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Predicting Exercise Adherence in College Students Using a Self-Determination Theory Framework

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Predicting Exercise Adherence in College Students Using a Self-Determination Theory Framework

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Abstract

College is a pivotal time for weight gain and unhealthy behavior changes in many young adults. Decreases in physical activity are common in this age group and likely contribute to the 1.6 to 1.8 kg weight gain that is often observed in the first year of college. Identifying groups of students who are at high-risk for decreasing or discontinuing physical activity may help develop more targeted interventions. The present study explored physical activity patterns in the first semester of college and examined predictors of exercise decreases to levels below recommended daily values within a Self-Determination Theory framework. Incoming freshman (n=174; 42.5% male; 85.6% White; 18.2$\pm$.8 yrs; BMI = 22.6$\pm$2.8 kg/m^2) that met recommended daily values (RDV; 150 minutes/week) for physical activity (PA) at the start of the semester completed baseline psychosocial questionnaires and then reported PA levels 12 weeks into the first semester. Logistic regression was used to identify significant predictors of exercise status (maintained or decreased below RDV). Of freshman who met PA recommended daily values upon entering college, 28.2% were no longer doing so by the end of the study. These students were most likely to endorse lack of willpower (p=.02) and lack of time (p=.07) as barriers than exercise maintainers. Females were twice as likely as males to fall into the decreased exercise category (p=.05). Consistent with the SDT model, greater autonomous motivation for exercise predicted maintenance status (p=.02); however, controlled motivation and competence were not significant predictors. Further examination of the role of motivation in exercise maintenance, particularly autonomous vs. controlled self-regulation and whether these forms of motivation can be modified, is warranted. Intervention studies targeting autonomous motivation levels as well as college females may greatly benefit this high-risk population.

Introduction

Obesity continues to be one of the most pressing and prevalent health issues in America today. Recent research indicates that 68% of adults are currently overweight or obese based on a body mass index (BMI) of 25 kg/m^2 or greater (Flegal, Carroll, Ogden & Curtin, 2010). Obesity is associated with numerous illnesses including, but not limited to, cardiovascular disease, high cholesterol, high blood pressure, type II diabetes, cancer, sleep apnea, arthritis, and polycystic ovarian syndrome which can impact female fertility (Finkelstein, Brown, Wrage, Allaire, & Hoerger, 2010). Furthermore, obesity is associated with $60+ billion in direct medical costs and almost 400,000 deaths each year (Finkelstein, Fiebelkorn, & Wang, 2005). Preventing obesity may reduce both the prevalence and severity of several of these illnesses, and reduce medical costs nationwide.

While much attention is paid to childhood obesity, young adulthood is a particularly important window during which many individuals gain a significant amount of weight in a short period of time. In fact, many young adults gain an average of one to two pounds per year throughout their twenties (Lewis et al., 2000; Truesdale et al., 2006). Weight gain commences even earlier however, with college students between 18 and 24 years old gaining a significant amount of weight while in school; 70% gain 4 kilograms (kgs) within their first two years of college (Centers for Disease Prevention and Control, 1997). The first year of college is especially pivotal; men gain an average of 1.8 kg within the first three months of college, while women gain an average of 1.6 kg within the same amount of time (Lloyd-Richardson, Bailey, Fava, & Wing, 2009). As these young adults gain weight and become overweight or obese, they too are at increased risk

for numerous health problems, including cardiovascular disease and metabolic syndrome, which can dramatically impact both their lifestyle and their lifespan (Norman, Bild, Lewis, Liu, & West, 2003; Lloyd-Jones et al., 2007).

College represents a crossroads for many young adults, with most students living away from their family homes for the first time. For many, college can serve as an obesogenic environment and many newly independent students make poor food choices and drastically decrease their physical activity upon starting school (Nelson, Kocos, Lytie & Perry, 2009; Racette, Deusinger, Strube, Highstein, & Deusinger, 2005). In fact, a study which included inventories of food items in student dorm rooms found that the average room contained 22,888 calories, typically in the form of salty snacks, carbohydrate-rich foods like cereal, granola bars and desserts, and candy (Nelson & Story, 2009). Few students kept lower-calorie items in their room such as low-calorie beverages, fruits and vegetables. Finally, parents purchased more high-calorie food items for participants than the students purchased for themselves, and the study authors suggest that "care packages" sent by parents may be responsible for this difference.

Additionally, many young adults begin drinking alcohol in their first year of college; both the calories from the alcohol as well as the late-night eating that often follows can add up to significant weight gain in a short period of time (Lloyd-Richardson, Lucero, DiBello, Jacobson, & Wing, 2008). Furthermore, binge-drinking patterns often seen in college students are associated with poor diet, sedentary behaviors, and even body dissatisfaction (Nelson, Lust, Story & Ehlinger, 2009). Students reporting that they "always" ate before or while drinking were more likely to be overweight, and college-age males were more susceptible to the effects of drinking on eating behaviors.

