcomes of green exercise, it would be advantageous to investigate whether different types of motivation exist for outdoor activity and nature-based physical activity compared to other types of physical activity, from a Self-Determination Theory (SDT; Deci & Ryan, 1985, 1995; Ryan & Deci, 2000) perspective.

The main purpose of this study is to determine if those who participate in more outdoor and, more specifically, nature-based physical activities are more internally motivated toward physical activity than those who participate mainly in other types of activities. It was hypothesized that the individuals who participate in more outdoor and nature-based activities will display a higher degree of autonomous motivation toward physical activity than those individuals who participate in other types of activities, and that, specifically, that those who engage in more nature-based activities will be more likely to exhibit intrinsic motivation for physical activity.

Chapter 2. Review of Literature

Regular physical activity can aid in strengthening muscles and bones, improving mental health and mood, reducing the risk of chronic disease, and increasing the chance of longevity (Centers for Disease Control and Prevention, 2010), yet less than half of American adults did not participate in the necessary amount of physical activity to achieve these health benefits in 2007 (Centers for Disease Control and Prevention, 2008). Although the physical and psychological benefits of regular exercise are well documented, nearly half of those who begin a physical activity program will drop out within the first six months (Buckworth & Dishman, 1982). Increasing motivation to improve adherence to a physical activity program is a challenging task. A theoretical approach that is receiving growing attention in various health promotion domains is the Self-Determination Theory (Ryan & Deci, 2000).

2.1 Self-Determination Theory

Self-Determination Theory (SDT; Deci & Ryan, 1985, 1995; Ryan & Deci, 2000) is a theory of human motivation, development, and wellness (Deci & Ryan, 2008). While previous theories of motivation have focused on the amount of motivation that individuals exhibit for certain behaviors, Self-Determination Theory distinguishes between types of motivation (Deci & Ryan, 2008). The theory is not only concerned with the specific nature of positive developmental tendencies, but also the environments that are destructive toward these tendencies (Ryan & Deci, 2000).

The fulfillment of basic psychological needs may result in participating in physical activity for self-determined reasons, which is the goal of Self-Determination Theory. Ryan and Deci (2002) designate the basic psychological needs as competence, autonomy, and relatedness. Competence is the ability to effectively master challenging tasks within an individual's

environment. Autonomy is the feeling of a sense of ownership over one's behaviors. Relatedness is the sense of a meaningful connection with others in the individual's social environment (Wilson, Mack, & Grattan, 2008). The satisfaction of these needs has shown to predict psychological well-being in all cultures (Deci & Ryan, 2008).

Incorporating several theories, the first sub-theory within Self-Determination Theory is Cognitive Evaluation Theory (CET). It describes the influence of psychological needs and social conditions on the tendency to regulate behavior for intrinsic reasons (Wilson et al., 2008). Cognitive Evaluation Theory focuses on the fundamental needs for competence and autonomy, and research has shown that feelings of competence will not augment intrinsic motivation unless complemented by a sense of autonomy (Ryan & Deci, 2000). The second sub-theory, Organismic Integration Theory (OIT), describes the amount of internalization accompanying extrinsically motivated behaviors and specifies that the quality of extrinsic motivation regulating behavior varies from highly controlled to more voluntary processes (Wilson et al., 2008). Also included within Self-Determination Theory is Causality Orientations Theory which delineates individual differences in personality with respect to how people are oriented toward self-determined functioning across life domains (Wilson et al., 2008). Basic Needs Theory, the fourth sub-theory, focuses on the role of competence, autonomy, and relatedness needs regarding motivation and well-being (Wilson et al., 2008).

Self-Determination Theory describes human motivation on a continuum, categorized by amotivation, external motivation (external regulation, introjected regulation, identified regulation, integrated regulation), and intrinsic motivation (Ryan & Deci, 2000). Amotivation is the state of lacking the intention to act, whether resulting from not valuing the activity, not feeling capable of performing the task, or not expecting it to produce a desired outcome (Ryan &

Deci, 2000). The least autonomous form of motivation is referred to as external regulation, performing the activity to satisfy an external demand or to receive a reward. Next in line is introjected regulation, taking in a regulation but not fully accepting it as one's own, such as performing the activity to avoid guilt or to attain ego enhancements. Identified regulation is characterized by a valuing of the behavior, such that the action is accepted as personally important. Most similar to intrinsic motivation is integrated regulation, when identified regulations are fully embraced by the self. The most autonomous, or self-determined, form of motivation is intrinsic motivation. At this stage, performance of the activity is for enjoyment purposes or for the inherent satisfaction of the activity itself (Ryan & Deci, 2000). Ryan and Deci (2000) propose that the process of internalization may follow the continuum and occur over time, but individuals do not have to progress through each form of regulation to become fully intrinsically motivated.

2.2 Self-Determination Theory and Exercise

Duncan, Hall, Wilson, and Jenny's (2010) research examined the relationships between frequency, intensity, and duration characteristics of exercise and the behavioral regulations assessed by the Behavioral Regulation in Exercise Questionnaire – version 2 (BREQ-2; Markland & Tobin, 2004). Results showed that for both males and females, on a scale of 0 to 4, identified regulation (Males 3.16 ± 0.74, Females 3.22 ± 0.68) was the most strongly endorsed followed by intrinsic motivation (Males 3.07 ± 0.82, Females 3.06 ± 0.75), integrated regulation (Males 2.76 ± 1.00, Females 2.70 ± 1.02), introjected regulation (Males 1.72 ± 1.15, Females 1.97 ± 1.08), external regulation (Males 0.84 ± 0.87, Females 0.82 ± 0.84), and amotivation (Males 0.20 ± 0.47, Females 0.13 ± 0.31), in that order. The three characteristics of exercise were more strongly correlated to intrinsic motivation and the more autonomous forms of extrinsic motivation for the males and females. For males, frequency ($r = 0.42$, $p < 0.001$) and

intensity ($r = 0.22$, $p < 0.001$) of exercise were most strongly related to identified regulation, whereas duration ($r = 0.30$, $p < 0.001$) was most strongly related to integrated regulation. For females, identified regulation had the strongest relationship with exercise intensity ($r = 0.22$, $p < 0.001$), integrated regulation was most strongly correlated with frequency ($r = 0.41$, $p < 0.001$), and integrated regulation was most strongly related to duration ($r = 0.30$, $p < 0.001$) of exercise. Based on the findings, one could gather that in order to improve exercise adherence, programs should be generated to target identified and integrated regulations to promote more autonomous reasons for exercise.

Among a sample of female exercise class participants, those who exercised for identified or intrinsic reasons were more likely to report higher perceptions of their physical self-worth. Conversely, the participants relying exclusively on external regulations reported lower physical self-esteem (Wilson & Rodgers, 2002). The results suggest that those who value the important health outcomes associated with physical activity or find exercise to be pleasurable and rewarding, are likely to report higher levels of physical self-esteem (Wilson & Rodgers, 2002).

Dyrlund and Wininger (2006) found that perceived competence ($r = .46$, $p < .01$) and relatedness ($r = .28$, $p < .01$) were positively related to exercise enjoyment. Abs class participants attended significantly more classes than those in the step and yoga classes, and the participants of the kickboxing class attended significantly more classes than those in the step class. Feelings of perceived competence in an activity were shown to be more important than feelings of self-efficacy, enjoyment, autonomy, and relatedness when considering adherence to an activity. Perceived autonomy support from important others were shown to result in the selection of more autonomous exercise regulations, improving intentions to continue exercising (Wilson & Rodgers, 2004). These greater perceptions of autonomy support revealed a

connection between identified and intrinsic regulations and future exercise intentions, agreeing with previous research. From a practical standpoint, these results indicate a need for the involvement of important others when designing programs to increase exercise adherence.

