

**Is the Level of Weight Gain During College Freshmen's First Semester Related to  
Changes in the Regulation of Food, Strength Training, and Appearance  
Satisfaction, During the Second Semester?**

by

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A thesis submitted to the Graduate Faculty of  
Auburn University  
in partial fulfillment of the  
requirements for the Degree of  
Master of Science

Auburn, Alabama  
December 12, 2011

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## **Abstract**

Multiple studies have found that college students gain a significant amount of weight during their college career. The present study goes beyond measuring the amount of weight that college student gain, and identifies college students' responses to their levels of weight gain in the first semester of freshman year. Of the 542 (191 males; 350 females) freshmen recruited for this study, 340 (123 males; 217 females) gained weight during their first semester in college. During the second semester of college, students who had gained weight during the first semester increased their autonomous regulation of food and decreased their controlled regulation of food. Females increased the amount of time spent in strength training exercises whereas males decrease the amount of time spent in strength training exercises. Future research should focus on identifying the most effective weight management strategies so interventionists can focus their efforts and help students engage in healthy lifestyles that promote a healthy weight.

## **Acknowledgments**

The author would like to thank Dr. Margaret Keiley for her patience and guidance throughout the thesis process, as well as her committee members, Dr. Scott Ketring, and Dr. Jacquelyn Mize.

## Table of Contents

Abstract .....	ii
Acknowledgments .....	iii
List of Tables .....	vi
List of Figures .....	viii
Introduction .....	1
Literature Review .....	3
Weight Gain in College Students .....	3
Regulation of Food Consumption .....	6
Strength Training .....	9
Appearance Satisfaction .....	11
This Study .....	13
Research Questions .....	14
Method .....	15
Sample .....	15
Procedure .....	15
Measure .....	16
Analysis Plan .....	17
Results .....	19
Summary of Results .....	30

Discussion .....	32
Limitations .....	33
Strengths .....	34
Future Research .....	34
Conclusion .....	36
References .....	37
Appendix A: Regulation of Eating Behavior Scale (REBS) .....	40
Appendix B: Strength Training Items .....	47
Appendix C: Appearance Satisfaction Items .....	48
Appendix D: Tables .....	49
Appendix E: Institutional Review Board Approval Form .....	54

## List of Tables

Table 1. Univariate statistics for the all study variables: weight gain, and changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female, for the subset of college students who gained weight. 19	
Table 2. Pearson correlation coefficients for the study variables: weight gain, and changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female, for college students who gained weight. ....20	
Table 3. A taxonomy of fitted multiple regression models in which college freshman students' level of weight gain in the 1 <sup>st</sup> semester is related to changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, female, and the interaction between female and strength training, for college students who gained weight during the 2 <sup>nd</sup> semester. ....27	
Table 4. Univariate statistics for the study variables: weight gain, and changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female for college students who gained weight. ....49	
Table 5. Pearson correlation coefficients for the study variables: weight gain, and changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female for college students who had <u>no</u> weight gain or lost weight. ....49	

Table 6. A taxonomy of fitted multiple regression models in which college students level of weight gain during the 1 <sup>st</sup> semester is related to changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, female, the interaction between female and strength training, for college students who had <u>no</u> weight change or lost weight. ....	50
Table 7. Univariate statistics for the study variables: weight gain, and changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female for full sample of college students .....	51
Table 8. Pearson correlation coefficients for the study variables: weight gain, and changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female for full sample of college students .....	51
Table 9. A taxonomy of fitted multiple regression models in which college students levels of weight gain during the 1 <sup>st</sup> semester is related to changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, female, the interaction between female and strength training during the 2 <sup>nd</sup> semester, for the full sample of college students. ....	52
Table 10. T-test comparisons between college students who gained weight ( $N = 340$ ), and college students who had no weight change or lost weight ( $N = 202$ ), at time 1.....	53

## List of Figures

Figure 1. Conceptual Model: Weight gain related to changes in regulation of food consumption, strength training and appearance satisfaction: female as a moderating variable. ....	18
Figure 2. Relationship of weight gain with changes in strength training moderated by sex, controlling for their main effects and changes in autonomous regulation, controlled regulation, and appearance satisfaction (held at their mean). ....	24
Figure 3. Plot of weight gain related to change in autonomous regulation, at high and low values of controlled regulation, holding changes in strength training, appearance satisfaction, and sex at their mean. ....	25
Figure 4. Plot of weight gain related to change in controlled regulation, at high and low values of autonomous regulation, holding changes in strength training, appearance satisfaction, and sex at their mean. ....	26

## **Introduction**

Obesity has become a leading national public health concern due to the mounting evidence that it increases both morbidity and mortality. Obesity has been associated with an increased risk of insulin resistance, hypertension, dyslipidemia, cardiovascular disease, non-insulin-dependent diabetes mellitus, gallstones, cholecystitis, respiratory dysfunction, sleep apnea, chronic hypoxia, hypercapnia, degenerative joint disease, and certain forms of cancer (Pi-Sunyer, 1993).