While these factors make the transition to college a critical time for weight gain, the same period of time may also serve as a strategic point for preventive intervention. With more than 20 million young adults enrolled in 2- or 4-year colleges in 2011, there is a large population that falls within this critical window of young adulthood and consequently a strong opportunity for targeted intervention (U.S. Department of Education, 20011). College campuses have the potential to provide an ideal setting for maintaining a healthy weight by providing access to exercise equipment, a strong social network, and education regarding nutrition.

In developing an intervention for college students, it is important to remember that while diet is essential for weight loss, regular, moderate physical activity is associated with numerous health benefits and is an important component in maintaining weight loss. Increasing physical activity leads to improved resting energy expenditure and can help those who have lost weight to maintain or even increase their weight loss (Villanova et al., 2006). Physical activity has also been demonstrated to be significant in preventing weight gain specifically in female college freshman (Jung, Bray, & Ginis, 2008). Physical activity has mental health benefits for several groups. For example, it offers adolescent girls a protective effect for the onset of major-minor depression, and reduces the risk of future depression (Jerstad, Boutelle, Ness, & Stice, 2010). Furthermore, engaging in physical activity is associated with reduced hopelessness, depression, and suicidal behavior (Talafiero, Rienzo, Pigg, Miller, & Dodd, 2009). Data suggest that the mental health benefits of physical activity may be context-dependent and have a dose-response effect; the activity must take place outside of work, and moderate

physical activity has a greater impact than low levels of physical activity (McKercher et al., 2009).

In spite of all the benefits of exercise, few Americans meet the recommended daily values suggested by the US Department of Health and Human Services. Federal guidelines were updated in 2007, and currently suggest moderate-intensity aerobic physical activity for a minimum of 30 minutes on 5 days each week or vigorous-intensity aerobic physical activity for a minimum of 20 minutes on 3 days each week, paired with activities that maintain or increase muscular strength and endurance a minimum of 2 days each week (Haskell et al., 2007). Data suggest, however, that fewer than 50% of American adults engage in sufficient exercise to meet minimums recommended by the government (World Health Organization, 2007). The effects of this physical inactivity cannot be underestimated; in 2007 the World Health Organization estimated that two million deaths occur worldwide annually due to a lack of physical activity (World Health Organization, 2007). The data regarding exercise adherence in college students are equally discouraging. A 2004 Canadian study found that while 66.2% of students in high school met United States Department of Health and Human Services recommendations for vigorous exercise, only 44.1% of students in their first two months of college met the same standards (Bray & Born, 2004). One third of students were significantly active in high school but were no longer active after transitioning to college. Examining what distinguishes those students who continue to meet recommended daily values for physical activity from those who do not is necessary to develop and tailor interventions towards maintaining weight during the transition to college.

One key factor impacting exercise adherence may be motivation. Self-Determination Theory (SDT) distinguishes between intrinsic or autonomous motivation, extrinsic or controlled motivation, and amotivation (Deci, Eghrari, Patrick, & Leone, 1994; Deci & Ryan, 2008). SDT posits that individuals have three innate psychological needs: autonomy, competence, and social relatedness (Deci & Ryan, 2000). In combination, satisfying these three needs is essential for optimizing growth, social development, and personal well-being. Much of the research that is guided by SDT focuses on motivation and the different factors that influence action. Specifically individuals may engage in an activity because they value it personally, or because there is some external push to engage in it. Those whose motivation for a particular behavior is authentic and therefore self-endorsed are more interested and excited, and therefore enjoy it more than those who are externally controlled; they display autonomous motivation as opposed to controlled motivation. Autonomous motivation and its heightened levels of interest and enjoyment typically result in improved persistence within an activity. The theory suggests that those who are autonomously motivated and therefore exercising because they find it enjoyable and satisfying are more likely to keep exercising. In contrast, those who are extrinsically motivated, or have high levels of controlled motivation, and consequently focused primarily on external controls of their behavior, are less likely to continue exercising, especially during a time of transition like the one to college. For example, someone who is engaging in exercise for autonomous reasons is choosing the behavior for his or her own reasons (e.g. “I want to run because it makes me feel good”) whereas an individual with high levels of controlled motivation is choosing the behavior for reasons external to him or herself (e.g. “I run to lose weight to please

others"). Autonomous motivation is predictive of both persistence and superior performance because the locus of control is internal—the behavior is initiated from within, rather than from some external source. SDT predicts that those students who keep exercising after transitioning to college do so because they are freely choosing to do so for self-generated reasons, and do not feel external pressure to think or behave in specific ways. Furthermore, autonomous motivation for physical activity is associated with improvements in eating self-regulation, which can also have a positive effect on weight maintenance and physical activity levels (Mata et al., 2009). Mata and colleagues found that autonomous motivation for physical activity predicted eating self-regulation in a community sample of women enrolled in a weight loss intervention, even when general self-determination and weight loss treatment motivation were controlled for. This research suggests that some interventions can address complementary health behavior changes, which could possibly inform interventions designed for the transition to college as well; while relationships between physical activity maintenance and motivation have been proposed, they have not been studied in an American college student population, and could impact other health behaviors as well.