Edmunds, Ntoumanis, and Duda (2006) found that introjected regulation positively predicted total exercise ($r = 0.20$, $p < 0.01$) and introjected ($r = 0.28$, $p < 0.01$) and identified ($r = 0.41$, $p < 0.01$) regulation were positive predictors of strenuous exercise behavior. This shows that individuals place value on exercise and recognize its importance to health and wellness. As expected, external regulation was shown to be a negative predictor of strenuous exercise behavior ($r = -0.09$). Although intrinsic motivation is the most highly endorsed form of motivation, it did not make an independent significant prediction to engagement in exercise when controlling for the other types of regulation (Edmunds, et al., 2006).

2.3 Indoor versus Outdoor Physical Activity

Ryan, Weinstein, Bernstein, Brown, Mistretta, and Gagne (2010) examined vitality (exhibiting physical and mental energy) levels produced by either indoor or outdoor physical activity. Study 1 entailed each participant viewing a packet of vignettes, differing by three variables: setting (indoor or outdoor), social interaction (among others or alone), and physical activity (active or inactive). While viewing these pictures, each individual was asked to imagine themselves in the particular setting and rate their level of vitality. All three variables had effects on vitality, with participants reporting higher vitality levels when outdoors, when with others, and when participating in physical activity ($p < 0.0001$).

In their second study, Ryan, et al. (2010) involved indoor and outdoor walking conditions, where the experimenter would guide participants on a silent 15 minute walk. Participants were randomly assigned to either an indoor condition, comprised of walking through a series of underground hallways and tunnels, or an outdoor condition, comprised of walking on

a tree-lined path along a river. Results revealed that the participants who walked indoors experienced no change in vitality ($F(1, 39) = 1.29$, $p > 0.25$, M before = 3.8 to M after = 2.3), and those who walked outdoors experienced an increase in vitality ($F(1, 39) = 15.12$, $p < 0.01$, M before = 3.9 to M after = 5.4).

In Study 3, Ryan, et al. (2010) subjected participants to either a nature or non-nature condition, involving viewing slides of scenes of buildings or of natural outdoor scenes. While viewing a set of four slides, participants listened to an audio recording familiarizing them to the experience. Prior to the session and immediately after, participants rated their level of vitality. The participants who were shown images of nature experienced an increase in vitality ($F(1, 44) = 4.29$, $p < 0.05$, M before = 2.8 to M after = 3.2). Conversely, those who were shown images of buildings experienced a decrease in vitality ($F(1, 52) = 20.20$, $p < 0.01$, M before = 2.9 to M after = 2.6).

2.4 Nature-Based Physical Activity

Research has shown that spending time in nature has a positive impact on health and well-being (Mitchell & Popham, 2007) and helps relieve stress (Wells & Evans, 2003). A consumer outreach report identified that the majority of individuals agreed that participating in outdoor activities gives them a feeling of accomplishment, an escape from life's pressures, and a connection with themselves (Outdoor Industry Foundation, 2004). Nature-based physical activity has been a research topic of interest among children; yet minimal research has been conducted focusing on the level of motivation for various types of physical activity within the adult population.

Pretty, Peacock, Hine, Sellens, South, and Griffin (2007) sought to explore the effects of green exercise on physical and mental health in the United Kingdom. Types of green exercise such as walking, fishing, mountain biking, and horse riding, etc., varying in intensity, duration,

number of participants, and environment were considered. To ensure equal representation, cluster sampling was used to select a random sample of case studies, followed by a stratified sampling technique. Participants ranged from visitors entering a park to formal activity groups. Among all types of green exercise, there was a significant improvement in self-esteem (pre-activity $M = 18.40 \pm 4.64$, post activity $M = 17.00 \pm 4.5$, $t(255) = 6.13$, $p < 0.0005$) and total mood disturbance (pre-activity $M = 144.87 \pm 20.62$, post activity $M = 139.67 \pm 19.10$, $t(250) = 4.48$, $p < 0.0005$) following participation. This suggests that all studied green exercise yields significant health benefits, regardless of intensity or duration. The results of this study revealed solely the short term benefits of green exercise. If the same were true regarding long term benefits, Pretty et al. (2007) concluded that a fit and emotionally stable population would minimize human suffering and be less of a burden on the economy.

Aiming to identify the appropriate dose of nature and green exercise to improve mental health, Barton and Pretty (2010) showed that acute exposures to green exercise improved self-esteem ($d = 0.46$) and mood ($d = 0.54$). The presence of water produced larger improvements in both self-esteem (increase of 0.29) and mood (increase of 0.19). Examining the dose response data, self-esteem and mood showed the greatest changes for the shortest duration of five minutes, showed smaller positive improvements for half-day activities, and increased overall for day-long activities. Self-esteem levels decreased with increasing intensity and improvements in mood were seen with light and vigorous activities.

Mackay and Neill (2010) sought to determine the effect of green exercise on state anxiety, focusing on the role of duration, intensity, and greenness of the environment. Green exercise was found to significantly reduce the participants state anxiety, but varied between exercises such as road cycling ($d = 0.84$, $p < 0.05$), boxercise ($d = 0.99$, $p < 0.05$), and mountain

biking (d = 1.02) when compared with mountain running (d = 0.14), orienteering (0.14), and cross-country running (0.24). A significant linear relationship (r = -0.28, d = -0.47) was found between greenness of the exercise environment and anxiety reduction. It appears that environments with more natural features have the tendency to be preferred and are also associated with additional positive physical and mental health outcomes.

Pretty, Peacock, Sellens, and Griffin (2005) aimed to determine the physiological and psychological effects of treadmill exercise while viewing rural and urban photographs. One hundred subjects were randomly assigned to one of five groups: those who viewed rural pleasant, rural unpleasant, urban pleasant, or urban unpleasant photos, and a control group who viewed no photos during a bout of exercise. During the twenty minutes of exercise, blood pressure and heart rate were continuously monitored, in addition to self-esteem and mood. The only group that saw significant reductions in all three blood pressure measures was those who viewed the rural pleasant scenes. With the control group experiencing a slight decrease in blood pressure, those participants who viewed the pleasant and unpleasant urban scenes had a slightly higher reported blood pressure. There was a significant improvement in self-esteem among all groups, with the greatest improvement seen with both pleasant groups. While both pleasant treatments produced the greatest increases in self-esteem, the control treatment produced a greater improvement in self-esteem than the two unpleasant treatments, suggesting that viewing the unpleasant photos have a depressive effect on self-esteem. The viewing of rural and urban pleasant scenes produced consistent improvements in the six measures of mood when compared to those viewing other scenes. It was found that viewing scenes appearing to threaten the environment had the greatest negative effects on mood. After reviewing the results, Pretty et al.

(2010) propose that green exercise may have important implications for public and environmental health.

2.5 Conclusions

Given the positive psychological outcomes associated with nature-based physical activity, it is reasonable to believe that this type of activity may be more associated with intrinsic motivation (which is characterized by positive emotional experiences) than other types of activity are. Intrinsic motivation, according to Self-Determination Theory, is important because the value of an activity has been acknowledged and ideally incorporated into an individual's sense of self (Deci & Ryan, 2008). Therefore, exploring whether intrinsic motivation for exercise is more prevalent in those that engage in nature-based activities compared to other activities is necessary because it would be beneficial to promote particular types of activities that individuals are more likely to internalize, and consequently, adhere to.