In addition to measuring the key features of Self-Determination Theory, including autonomy, motivation, autonomy support and perceived competence, studies of exercise adherence must examine barriers to participation in physical activity. A study of Canadian females found decreasing levels of physical activity over the course of adolescence, with participants reporting several barriers including lack of time, the influence of parents an peers, and concerns about safety (Dwyer et al., 2006). While there is considerable literature on barriers to physical activity in adolescent, adult, and

elderly populations, there are few studies that examine barriers to participation specifically in a college population. One study of students in seventh grade through the first year of college found that barriers reported by first year university students included anxiety, depression, and external stressors, such as illness or injury, a lack of sleep, or a lack of money to pay for physical activity expenses (Gyurcsik et al., 2006). Gyurcsik and colleagues additionally found that barriers to physical activity increased in students over time, with first year college students reporting significantly more ecological barriers such as a lack of transportation and weather concerns than middle and high school students. This finding combined with the limited literature on self-reported barriers to physical activity in college students suggests a need for research focused on this at-risk population.

The current study will build on previous research by examining exercise adherence in first semester college students using a Self-Determination Theory framework. We will first examine whether the decreases in physical activity in college students found in the Canadian studies (Bray & Born, 2004; Martin, 2010) are observed in students at a major Northeast American university. We will then examine the relationships between exercise adherence and key constructs from SDT, namely autonomous and controlled motivation as well as perceived competence. We will also explore associations between exercise adherence and weight maintenance and mental health variables during the transition to college. These questions were examined in a large sample of first-semester college students who provided self-report assessments of physical activity levels and demographic information at three different points throughout their first semester of college (week 2, week 4, and week 12 of the fall semester). At the

start of the semester, data were collected regarding students' motivation, social support, depressive symptoms, and barriers that may be impacting their participation in physical activity, with the hope of examining what distinguishes those students who maintain recommended levels of physical activity in the transition to college from those who do not. We hypothesized that students' levels of autonomous and controlled motivation would predict whether they continued to meet recommended levels of weekly physical activity, with high levels of autonomous motivation predicting continued exercise adherence, and high levels of controlled motivation predicting a decrease in physical activity to levels below the recommended weekly values. Finally, we predicted that high levels of perceived stress and depression would be associated with lower levels of physical activity over time.

Methods

Participants

Participants (n=174) were recruited through the Introductory Psychology Participant Pool at the University of Connecticut (UConn). To be eligible for the study, individuals had to be at least 18 years old when the Participant Pool screener was administered and they had to report engaging in at least 150 minutes of moderate aerobic activity (e.g., brisk walking) each week during the previous 30 days. Participants were excluded if they did not speak or read English, or if they did not have reliable Internet access.

Procedures

The Participant Pool screener was completed during the first two weeks of the semester and assessed student age, self-reported height and weight, their semester

standing at UCONN, as well as information about the quantity and quality of their physical activity during the previous 30 days, and their participation in varsity, club, or intramural sports at UCONN. Those students who met recommended daily values for exercise (150 minutes of moderate physical activity each week) were eligible to participate in the study, and an advertisement was posted on the participant pool website. Eligible students also received an e-mail advertising the study. Interested students were provided with an information sheet outlining study procedures, the risks and benefits of the study, information about participants' rights and how personal information would be protected, and contact information for study investigators. No deception was used during the course of the study and students were given the opportunity to complete online surveys in order to earn credit for Introductory Psychology. The investigation was approved by the Institutional Review Board at the University of Connecticut.

Those who elected to participate completed the surveys, which assessed how much they exercise, what type of exercise they do, and their reasons for exercising. The surveys also included some brief symptom questionnaires to assess for depression and stress levels, which may impact motivation to exercise. Participating students completed the entire set of surveys in September 2010, as well as November, 2010.

Participants in the Psychology participant pool received up to 4 experimental credits for participation in this study. Questionnaires took approximately 45 minutes to 1 hour to complete and two credits each were given for responses collected at 0 weeks and 8 weeks. In order to encourage students to complete both sets of questionnaires, those that completed the second set of

questionnaires were entered into a raffle for an iPod shuffle. The raffle took place at the end of the semester, at which time the winning participant was notified.

Every effort was made to ensure confidentiality for study participants. Participants were assigned a subject code consisting of their first and last initial followed by a three digit number indicating how many participants are enrolled in the study. Surveys were administered using Psychsurveys.org. According to the Psychsurveys.org website (retrieved July, 2010), all data are stored in a password protected database at a web hosting site that provides extensive security including firewalls, real-time security alerting using intrusion detection scanners, and 24-hour monitoring from their network operations center. Physical security of servers includes perimeter fencing, green field space, card access, biometric entries, mantraps, 24-hour security guards and continuous camera surveillance inside and outside the facility's buildings. All data is encrypted in transmission using SSL (Secure Sockets Layer). All electronic files are password protected and only research staff had access to the information or were able to associate subject codes with individuals. Raw data was stored in locked filing cabinets and will be discarded after an appropriate period of time, and emails were destroyed after data were collected.

Measures

Demographics. Basic demographic information including gender, age, and education level was obtained by self-report. Additional items assessed whether the participants participate in sports at UCONN and whether or not they receive any type of compensation for that participation (i.e. scholarship money).

Weight/Height. Self-reported weight and height was collected because of the online nature of the study. Weight was reported in pounds and height was reported in inches. The data were then used to calculate body mass index. Self-reported height and weight, while less accurate than that collected by study investigators in a laboratory setting, is considered a reliable way to assess BMI and obesity status in adolescents (Goodman, Hinden, & Khandelwal, 1999).

Physical Activity. Physical activity levels were assessed by self-report. Individuals reported their average number of minutes of physical activity each week over the previous 30 days. Items assessing physical activity levels were developed based on the Center for Disease Control's recommendations for physical activity, as well as the Youth Risk Behavior Survey (Centers for Disease Control and Prevention, 2009).

Self-Determination variables: Participants completed several questionnaires to evaluate variables related to SDT. The Motives for Physical Activity Measure-Revised (MPAM-R) was utilized in order to assess students' motives for participating in moderate physical activity. The 30-item measure has been used to measure motivation and also to predict behavioral outcomes (Frederick & Ryan, 1993; Ryan at al., 1997). Participants responded using a 7-point Likert scale, ranging from "not at all true for me" to "very true for me." Frederick and Ryan (1993) demonstrated that the scale consists of three clear factors; a body-related factor (eigenvalue = 7.17), a competence factor (eigenvalue = 5.62), and an interest/enjoyment factor (eigenvalue = 1.87). Cronbach alpha coefficients for the factors were .90, .91, and .91 for these factors respectively. The scale has demonstrated reliability and validity, internal consistency (α above .87 for each subscale), and has been used in several published studies.

Participants' perceived competence was measured using the Perceived Competence Scale (PCS) for exercise, a scale designed to assess the degree of confidence participants have about maintaining a healthy behavior (Williams, Freedman, & Deci, 1998). Perceived competence is associated with maintenance of behavior change. Participants respond to items using a 7-point Likert scale ranging from 1 "not at all true" to 7 "very true." The scale has demonstrated excellent internal consistency in studies of perceived competence of diabetes (Cronbach's α between 0.80 and 0.94) and when compared to other motivational measures, perceived competence loaded cleanly on a factor separately from other motivational constructs such as autonomous motivation and interest levels.

We measured autonomous motivation using the Treatment Self-Regulation Questionnaire (TSRQ), which examines reasons why people engage in a physical activity. It has been used successfully in other research on healthy behavior change, with findings that autonomous motivation is positively associated with smoking cessation and long-term maintenance of weight loss and exercise behaviors in the morbidly obese (Williams, Gagné, Ryan & Deci, 2002; Williams, Grow, Freedman, Ryan & Deci, 1996). Participants respond to items using a 7-point Likert scale ranging from 1 "not at all true" to 7 "very true." Cronbach α's for the measure have been demonstrated to be strong, ranging from .80 to .86 in a smoking cessation study (Williams, Gagné, Ryan & Deci, 2002).

Psychosocial variables. Depressive symptoms were measured using the Center for Epidemiological Studies Depression Scale (CES-D; Donker, van Straten, Marks, & Cuijpers, 2010; Radloff, 1977). Findings suggest that this is a reliable and valid tool to

screen for depression in research settings, and an internet-administered version of the CES-D is also reliable and valid (Cronbach's $\alpha = 0.93$) in an adolescent population (Cuijpers et al., 2007a). Participants also completed the Perceived Stress Scale (PSS). This four-item measure has demonstrated adequate reliability, with Cronbach $\alpha = .72$ and test-retest reliability over two months at .55 (Cohen, Kamarck, & Mermelstein, 1983).