Chapter 3. Methods

3.1 Participants

Participants (N = 1,051) were male (N = 403) and female (N = 483) adults. Recruitment was done via e-mail sent to a random sample of university alumni. The demographic data for these participants are presented in Table 1. The participants ranged in age from 22 to 82 years, with a mean age of 43.5 ± 11.1 years. The mean BMI was 26.4 ± 5.3 kg/m^2. Captured by the Stage of Change questionnaire, 619 (58.9%) participants reported being in the maintenance stage, 159 (15.1%) in action, 150 (14.3%) in preparation, 82 (7.8%) in contemplation, and 40 (3.8%) in precontemplation, indicating a fairly physically active sample. The majority of the participants (914) reported currently being employed, working an average of 42.4 ± 16.1 hours per week.

Of those that provided information about their ethnicity (76.7%), the majority (90.7%) of respondents reported being White, 2.5% were Asian, 2.3% were American Indian or Alaskan Native, 2.1% were Black or African American, 1.0% were Hispanic, and 1.3% chose the "other" category. Of those that provided information about their education level (77.2%), 44.5% completed 4 or more years of undergraduate college, 36.7% earned a Master's degree, 16.5% finished a college PhD program, 1.7% attended another type of school, 0.4% completed through grade 12 of high school, and 0.3% completed 2 years of undergraduate college.

3.2 Procedure

Prior to data collection, Institutional Review Board approval was obtained. All questionnaires were distributed electronically using SurveyGizmo (Widgix LLC, 2006), a web-based survey software, sent to a Midwestern university's alumni e-mail database. The electronic message sent to the university alumni provided a detailed description of the study, and those who agreed to take part provided their informed consent upon returning the completed survey.

3.3 Measures

Seven-Day Physical Activity Recall (7-Day PAR). The Seven-Day Physical Activity Recall (7-Day PAR; Blair et al., 1985; Hayden-Wade, Coleman, Sallis, & Armstrong, 2003) was used to determine the intensity and duration of physical activities. The questionnaire was modified to include questions to assess the location and type of physical activity. To encompass the majority of indoor and outdoor activities, the participants were asked to choose from the following location categories: indoor-gym, indoor-exercise class, indoor-track, indoor-sport, indoor-home, outdoor-urban, outdoor-nature, outdoor-sport, outdoor-home, and other-describe. Participants were given space to describe the location if they chose the 'other-describe' location option. Along with the activity descriptions, these particular location responses were reviewed by two researchers and were put into another category if both researchers thought they were a better fit to a different category. For example, a participant chose the 'other-describe' option and wrote in 'indoor-studio' for a hot yoga class. After review, this was changed to the location of 'indoor-exercise class.' The participants were asked to recall the time spent engaging in moderate and vigorous physical activity for the past seven days. Previous studies have supported the reliability and validity of the Seven-Day Physical Activity Recall as a measure of physical activity in adults (Washburn, Jacobsen, Sonko, Hill, & Donnelly, 2003). The 7-Day PAR was found to have reasonable accuracy in determining total activity in 20 to 59 year old male ($r = 0.60$, $p \leq 0.01$) and female ($r = 0.36$, $p \leq 0.05$) participants (Richardson, Ainsworth, Jacobs, & Leon, 2001). The ability of the 7-Day PAR to assess habitual activity was greater for vigorous than for lower intensity physical activity (Richardson et al., 2001).

Stage of Change. To determine how long individuals have been participating in regular physical activity, a stage of change question (Reed, Velicer, Prochaska, Rossi, & Marcus, 1997) was included in the survey. After reading a definition of regular exercise, participants reported if they

have been regularly active for more than six months (maintenance), less than six months (action), if they intend to begin in the next 30 days (preparation), if they intend to begin in the next six months (contemplation), or if they do not intend to begin in the next 6 months (precontemplation). Versions of this measure have been found to be both reliable and valid (Courneya, 1995; Marcus et al., 1992; Marcus et al., 1992; Marcus & Simkin, 1993; Nigg & Courneya, 1998; Reed et al., 1997).

Behavioral Regulation in Exercise Questionnaire (BREQ-2). The Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2; Markland & Tobin, 2004) is a 19-item measure assessing motivation to engage in exercise. Using a 0-4 scale (0 = not true for me, 4 = very true for me), individuals rate the separate subscales for amotivation (e.g., "I don't see the point in exercising"), external regulation (e.g., "I exercise because other people say I should"), introjected regulation (e.g., "I feel guilty when I don't exercise"), identified regulation (e.g., "I value the benefits of exercise"), and intrinsic motivation (e,g., "I exercise because it is fun"; Edmunds, J., Ntoumanis, N., & Duda, 2007; Wilson & Rodgers, 2004). The BREQ-2 has recently been extended to include additional items assessing integrated regulation (e.g., "I exercise because it is consistent with my values"; Wilson, Rogers, Loitz, & Scime, 2006), which were included in the current study. Cronbach's alpha values for all BREQ-2 subscales ranged from 0.77 to 0.94, indicating good reliability.

Demographics. Participants provided their age, sex, ethnic group, education level, profession, place of residence, height, and weight at the time of data collection.

3.4 Data Reduction and Analysis

Using the information gathered by the 7-Day PAR, the intensity variable was entered as either moderate or vigorous (which differed slightly from the original version of the 7-Day PAR

which used intensities of moderate, hard, and very hard.) According to the 7-Day PAR, moderate intensity is equivalent to 4 METS, hard intensity is equivalent to 6 METS, and very hard intensity is equivalent to 10 METS. For the current study, moderate intensity was considered to be 4 METS and vigorous was considered to be 8 METS (the value directly in between 6 and 10 METS from the original version). For the duration of physical activity variable, participants were able to choose from 0-10 hours and 10-50 minutes (in 10 minute increments). These values were then converted into minutes to obtain a total time variable in addition to calculating MET-minutes by multiplying the time in minutes by the corresponding MET value for moderate physical activity (MPA), vigorous physical activity (VPA), and moderate and vigorous physical activity combined (MVPA). To obtain the frequency of physical activity variable, active days per week were summed to obtain frequency in days per week.

For the purpose of this study, the ten location categories were then coded to create two variables: 'outdoor versus indoor activities' and 'nature-based versus other activities' that were used for statistical analyses. To take into account participants' frequency of outdoor and nature-based physical activity relative to overall physical activity, the percentage of physical activities that took place outdoors and in nature were calculated by dividing the number of outdoor or nature-based bouts of physical activity by the total number of sessions of physical activity for the week.

Independent t-tests were performed to determine if there were differences between male and female participants on all the physical activity and behavioral regulations variables. Bivariate correlations were then conducted to determine whether regulatory styles were associated with the physical activity variables. Finally, multiple linear regression analyses were

conducted to examine the degree to which exercise regulations predicted the amount of nature-based and outdoor physical activity.

Chapter 4. Results

The recruitment e-mail was sent to 1,000 random alumni e-mail addresses from each year beginning with 1983 and ending with 2011. Of the approximately 29,000 alumnus that were sampled, a total of 1,487 responses were received within a two-week time frame. Participants were removed from the analyses if they did not fully complete the 7-Day PAR and BREQ-2, bringing the sample size to 1,160 individuals. Due to the importance of a physically active sample for the study, participants were considered inactive and removed from the sample if they reported no physical activity (0 MET-minutes) for the week.

The data were screened in order to detect outliers, as well as to test for homogeneity of variance and normality. Through an examination of outliers, histograms, normality plots, and scatterplots, substantial skewness and kurtosis was evident within the MVPA variable, and consequently, outliers were removed. Specifically, participants were removed from the sample if their calculated MET-minutes of physical activity exceeded two standard deviations (5,531.35 MET-minutes per week) from the mean.

After filtering out the inactive participants (MET-minutes ≤ 0) and outliers, the final sample included 1,051 individuals. Out of the 1,051 individuals, only 807 provided their age, 782 provided their height and weight in order to obtain a value for BMI, and 808 provided their sex. Given the high levels of physical activity in this sample, secondary analyses were conducted on a subsample of participants that reported meeting physical activity guidelines (i.e., frequency of ≥ 3 times per week and intensity of ≥ 600 MET-minutes). This sample consisted of 849 of participants (302 male, 363 female), 665 of which provided information about sex, 662 about age, and 642 about height and weight (to calculate BMI).

4.1 Descriptive Statistics

Descriptive statistics for the entire sample are found in Table 1. Since weather and extreme temperatures can often impact outdoor activity, participants provided their location of residence which was then coded into three categories based on average annual extreme minimum temperatures (United States Department of Agriculture, 2012). A total of 541 (51.5%) individuals lived in a cold climate (less than -10 degrees Fahrenheit minimum), 145 (13.8%) lived in a moderate climate (greater than -10 degrees Fahrenheit and less than 10 degrees Fahrenheit minimum), 91 (8.7%) lived in a warm climate (greater than 10 degrees Fahrenheit minimum), and 274 (26.1%) did not provide their location of residence or lived outside of the United States.

However, during the two week period of data collection (April 5th – April 19th), the average minimum and maximum temperatures in the 'cold' climate states were much higher than normal. According to the National Climate Data Center (NCDC, 2012), the minimum temperature ranged from 24.8 to 46.4 degrees Fahrenheit and maximum temperature ranged from 53.6 to 75.2 degrees Fahrenheit for the month of April. Therefore, it appears unlikely that climate confounded the 'location of physical activity' data.

Table 1. Descriptive statistics

Variables	Meeting Guidelines (N=849)		Total Sample (All Activity) (N=1,051)		
	M	**SD**	**M**	**SD**	**α**
Age (years)	43.5	11.2	43.5	11.1	
BMI (kg/m^2)	26.5	5.3	26.4	5.3	
Frequency (days/week)	5.3	1.3	4.7	1.7	
Total Duration (minutes)	398.5	219.8	346.5	299.8	
Moderate PA (MET-minutes)	1,017.9	920.5	897.6	879.0	
Vigorous PA (MET-minutes)	1,076.0	1,078.8	909.3	1,049.7	
Total MVPA (MET-minutes)	2,096.0	1,085.4	1,808.6	1,170.3	
Percentage Nature	14.2%	24.5%	14.5%	26.1%	
Percentage Outdoor	57.1%	34.4%	58.8%	35.9%	
Intrinsic motivation	2.8	1.0	2.6	1.0	0.93
Integrated regulation	2.5	1.2	2.3	1.2	0.91
Identified regulation	3.2	0.8	3.0	0.8	0.81
Introjected regulation	1.7	1.1	1.7	1.1	0.81
External regulation	0.7	0.8	0.7	0.8	0.77
Amotivation	0.2	0.5	0.2	0.5	0.86

Note: Intrinsic motivation, Integrated regulation, Identified regulation, Introjected regulation, External regulation and Amotivtion scores range from 0 – 4.

T-tests revealed that males and females only differed significantly for BMI ($p < 0.001$), with a mean difference of 1.6 (SD = 0.4). No significant differences were observed between males and females for other demographic variables including age, hours worked, total time spent being physically active, total MVPA MET-minutes, or BREQ-2 subscales. Therefore, subsequent analyses were conducted on the entire sample (not differentiating between males and females).

As the focus of the current study was primarily on location of physical activity, the percentage of time (over the course of the week of data collection) spent participating in both nature and outdoor physical activity was calculated and is displayed in Figure 1 and Figure 2. The mean percentage of physical activities that took place in nature was 14.2 ± 24.5%. The mean percentage of physical activities that took place outdoors (including nature) was 57.1 ± 34.4%.