Barriers to Physical Activity. Participants answered questions regarding what barriers prevent them from engaging in regular moderate physical activity (i.e., Not enough time, not enough access.) While this measure does not have psychometric data available, it was included to evaluate whether themes about barriers to engaging in physical activity within this specific population emerged.

Potential Interventions. Finally, participants were questioned about what types of interventions they may be interested in (i.e., on-campus intervention versus on-line intervention.) While these data were collected, there is no psychometric information available since it is not a research measure. Rather, it was included based on the possibility that it could provide information about future interventions administered on college campuses.

Data Analysis Plan

Data were analyzed using Statistical Package for the Social Sciences (SPSS for Mac, version 18.0, IBM, Somers, NY, USA). Participants were divided into two groups; those who continued to meet recommended daily values for physical activity (exercise maintainers; EM), and those who fell below RDVs for physical activity by week 12 of the semester (exercise decreasers; ED). Demographic differences between EM and ED were examined using chi-square or independent t-tests. Logistic regression analyses, adjusted

for demographic differences, were conducted to identify significant predictors of group status. While the logistic regression could have focused on numerous possible predictors, study authors were limited by number and therefore, based on study hypotheses and questions, chose to focus on those variables which are considered most important within Self-Determination Theory. For this study, we expected to find that autonomous motivation levels significantly predict exercise adherence through the transition to college.

Results

Participants

A total of 1703 students completed the Participant Pool prescreening assessment in the fall of 2010. Of these students, 692 reported meeting recommended daily values (RDV) for physical activity (at least 150 minutes of moderate physical activity each week). These students were contacted via email and provided with a description of the study and if interested, were encouraged to enroll in the study via a web-link to the participant pool website. A total of 309 students enrolled, of whom174 were first-semester students and were retained for the analyses. Participants were 42.5% male, 85.6% non-Hispanic white, and 18.2 $\pm$ .8 years old. The mean body mass index (BMI) for the total sample was 22.6 $\pm$ 2.8 kg/m^2.

Correlations between baseline variables

In the overall sample, correlations between autonomous motivation and several motives for physical activity were noteworthy; autonomous motivation was most highly correlated with fitness and competence variables (Table 2). Interest/Enjoyment for physical activity was most highly correlated with autonomous motivation, whereas there

was no significant correlation between interest/enjoyment and controlled motivation. Controlled motivation was most highly correlated with appearance variables, although there were also significant correlations between controlled motivation levels and fitness and social motives for physical activity.

Exercise status

By definition, 100% of participants were meeting RDV for physical activity at study entry, with participants reporting an average of 345.7 (± 180.8) minutes/week of moderate intensity physical activity. At the end of the first semester, the percentage of participants meeting the RDV had decreased to 71.8%. Two groups were created, those who maintained RDV (Exercise Maintainers (EM; n=125) and those who did not (Exercise Decreasers (ED; n=49). At follow-up, EM reported an average of 304 (± 152.0) minutes/week of physical activity compared to 84.1 (± 46.9) minutes/week in ED. This represents a 0% decrease in exercise minutes on average for the EM group and 65% for the ED group over an twelve-week period. Baseline demographic and psychosocial differences between the groups are reported in Table 2. The groups were significantly different in terms of gender composition, with more men classified as EM than ED (79.7% vs. 20.3% men, respectively, p=.047). The EM group had higher baseline BMI levels on average than ED (22.8 ± 3.0 kg/m^2 vs. 21.9 ± 2.4 kg/m^2, p = .038). No other demographic differences emerged.

The groups differed at study entry in their motivation and perceived competence for physical activity (Table 2). Those in the EM group reported significantly higher levels of autonomous motivation ($p < .05$), whereas there were no significant differences between groups in levels of controlled motivation or amotivation. The EM group also

reported higher overall levels of perceived competence for physical activity than those in the ED group (5.80 $\pm$ 1.16 vs. 5.21 $\pm$ 1.21, $p < .01$).

Analyses of specific types of motivators revealed that students in the EM group were more likely to report interest/enjoyment ($p < .01$) and fitness ($p = .05$) as motivators for physical activity than those in the ED group. There were no group differences in reports of appearance and social aspects as motivators for physical activity. Some group differences were apparent in self-reported barriers to exercise. Those in the ED group were significantly more likely to report a lack of willpower as a barrier to exercise ($p = .01$) and tended to have higher scores on lack of time as a barrier to exercise ($p = .06$).

Multivariate Analyses

Logistic regression analyses showed that several variables were significant independent predictors of maintenance of physical activity levels during the transition to college (Table 3). Gender was a significant predictor of exercise status; being female significantly predicted decreases in physical activity to levels below recommended daily values ($p = .05$, OR = 2.17[.995 – 4.719]). After adjusting for demographic variables, autonomous motivation was a significant negative predictor of decreases in exercise ($p = .01$, OR = .912[.849 - .981]). Those reporting higher levels of autonomous motivation were significantly more likely to continue exercising throughout the transition to college, whereas those reporting lower levels of autonomous motivation were more likely to fall below RDVs for physical activity by the end of the semester. Controlled motivation was a marginally significant predictor of exercise status ($p = .07$, OR = 1.06[.995 – 1.127]), with those reporting more controlled motivation more likely to fall into the ED group at the end of the semester. While the logistic regression also included blocks containing

perceived competence as well as motivation variables associated with self-determination theory, the variables overlapped considerably with autonomous motivation and therefore did not add to the model's overall significance.

Possible Interventions

To evaluate students' interest level in possible interventions, participants were asked to indicate which type of physical activity intervention they were most likely to engage in. Preferences for interventions were similar across EM and ED groups. The most frequently endorsed intervention option was a one-on-one personal trainer, with 47.1 percent of total participants indicating that they were likely to take advantage of such an option. Group fitness classes such as Zumba® and Spinning were also popular options, with 24.1 percent of participants indicating a high level of interest in such an option. Other options, such as group training (16.7 percent), an exercise manual (7.5 percent) and an online personal trainer (4.6 percent) were endorsed less frequently, although indicated a wide range of interests in possible interventions in this particular population.

Discussion

Entering college is a time of major life transition and presents several opportunities for health behavior change, both positive and negative. For the majority of first semester students, college is the first time that they are living outside of their home environment and making independent decisions about energy intake and expenditure. While this may present an opportunity for individuals to increase their healthy behaviors, unfortunately the opposite is true more often, with college students making poor food choices and also increasing calorie intake with alcohol (Lloyd-Richardson, Lucero,

DiBello, Jacobson, & Wing, 2008). Undergraduate education also lacks the high level of structure that is typical of high school, and there are no requirements for physical activity; individuals who are not varsity team members have the freedom to decide whether or not they want to exercise and how much they want to do so. In spite of widespread recognition that college is a period of significant change, little attention has been paid to this period of transition in terms of its potential as a critical moment to undertake positive health behavior change and also maintain established healthy habits. This study focused on physical activity and explored the variables that distinguish individuals who continue exercising through the transition to college from those who significantly decrease their physical activity levels. To our knowledge, this is the first study to consider exercise adherence in first year college students from a Self-Determination Theory perspective.

Study results indicate that nearly one third of first semester students who met recommended daily values for physical activity ($\geq$ 150 minutes/week) upon beginning college were no longer doing so by the end of the semester. This finding was not unexpected and was similar to findings reported elsewhere (Bray & Born, 2004). The drop-off in exercise within the sample was dramatic, with students in the ED group reporting a decrease from a mean of 240.4 ($\pm$ 175.2) minutes to 84.1 ($\pm$ 46.9) minutes per week. Demographic differences between exercise maintainers and exercise decreasers may suggest some variables to consider in designs for future interventions. For example, those in the ED group had significantly lower BMIs than those who continued meeting recommended daily values for physical activity. One reason for this difference may be that students with lower BMIs may be less concerned about possible weight gain due to

decreased physical activity; perhaps they view their normal body weight as a protective factor and therefore are less motivated to exercise to maintain their weight. Furthermore, those who maintain physical activity levels by engaging in regular strength training to increase muscle mass may have influenced the relationship between physical activity maintenance and BMI. Interventions targeting college students may want to highlight that even those who fall within the normal range of BMI upon entering college are at-risk for perceived weight gain and will benefit from continued physical activity (LaRose, Gorin, Clarke & Wing, in press).

Group differences also suggested that, consistent with Self Determination Theory, reasons for exercising predict adherence. Autonomous motivation was associated with several self-reported reasons for physical activity, including interest/enjoyment, competence, and fitness levels and most importantly was predictive of continued physical activity over the first semester of college. This finding was consistent with SDT, which posits that autonomous motivation is predictive of long-term persistence (Deci, Eghrari, Patrick, & Leone, 1994). Furthermore, many prior studies have found autonomous motivation to be associated with the maintenance of numerous other health behaviors, including but not limited to smoking cessation, exercise adherence, and weight loss (Williams et al., 2006a; Silva et al., 2010; Webber, Tate, Ward & Bowling, 2010). The EM group also reported higher levels of perceived competence at study entry, and they were more likely to endorse interest/enjoyment as a motivator for physical activity; both of these variables are highly correlated with autonomous motivation, and consistent with previous SDT findings. While we predicted that controlled motivation would predict decreases in physical activity, no group differences in controlled motivation were