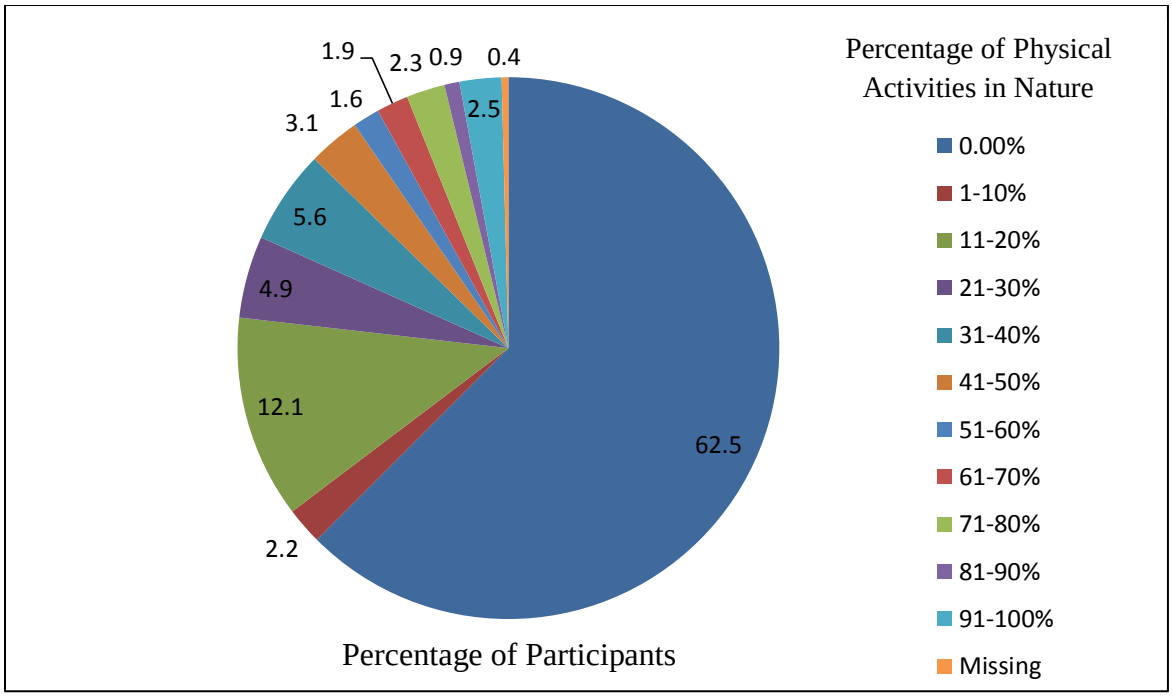

Figure 1: Percentage of participants reporting nature-based physical activity

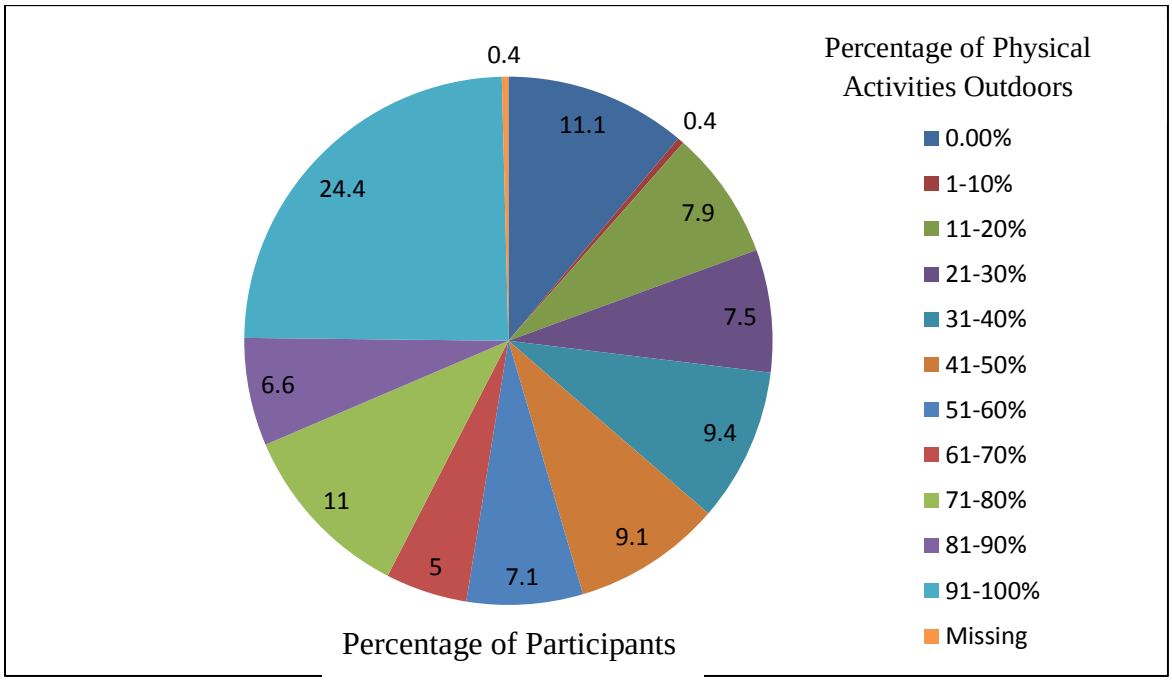

Figure 2: Percentage of participants reporting outdoor physical activity

4.2 Bivariate Correlations

Bivariate correlations were conducted on all of the BREQ-2 subscales, frequency (days per week), total time, MPA, VPA, MVPA, and percentage of physical activities that took place outdoors and in nature for all participants reporting any physical activity from the week of data collection (Table 2) and for participants meeting the current physical activity guidelines (Table 3). For the participants reporting any amount of physical activity for the week of data collection (Table 2), frequency (days per week) was positively correlated with intrinsic motivation, integrated regulation, and identified regulation and negatively correlated with external regulation and amotivation ($p < 0.01$). Total time was positively related to intrinsic motivation ($p < 0.05$), integrated regulation ($p < 0.01$), and identified regulation ($p < 0.05$), yet negatively related to external regulation ($p < 0.01$). Moderate intensity (MPA MET-minutes) was negatively correlated with intrinsic motivation, integrated regulation, identified regulation, and introjected regulation ($p < 0.01$), there was no relationship with external regulation, and a positive correlation with amotivation ($p < 0.01$). Vigorous intensity (VPA MET-minutes) was found to be moderately correlated in the positive direction with intrinsic motivation, integrated regulation, and identified regulation ($p < 0.01$) and a small positive correlation with introjected regulation. Significant negative correlations were found between vigorous physical activity and external regulation and amotivation.

There was no relationship found between the percentage of physical activities that took place in nature and the BREQ-2 subscales. Conversely, the percentage of physical activities that took place outdoors was negatively correlated with integrated regulation, identified regulation, and introjected regulation ($p < 0.01$). A positive relationship was found between outdoor physical activity and amotivation ($p < 0.05$).

Table 2. Bivariate correlations between BREQ-2 subscales and physical activity variables for participants reporting any amount of physical activity

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1. Frequency (days/week)	1	.52**	.35**	.28**	.51**	-.04	-.03	.25**	.28**	.29**	.02	-.13**	-.14**
2. Total Duration (minutes)		1	.81**	.32**	.89**	-.01	-.01	.07*	.11**	.07*	-.06	-.09**	.04
3. MPA (MET-minutes)			1	-.27**	.51**	.01	.11**	-.11**	-.09**	-.13**	-.15**	-.03	.14**
4. VPA (MET-minutes)				1	.69**	-.03	-.18**	.31**	.34**	.33**	.13**	-.10**	-.15**
5. MVPA (MET-minutes)					1	-.02	-.08*	.20**	.24**	.20**	.01	-.12**	-.04
6. Nature Percentage						1	.31**	.05	.06	.04	-.05	.03	.00
7. Outdoor Percentage							1	-.05	-.12**	-.11**	-.12**	.02	.07*
8. Intrinsic motivation								1	.72**	.73**	.22**	-.17**	-.41**
9. Integrated regulation									1	.76**	.30**	-.11**	-.35**
10. Identified regulation										1	.38**	-.14**	-.49**
11. Introjected regulation											1	.27**	-.11**
12. External regulation												1	.22**
13. Amotivation													1

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

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

For the participants meeting the physical activity guidelines (Table 3), small but significant positive correlations were found between frequency (days per week) and the BREQ-2 subscales of intrinsic motivation, integrated regulation, and identified regulation ($p < 0.01$). Conversely, negative correlations were found between the more controlled forms of regulation including introjected regulation, external regulation ($p < 0.01$), and amotivation ($p < 0.05$). Total time was negatively correlated with identified regulation ($p < 0.05$) and positively correlated with amotivation ($p < 0.01$). Moderate intensity (MPA MET-minutes) was negatively correlated with each BREQ-2 subscale except external regulation ($p < 0.01$). However, vigorous intensity (VPA MET-minutes) was found to be positively correlated with the autonomous forms of regulation and introjected regulation ($p < 0.01$), yet negatively correlated with external regulation ($p < 0.05$) and amotivation ($p < 0.01$).

Also for the participants meeting the physical activity guidelines, the percentage of physical activities that took place in nature was found to be positively correlated with intrinsic motivation, integrated regulation, and identified regulation ($p < 0.05$). No relationship was found between the percentage of physical activities that took place in nature and the controlled forms of regulation. The percentage of physical activities that took place outdoors was negatively correlated with integrated regulation, identified regulation, and introjected regulation ($p < 0.01$). No relationship was found between outdoor physical activity and intrinsic motivation, external regulation, and amotivation.

Table 3. Bivariate correlations between BREQ-2 subscales and physical activity variables for participants meeting the physical activity guidelines (i.e., Frequency ≥ 3x per week and Intensity ≥ 600 MET-minutes)

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1. Frequency (days/week)	1	.38**	.27**	.13**	.36**	-.00	.08*	.16**	.15**	.16**	-.03	-.11**	-.07*
2. Total Duration (minutes)		1	.80**	.18**	.86**	-.01	.06	-.06	-.03	-.08*	-.09**	-.05	.14**
3. MPA (MET-minutes)			1	-.42**	.43**	.01	.16**	-.21**	-.20**	-.25**	-.18**	-.00	.21**
4. VPA (MET-minutes)				1	.64**	-.02	-.16**	.27**	.29**	.30**	.15**	-.08*	-.13**
5. MVPA (MET-minutes)					1	-.02	-.03	.09**	.12**	.08*	-.01	-.09*	.05
6. Nature Percentage						1	.33**	.08*	.08*	.07*	-.05	.01	-.03
7. Outdoor Percentage							1	-.05	-.11**	-.10**	-.13**	.01	.07
8. Intrinsic motivation								1	.72**	.70**	.22**	-.16**	-.40**
9. Integrated regulation									1	.75**	.33**	-.09*	-.36**
10. Identified regulation										1	.40**	-.13**	-.49**
11. Introjected regulation											1	.28**	-.08*
12. External regulation												1	.25**
13. Amotivation													1

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

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

4.3 Multiple Linear Regression Analyses

Regression analyses were conducted to examine the degree to which exercise regulations predicted nature-based and outdoor physical activity. For the entire sample, results of the analyses revealed that 0.6% of the variance in the percentage of nature-based physical activity can be predicted from the exercise regulations. The combination of variables did not significantly predict nature-based activity. Only introjected regulation was a negative and significant predictor of nature-based physical activity (Table 4). In terms of outdoor physical activity, 2.5% of the variance in the percentage of outdoor activity can be predicted from the exercise regulations. The combination of variables significantly predicted outdoor activity ($p < .001$), with intrinsic motivation a significant and positive predictor, in addition to integrated and introjected regulation as significant and negative predictors.

For the subsample meeting the physical activity guidelines, results of the analyses revealed that 1.1% of the variance in the percentage of nature-based physical activity can be predicted from the exercise regulations. The model was significant, with the combination of variables significantly predicted nature-based activity ($p < 0.05$). However, only introjected regulation emerged as a negative and significant predictor of nature-based physical activity (Figure 5). In terms of outdoor physical activity, 1.9% of the variance in the percentage of outdoor physical activity can be predicted from the exercise regulations. The combination of variables significantly predicted outdoor activity ($p < .001$), with introjected regulation the only negative and significant predictor for outdoor physical activity as well.

Table 4. Multiple regression analysis: predicting nature-based and outdoor physical activity from exercise regulations for the entire sample (N = 1, 051)

Variable	***F***	**df**	R^{2adj}	***β***	***t***	**Sig.**
Nature	1.998	6, 1044	.006			
Intrinsic				.020	.411	.681
Integrated				.064	1.253	.210
Identified				.026	.456	.649
Introjected				-.091*	-2.536	.011
External				.065	1.930	.054
Amotivation				.025	.699	.485
Outdoor	5.500	6, 1044	.025			
Intrinsic				.101*	2.081	.038
Integrated				-.133**	-2.612	.009
Identified				-.023	-.410	.682
Introjected				-.107**	-3.014	.003
External				.044	1.324	.186
Amotivation				.035	.976	.329

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

Table 5. Multiple regression analysis: predicting nature-based and outdoor physical activity from exercise regulations for the subsample meeting the physical activity guidelines (N = 849)

Variable	***F***	**df**	R^{2adj}	***β***	***t***	**Sig.**
Nature	2.517	6, 842	.011			
Intrinsic				.037	.698	.486
Integrated				.039	.680	.497
Identified				.079	1.297	.195
Introjected				-.115**	-2.861	.004
External				.062	1.651	.099
Amotivation				.011	.278	.781
Outdoor	3.756	6, 842	.019			
Intrinsic				.053	1.009	.313
Integrated				-.099	-1.739	.082
Identified				.014	.228	.819
Introjected				-.125**	-3.106	.002
External				.033	.886	.376
Amotivation				.041	1.023	.307

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

Chapter 5. Discussion

The purpose of this study was to determine if individuals who participate in nature-based and outdoor physical activity are more internally motivated toward physical activity than those who participate in other types of activities (e.g., outdoor-sport activities, outdoor-home, or indoor-gym activities), from a Self-Determination Theory perspective. Using a self-report survey sent to university alumni, physical activity, behavioral regulation, and demographic data were collected for analysis. Though previous studies have investigated the relationship between motivation and intensity, duration, and frequency of physical activity (Duncan et al., 2010; Edmunds et al., 2006), the current study focused on motivation and location of physical activity and how that may impact the level of motivation to sustain a physically active lifestyle.

5.1 Location of Physical Activity

5.1.1 Correlations between Nature-Based Physical Activity and Behavioral Regulations

It was first hypothesized that individuals who participate in more nature-based activities will display a higher degree of autonomous motivation toward physical activity than those individuals who participate in fewer or no nature-based activities. When looking at the total sample (participants reporting any amount of physical activity), no significant relationships were found among any of the behavioral regulations and the percentage of physical activities that took place in nature. For participants meeting the current physical activity guidelines, it was found that there was a small, positive relationship between the percentage of physical activities that took place in nature and intrinsic motivation, integrated and identified regulation, and no relationship with the more controlled forms of regulation.

These findings support the first hypothesis and suggest that individuals participating in physical activity located in nature do so for reasons of enjoyment and pleasure (intrinsic motivation), being consistent with their values (identified regulation), and seeing the activity as personally significant (integrated regulation). These findings indicate that the amount or frequency of nature-based physical activity has an impact on an individual's motivation for that particular location physical activity. The more sessions spent in nature resulted in more autonomous reasons for participating in physical activity. If individuals experience the positive physiological and psychological outcomes of activity in a natural environment as previous research has revealed (Pretty et al., 2005; Pretty et al., 2007; Barton & Pretty, 2010; Mackay & Neill, 2010), it may be that this could motivate them to continue spending time in nature.

5.1.2 Correlations between Outdoor Physical Activity and Behavioral Regulations

It was also hypothesized that individuals who participate in more outdoor physical activity will display a higher degree of autonomous motivation toward physical activity than those individuals who participate in more indoor physical activity. For the participants reporting any amount of physical activity, a small, negative relationship was observed between integrated regulation, identified regulation, and introjected regulation. For this particular group of individuals, there was also a small, positive relationship with amotivation. Similarly, for the participants meeting the current physical activity guidelines, it was found that there was a small, negative relationship between the percentage of physical activities that took place outdoors and integrated regulation, identified regulation, and introjected regulation. Since outdoor physical activity was found to be negatively associated with integrated regulation, identified regulation, and introjected regulation, the results can also be

interpreted as those particular behavioral regulations being positively associated with indoor physical activity. Therefore, the percentage of physical activity located indoors was done so because the activity was accepted as personally significant, the activity was consistent with personal values, or it was performed out of guilt.

These findings are not consistent with the second hypothesis, and suggest that more outdoor physical activity participation led to less self-determined reasons for activity. This was somewhat surprising, but individuals may have been more likely to report work-related activities and chores as outdoor activities (e.g. gardening, farming, or exercise for transportation). If the outdoor activities reported were often considered to be chores, this could perhaps explain the negative correlation between outdoor activities and the autonomous forms of regulation. These results suggest that outdoor physical activity participation has an inverse relationship with motivations such as the activity being consistent with values, accepting the behavior as personally significant, and performing the behavior out of guilt. So could it be that outdoor physical activity was often considered to be a chore and consequently was completed because it "had" to be done? This seems like a plausible explanation since many participants reported "outdoor-home" as the location of physical activity, which may imply yard work, etc. There is no other research that found this, so it might be something to consider for future research. Nevertheless, more research is needed on the relationship between motivation and outdoor physical activity from a Self-Determination Theory standpoint before any conclusions can be drawn.

5.1.3 The Extent To Which Behavioral Regulations Predict Nature-based and Outdoor Physical Activity

Given the continued interest in location of physical activity, multiple linear regression analyses were conducted after viewing the bivariate correlations. Introjected regulation was the strongest and only significant (yet negative) predictor of nature-based physical activity, indicating that individuals were less likely to be active in nature if they do it because the feel guilt or shame if they don't. The positive associations between nature-based activity and more autonomous forms of motivation that were found using bivariate correlations did not emerge as significant in the regression model. The obvious conclusion would be that nature-based physical activity cannot be predicted by autonomous motivations. However, it may also be that the percentage of participants that actually engaged in nature-based physical activity was so small compared to the rest of the sample that it reduced the power of this regression model, causing any associations to disappear. Given the findings from the bivariate correlations, it would be worth investigating this more carefully in the future with a larger portion of participants engaging in nature-based physical activity.