reported at study entry. Nor were there group differences in reports of external motivators for physical activity, such as appearance and social aspects, which are more highly correlated with controlled motivation than autonomous motivation. However, controlled motivation was a marginally significant predictor of maintenance, with those reporting more controlled motivation slightly more likely to fall into the ED group at study completion. This suggests a trend in the relationship between controlled motivation and exercise maintenance; however we were unable to confirm our hypothesis that it would significantly predict group membership. This lack of indisputable evidence linking controlled motivation to adherence (or a lack thereof) confirms finding from other studies. For example, while Webber and colleagues found that autonomous motivation predicted persistence in self-monitoring as well as weight loss, controlled motivation showed no significant association with either outcome variable (Webber, Tate, Ward & Bowling, 2010). The current study is similarly unable to find a definitive association between controlled motivation and adherence; however it does suggest that a relationship may exist between controlled motivation and exercise persistence through the transition to college.

Perhaps the lack of a significant association between motivation and behaviors in this study is because those who have high levels of motivation, regardless of whether it is externally or internally motivated, continue engaging in physical activity at least through the transition to college, or that those with such high levels of PA have higher levels of motivation in general than other college students. Additional research using a larger sample size and perhaps a longer time period may be necessary to determine whether controlled motivation has deleterious effects on exercise persistence over the long term.

Group differences in self-reported barriers were also revealing and results appear to be consistent with SDT; those in the ED group were more likely to report a lack of willpower and a lack of time as barriers to maintaining physical activity. This finding again suggests that autonomous motivation is integral to behavior maintenance throughout the transition to college—those who are more autonomously motivated to exercise may be more likely to find time in their busy student schedules to do so since they do so specifically because they enjoy it, find it satisfying, and they are driven to do so based on their own desires, rather than some external source. This finding echoes previous research; those who report that they exercise for enjoyment and competence are more likely to continue engaging in physical activity than those who report that they are motivated for body-related reasons (Ryan, Frederick, Lepes, Rubio & Sheldon, 1997). However, in contrast with Ryan and colleagues' results, the current study did not find a relationship between social motivation for physical activity and adherence throughout the transition to college. While reported barriers in this study were similar to those reported in adolescent samples, they are distinct from those reported in adult and elderly populations, which include physical health problems, fear of injury, past sedentary lifestyle, and a lack of understanding of physical activity (Dwyer et al., 2006; Gyurcsik et al., 2006; Chen, 2010). These findings suggest that college may provide an opportunity for intervention before new barriers to physical activity including frailty, injury, and illness arrive.

Some study findings were unexpected. Perhaps most unexpectedly, gender was a significant predictor of group membership; female undergraduates were twice as likely to belong to the ED group. Female undergraduates may deserve special consideration,

especially considering previous findings that physical activity reduces the risk of depression in females (Jerstad, Boutelle, Ness, & Stice, 2010). Furthermore, research suggests that physical activity is particularly important for weight maintenance in female college freshman, so maintaining established levels may prevent overweight and obesity in this vulnerable group (Jung, Bray, & Ginis, 2008). Finally, we were surprised to find no group differences in depression or perceived stress. While previous research has suggested an inverse relationship between physical activity levels and depression symptomatology, the fact that all participants were meeting RDVs for exercise at baseline may have limited the study's ability any significant findings between CESD scores and exercise adherence. While physical activity is known to be associated with lower levels of hopelessness, depression, and suicidal behavior, study participants who did decrease their exercise levels over the 12-week study may not have experienced a deterioration in their mental health within the short window during which data was collected, hence depression and stress scores were not significant predictors of group membership in this study (Talafiero, Rienzo, Pigg, Miller, & Dodd, 2009). Furthermore, mean scored on the CESD were generally low in both groups; perhaps physical activity reported at baseline had a protective effect in terms of self-reported depression throughout the course of the study.

Participants indicated that they would be most interested in physical activity programs incorporating the use of a personal trainer, followed by group exercise classes such as Zumba® or Spinning. Previous physical activity interventions with college students have typically relied on self-instruction manuals or been delivered via the internet, presumably to control costs and ensure ease of use (Magoc, Tomaka & Bridges-

Arzaga, 2011; Woods, Mutrie & Scott, 2002). Future interventions incorporating some face-to-face contact, such as an individual in-person training component or group classes with a social component may be popular with college students and improve physical activity levels.

Our findings add to the growing literature highlighting the importance of motivation type on health behavior maintenance. However, this study had considerable limitations as well. Diversity was severely limited in the sample, however it is representative of the general university population; future research with a more ethnically diverse sample would further inform future interventions and also may reveal group differences based on race as well. Second, while the study's finding regarding the importance of autonomous motivation is consistent with SDT theory, since it was not an intervention, it did not explore how increasing autonomous motivation in individuals may impact exercise adherence. Previous literature on interventions targeting autonomous motivation levels indicates that this can be done so successfully and that doing so has a positive impact on health behaviors, including weight management and smoking cessation (Williams et al., 2006a; Silva et al., 2010). Third, this study did not examine changes in psychosocial variables over time, but rather considered how baseline scores predicted outcomes. A study focused on changes in depression and stress scores over time may reveal more than baseline scores alone in terms of their influence on physical activity levels. Finally, and perhaps most importantly, another limitation in this study is its reliance on self-report measures of both weight and physical activity. Decreases seen in self-reported physical activity could represent a regression to the mean, or perhaps less concern regarding social desirability at follow-up than at baseline. College students with

low autonomous motivation for physical activity represent a vulnerable group who may benefit from future intervention studies.

In conclusion, study findings suggest that there is a significant drop-off in physical activity levels in young adults in their first semester of college among those who were already active at or above RDV. This study found several important predictors of exercise adherence. Namely, autonomous motivation and gender predict exercise maintenance during the first semester of college, and females are at the greatest risk for discontinuing those healthy habits that they were engaging in when they began college. Students expressed interest in many types of physical interventions that may be feasible to conduct on a college campus. Regardless of the form they take, interventions focused on increasing autonomous motivation levels in college students, as well as those tailored to female freshman could have a significant impact on the health and weight of this vulnerable population.

Table 1

Motivation and Competence Variables: Correlations (n = 174)

Variables	1	2	3	4	5	6	7	8
1. TSRQ: Autonomous Motivation	–							
2. TSRQ: Controlled Motivation	.466**	–						
3. MPAM: Interest/Enjoyment	.349**	-.082	–					
4. MPAM: Competence	.414**	.013	.744**	–				
5. MPAM: Appearance	.400**	.547**	-.046	.049	–			
6. MPAM: Fitness	.557**	.192*	.414**	.460**	.511**	–		
7. MPAM: Social	.198*	.210**	.365**	.323**	.004	.140	–	
8. Perceived Competence Scale	.401**	.022	.385**	.413**	.025	.273**	.086	–

Note: $*p < .05$. $**p < ..01$.

Table 2

Baseline Characteristics of Groups

	Participants (n = 174)					
	Exercise Maintainers (n = 125)			Exercise Decreasers (n = 49)		
Variables	N (%)	M	SD	n(%)	M	SD
Demographics						
Male	59 (47.2)	-	-	15 (30.6)	-	-
White, Non-Hispanic	105 (84)	-	-	44 (89.9)	-	-
Black or African-American	3 (2.4)	-	-	1 (2.0)	-	-
Native American	1 (.08)	-	-	0 (0.0)	-	-
Asian or Pacific Islander	11 (8.8)	-	-	2 (4.1)	-	-
Latino, Hispanic, Mexican American	4 (3.2)	-	-	2 (4.1)	-	-
Other	1 (.08)	-	-	0 (0.0)	-	-
Age	-	18.25	.85	-	18.06	.43
Body Mass Index (kg/m^2)	-	22.8*	3.0	-	21.9	2.4
Physical Activity						
Average Minutes of Physical Activity per Week at Baseline	-	304.6*	162.3	-	240.4	175.2
Psychosocial Variables						
CESD score	-	11.2	9.7	-	12.8	8.9
PSS score	-	5.1	3.1	-	5.5	2.7
SDT-related variables						
MPAM: Interest/Enjoyment	-	38.1**	7.0	-	34.3	7.5
MPAM: Competence	-	37.1**	8.2	-	33.1	9.4
MPAM: Appearance	-	33.8	6.4	-	34.6	6.4
MPAM: Fitness	-	30.4	3.9	-	29.0	3.8
MPAM: Social	-	19.9	6.9	-	20.7	6.4
PCS Score	-	5.8**	1.2	-	5.2	1.2
TSRQ: Autonomous Motivation	-	33.2*	6.2	-	31.2	5.8
TSRQ: Controlled Motivation	-	21.2	7.5	-	22.4	8.1
TSRQ: Amotivation	-	7.0	3.0	-	7.2	3.0

Note: *$p < .05$. **$p < .01$

Table 3

Summary of Logistic Regression Analyses for Variables Predicting Group Membership (n = 174)

	Exercise Decreasers (n = 49)		
Predictor	B	SE B	e^B
Exercise Decreasers			
Gender	.773*	.397	2.167
Age	-.331	.442	.718
Race/Ethnicity	-.102	.185	.903
CESD Scores	.023	.277	1.002
Perceived Stress Scale Score	.053	.281	1.054
Controlled Motivation	.443	.244	1.558
Autonomous Motivation	-.569*	.230	.566
Constant	4.494		
χ^2	264.15		
df	7		

Note: $*p < .05$.

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