For the sample including all participants, intrinsic motivation was a positive predictor of outdoor physical activity, while both integrated and introjected regulation were negative predictors. Yet, with the subsample of those participants meeting the physical activity guidelines, introjected regulation was the only significant and negative predictor of outdoor physical activity. When reviewing the results of the regression analyses for outdoor activity, it is interesting that intrinsic motivation was a positive predictor, yet integrated regulation was a negative predictor. The results imply that individuals are more likely to go outdoors to be active if they are intrinsically motivated and less likely to be active outdoors if they do it

because they feel guilt or shame if they don't. This particular pattern is consistent with SDT, but is in complete opposition to the results of the correlational analyses. Given the contrast between the results of the correlation analyses and the regression analyses and the small correlations, it appears that there is no clear pattern regarding which regulatory styles predict nature-based and outdoor physical activity. Due to the overall large sample size, it is plausible that a type I error may exist, meaning the true null hypothesis was incorrectly rejected. Therefore, additional research is needed to further examine whether these observations are reliable.

5.2 Frequency of Physical Activity

For both groups, frequency of physical activity was found to be positively related to intrinsic motivation, integrated regulation, and identified regulation, indicating that the greater the number of active days per week was motivated by more autonomous motivation. It appeared that the more active an individual was throughout the week, the better the chance of truly integrating the behavior with their sense of self. This finding is supported by the research of Duncan et al. (2010), who also found a positive correlation between exercise frequency and all of the autonomous forms of regulation for both males and females, although this study only looked at leisure-time physical activity. Similarly, Puente and Anshel (2010) observed that autonomous motivation was associated with exercise frequency, although they looked at physical activity in a group setting as opposed to all types of physical activity.

5.3 Duration of Physical Activity

For the entire sample, the total time spent participating in physical activity was found to be positively correlated with intrinsic motivation, integrated regulation, and identified

regulation. Similar results were found by Duncan et al. (2010), where duration of exercise was positively correlated with intrinsic motivation ($p < 0.01$), integrated and identified regulation ($p < 0.001$), and introjected regulation ($p < 0.01$) for both males and females. These results propose that the time spent in physical activity has a positive effect on autonomous forms of regulation. This seems plausible; assuming that the more time that is spent participating in physical activity is done so for reasons of enjoyment, pleasure, and accepting and valuing the behavior as a part of oneself. In opposition, introjected regulation was also positively associated with duration of physical activity, which is doing the behavior to avoid guilt or shame. This finding was somewhat unexpected. However, when looking at only the participants that met the physical activity guidelines, total time was negatively correlated with identified regulation and positively correlated with amotivation, which was contrary to expectations.

5.4 Intensity of Physical Activity

Contrary to expectations, moderate intensity physical activity was found to be negatively correlated with all the autonomous forms of regulation. These results suggest that the greater amount of moderate physical activity participation was done so for less autonomous reasons. In partial support, Edmunds, et al. (2006) found that none of the behavioral regulations were correlated with moderate exercise. Given that the percentage of activities that took place outdoors and MPA are positively related, it could also be that individuals are more likely to report work-related activities and chores as moderate intensity (e.g., gardening, farming, cleaning), which could explain these negative relationships.

Conversely, there was a positive relationship between vigorous intensity physical activity and intrinsic motivation, integrated regulation, identified regulation, and introjected

regulation. This finding is in line with previous research, where Edmunds, et al. (2006) found that both introjected and identified regulations were positive predictors of strenuous exercise behavior. As expected, external regulation and amotivation had a negative relationship with vigorous intensity physical activity. When moderate and vigorous intensity were combined into one variable (MVPA), there was a positive relationship with intrinsic motivation, integrated regulation, and identified regulation among both groups. Silva et al. (2010) found similar results: moderate and vigorous exercise was positively correlated with intrinsic motivation, identified regulation, and introjected regulation. When mild, moderate, and strenuous exercise were combined into a total exercise variable, Edmunds et al. (2006) also found significant, positive correlations between intrinsic motivation, identified regulation, and introjected regulation and total exercise. If work-related activities and chores are likely to be reported as moderate intensity, it could be that leisure-time activities (e.g., running, biking, and swimming) are more likely to be reported as vigorous intensity, which could explain the difference between the moderate and vigorous intensity findings. As many other measures have defined moderate intensity as 3 METS and vigorous intensity as 6 METS, these differences need to be taken into account when interpreting the results of the current study.

5.5 Practical Implications

With many health issues on the rise, it has become critical to develop physical activity interventions that individuals are able to adopt into their daily lifestyle. The findings of the present study suggest that people engaged in vigorous intensities and higher frequencies appear to be more autonomously motivated than others. Furthermore, outdoor activities appear to be engaged in for less introjected reasons (or, perhaps, indoor activities

are done for more introjected reasons. Based on the results and principles underpinning Self-Determination theory, it can be suggested that increasing autonomous forms of motivation may result in higher frequencies and intensities of physical activity. This suggestion is consistent with the findings of other studies. Furthermore, increasing the amount of time spent in outdoor and nature-based activities may help in a small way to reduce the more controlled forms of behavioral regulation that active individuals experience (although much more research is needed before major conclusions can be drawn about the impact of location on motivational style). .

5.6 Limitations and Future Research

Several limitations are important to consider when interpreting the findings of this study. First, the sample consisted of mainly Caucasian, college-educated adults, graduating between the years of 1973 and 2011. In addition, 81% of participants in the present study reported meeting guidelines for physical activity, which is much higher than the 2009 population average of 51% (Centers for Disease Control and Prevention, 2012). These results should only be generalized to similar populations. The data were collected by means of an electronic self-report survey. Self-reported physical activity can often be overestimated to improve the level of social desirability. Additionally, the measure collecting the physical activity data was a one-week recall. Recalling seven days of activity may be difficult, and forgetting relevant details could affect the overall outcome. Furthermore, the Seven-Day Physical Activity Recall was created to be interviewer-administered to aid in the recall process, but in the present study the 7-Day PAR data was collected via an online, interactive questionnaire. Although the Principal Investigator's contact information was provided if participants had questions about the survey content, very few took advantage of asking

questions. With the absence of person-to-person contact, participants were unable to clarify questions that arose while answering the questions. Although it was not interviewer-administered, the electronic version allowed a large sample to be recruited which could not have been done otherwise. In addition, this version of the 7-Day PAR asked for physical activity to be coded as moderate or vigorous in intensity. These intensities may feel different for different individuals (e.g., more physically fit versus less physically fit), which may produce discrepancies. While the 7-Day PAR may have its own downfalls, it was chosen in order to collect all types of physical activity as opposed to solely leisure-time activity or "exercise," in addition to it being one of the most well-studied and well-supported self-report measures available. Since public health recommendations for physical activity are emphasizing accumulating any and all activity throughout the day, it was important to include all activity in the current study.

In order to increase the generalizability of the present findings, it is necessary to conduct similar studies utilizing a sample with a broader range of age groups, ethnicities, and education levels. The majority of the sample resided in the cold climate region (primarily the Midwestern United States). Future studies could benefit from including more individuals from other areas of the United States to ensure geographic location is not a confounding factor. It may also be advantageous to modify the BREQ-2 to ask about specific types of activities that were reported, as opposed to answering each BREQ-2 statement about a broad range of physical activities. Another suggestion would be to differentiate between work-related and leisure physical activity in the physical activity questionnaire and separately ask about motivations for work-related and leisure physical activity. If repeated, clarification of

questionnaire wording and instructions, in addition to providing examples or definitions of the location categories would be essential.

5.7 Conclusion

The present study suggests that there may be a relationship between type of motivation and outdoor or nature-based locations of physical activity, as it appears that people who exercise more outdoors and in nature are less likely to perceive that the activity is an obligation (i.e., introjected regulation). However, it is difficult to draw any major conclusions due to inconsistencies between the results of the regression analyses and correlational analyses. The relationship between location of physical activity and motivation clearly requires further investigation in order to form any definite conclusions. Consistent with previous research, it was also found that vigorous intensities and frequencies of three or more days per week of physical activity was related to type of motivation for activity, which may be important to consider when prescribing physical activity.

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Appendix A. Survey

7-Day Physical Activity Recall (7-Day PAR)

Think of all of the physical activities you have done in the past seven days. Starting with yesterday and working backward, recall the amount of physical activity performed each day. Categorize the intensity of the activity into one of two groups: moderate or vigorous. Moderate intensity is similar to how you feel when walking at a normal pace and vigorous intensity is similar to how you feel when running.

1. Were you employed in the last seven days? O. No (Skip to Q#4) 1. Yes

2. How many days of the last seven did you work? _____days

3. How many total hours did you work in the last seven days? _____ hours last week

4. What two days do you consider your weekend days? _____ _____

Were you physically active on Day 1 (i.e. yesterday)?

☐No ☐Yes, one activity ☐Yes, two or more activities

Of all of the activities that you did, please list the one (or two) of the longest duration.

ACTIVITY 1: What activity did you participate in? _____

ACTIVITY 1: Was it moderate or vigorous in intensity? ☐Moderate ☐Vigorous

ACTIVITY 1: Where did the activity take place?

☐Indoor-gym ☐Outdoor-urban

☐Indoor-exercise class ☐Outdoor-nature

☐Indoor-gym ☐Outdoor-sport

☐Indoor-sport ☐Outdoor-home

☐Indoor-home ☐Other. Describe: _____

ACTIVITY 1: How long did you participate in the activity?

Hours 0 1 2 3 4 5 6 7 8 9 10

Minutes 10 20 30 40 50

ACTIVITY 2: What activity did you participate in? _____

ACTIVITY 2: Was it moderate or vigorous in intensity? ☐Moderate ☐Vigorous

ACTIVITY 2: Where did the activity take place?

☐Indoor-gym ☐Outdoor-urban

☐Indoor-exercise class ☐Outdoor-nature

☐Indoor-gym ☐Outdoor-sport

☐Indoor-sport ☐Outdoor-home

☐Indoor-home ☐Other. Describe: _____

ACTIVITY 2: How long did you participate in the activity?

Hours 0 1 2 3 4 5 6 7 8 9 10

Minutes 10 20 30 40 50

***This process was repeated for all seven days.

---

4. Compared to your physical activity over the past 3 months, was last week's physical activity more, less, or about the same?

1. More 2. Less 3. About the same

5. Were there any special circumstances concerning this physical activity recall?

0. No 1. Yes. If yes, what were they? (circle)

1. Injury all week 2. Illness all week 3. Illness part week

4. Injury part week 5. Pregnancy 6. Other

Behavioral Regulations in Exercise Questionnaire-2

Instructions: We are interested in the reasons underlying peoples' decisions to engage, or not engage in physical exercise. Using the scale below, please indicate to what 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 exercise. Your responses will be held in confidence and only used for our research purposes.

		Not true for me		Sometimes true for me		Very true for me
1.	**I exercise because other people say I should**	0	1	2	3	4
2.	**I feel guilty when I don't exercise**	0	1	2	3	4
3.	**I value the benefits of exercise**	0	1	2	3	4
4.	**I exercise because it's fun**	0	1	2	3	4
5.	**I don't see why I should have to exercise**	0	1	2	3	4
6.	**I exercise because it is consistent with life goals**	0	1	2	3	4
7.	**I take part in exercise because my friends/family/partner say I should**	0	1	2	3	4
8.	**I feel ashamed when I miss an exercise session**	0	1	2	3	4
9.	**It's important to me to exercise regularly**	0	1	2	3	4
10.	**I can't see why I should bother exercising**	0	1	2	3	4
11.	**I consider exercise to be part of my identity**	0	1	2	3	4
12.	**I enjoy my exercise sessions**	0	1	2	3	4
13.	**I exercise because others will not be pleased with me if I don't**	0	1	2	3	4
14.	**I don't see the point in exercising**	0	1	2	3	4
15.	**I consider exercise a fundamental part of who I am**	0	1	2	3	4
16.	**I feel like a failure when I haven't exercised in awhile**	0	1	2	3	4
17.	**I think it is important to make**	0	1	2	3	4

	the effort to exercise regularly					
18.	**I find exercise a pleasurable activity**	0	1	2	3	4
19.	**I feel under pressure from my friends/family to exercise**	0	1	2	3	4
20.	**I get restless if I don't exercise regularly**	0	1	2	3	4
21.	**I get pleasure and satisfaction from participating in exercise**	0	1	2	3	4
22.	**I think exercising is a waste of time**	0	1	2	3	4
23.	**I consider exercise consistent with my values**	0	1	2	3	4

Stages of Change

Regular Exercise is any *planned* physical activity (e.g., brisk walking, aerobics, jogging, bicycling, swimming, rowing, etc.) performed to increase physical fitness. Such activity should be performed *3 to 5 times* per week for *20-60 minutes* per session. Exercise does not have to be painful to be effective but should be done at a level that increases your breathing rate and causes you to break a sweat.

Question: Do you exercise regularly according to that definition?

1. Yes, I have been for MORE than 6 months.
2. Yes, I have been for LESS than 6 months.
3. No, but I intend to in the next 30 days.
4. No, but I intend to in the next 6 months.
5. No, and I do NOT intend to in the next 6 months.

Background Information

Age _____years

Sex Male Female

Height _____feet _____inches

Weight _____pound

Where do you live (e.g. Ames, IA)? _____

Ethnic Group – Please specify your race:

☐ American Indian or Alaskan Native

☐ Asian

☐ Hispanic

☐ Black or African American

☐ White

☐ Other _____

Education Level – Circle the last year of school attended:

1 2 3 4 5 6 7 8	9 10 11 12	1 2 3 4	M.A.	Ph.D.
Grade School	High School	College		

Other type of school_____

Profession_____

Thank you for taking part in our research!

Appendix B. Recruitment E-mail

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Human Sciences
Department of Kinesiology
235 Barbara E. Forker Building
Ames, Iowa 50011-1160
515-294-8009
www.kin.hs.iastate.edu

Dear Participant,

The United States has a growing need for improvement of community health education programs. Researchers at Iowa State University are asking for your help in learning about the thoughts of occupants of the United States regarding their health and physical activity status. The goal of this research is to learn more about the motivational responses resulting from various types and locations of physical activity, and about how certain individual differences impact this relationship. The results may be used for publications, future research, and fund-seeking initiatives related to community health issues.

Please click on the link and complete the survey as soon as possible. It should take approximately 10-20 minutes of your time. The survey is located at the following link: **http://humansciences.physicalactivity.sgizmo.com/s3/**.

Your participation in this study is completely voluntary and you may refuse to participate. If you decide to not participate in the study, it will not result in any penalty. You can skip any questions that you do not wish to answer. Additionally, there are no foreseeable risks at this time for participating in this study.

Although your participation in this study is voluntary, it is important that your opinions and experiences are included so that we obtain an accurate understanding. No identifying information will be collected or retained. The data will be retained until the analysis is complete whereupon, the data will then be destroyed. If the results are published, your identity will remain anonymous.

If you have any questions about the survey, please contact the Principal Investigator at (515) 294-2928. You may also email me at **akbanks@iastate.edu**.

Thank you very much for your help.

Sincerely,

Andrea Banks
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