The National Health and Nutrition Examination Survey (NHANES), a cross-sectional study on a representative sample of U.S. residents, reported that obesity prevalence doubled in adults aged 20 years or older between 1980 and 2002 (Ogden et al., 2006). In 1999-2002 the percent of overweight or obese participants exceeded 50% in almost every age and racial/ethnic group. Specifically, 65% of adults were classified as overweight or obese, and 5% were classified as extremely obese. The NHANES also indicated differences in overweight and obesity rates by age and sex. In the 20 to 29 year age group, 69% of men were classified as overweight and obese, and 62% of women were classified as overweight and obese. Additionally, 33% of women and 28% of men were classified as extremely obese (Hedley et al., 2004). The increased prevalence of obesity, combined with the severity of the consequences of being obese, has inspired more research focused on understanding weight gain across the lifespan.

Weight gain is a risk during any developmental period, but young adulthood is a particularly risky time because it is the age during which individuals differentiate from their family of origin. A majority of the existing research on weight gain during young adulthood focuses on quantifying the amount of weight that college students gain. This

may be because college students are easy to study and because, college students gain a significant amount of weight across their college careers, although they gain nowhere near the highly publicized “freshman 15” (Economos, Hildebrant, & Hyatt, 2008; Hajhosseini et al., 2006; Jung, Bray, & Ginis, 2008; Levitsky, Halbmaier, & Midjenovic, 2004). This literature also shows a discrepancy between the amount of weight gained by men and women; specifically men gain more weight, on average, than do women. (Hoffman et al., 2006; Mihalopoulos et al., 2008; Racette et al., 2008).

The present study will add to the existing literature by examining whether or not changes college students make to their behaviors following weight gain during the first semester of their freshman year. We hypothesize that weight gain during a college student’s first semester will predict behavior changes during the second semester. Specifically, we predict that weight gain during the first semester of college will predict increases in -regulation of food consumption, strength training, and appearance satisfaction. If an association does exist we will assess whether this association is moderated by sex.

## **Literature Review**

### ***Weight Gain in College Students***

The “Freshman 15” is a well known concept that refers to the belief that college students gain an average of 15 pounds during their freshmen year of college. Although this concept is accepted by a majority of Americans, college students gain nowhere near 15 pounds (Graham & Jones, 2002; Hodge, Jackson, & Sullivan, 1993; Mihalopoulos, Auinger, & Klein, 2008). Graham and Jones (2002) examined a sample of 81 volunteers (65 women; 16 men) to determine whether freshmen’s reported weight gain during their first year of college was perceived weight gain or actual weight gain. Time 1 data included measurements of body fat and weight, and a questionnaire that included the Eating Attitudes Test, and the Body Shape Questionnaire. Sixty-two percent of the original participants (39 women; 10 men) returned at the end of the academic year to complete the same measurements at time 2. On average, college students lost 1.5 pounds during their freshmen year of college, although they believed they had gained an average of 4.1 pounds (Graham & Jones, 2002). This misperception by students could contribute to spreading the myth of the “Freshman 15.” Although this study concluded that, on average, college freshmen lost weight many other studies dispute this finding.

Jung et al. (2008), Economos et al. (2008), Hajhosseini et al. (2006), and Levitsky et al. (2004), found significant weight gain among college students. Mihalopoulos et al. (2008) reported that weight gain in the general population is, on average, .07 pounds per month; however, college students gain approximately 6 times this amount, which is equal to approximately .39 pounds per month.

Jung et al. (2008) examined weight change over the first year of college. A total of 133 female volunteers, participated in this study. To be eligible for this study the participants had to be 18-19 years of age, live on campus, be a first-year student, and self-report that they did not have a hormonal or eating disorder. Seventy-six percent of the participants completed the study that included measurements at baseline, 8 weeks, 25 weeks, and 52 weeks later. The results of this study found that, on average, students gained 3.08 pounds ( $SD = 8.35$ ) (Jung et al., 2008).

In 1998 a private east coast university began a longitudinal health study to follow the health and behaviors of undergraduate students. Economos et al. (2008) used these data to examine freshmen weight change. For this study the data were collected from August 2000 until April 2005. A total of 396 freshmen (66% female) completed a 40-item health behavior survey. Height and weight were collected by self-report and measurements obtained in the lab, at baseline (July/August) and during the follow up (April). The results of this study found that, on average, students gained 5.3 pounds over the year, with 80% of the students gaining weight (Economos et al., 2008).

Hajhosseini et al. (2006) documented changes that occur in body weight in newly enrolled college freshmen. A convenience sample of 27 first-year male ( $n = 5$ ) and female ( $n = 22$ ) students attending San Jose State University were selected to complete a 16 week longitudinal study. Weight was measured during the initial visit, between weeks 7 and 8, and finally between weeks 14 and 16, using a dual-beam balance scale during each session. On average, students gained 3.0 pounds over the 16 week period (Hajhosseini et al., 2006).

Levitsky et al. (2004) designed their study to quantify weight gain of college freshmen at Cornell University across the first 12 weeks of their first semester. Sixty-eight students (51 females; 9 males) were recruited from two large introductory classes entitled Human Development and Nutrition and Health, and Concepts and Controversies. Each participant was weighed at the beginning of their first semester with a digital scale. Eighty-eight percent of the participants completed a second measurement 12 weeks later at the end of their first semester of college. On average, college freshmen gained 4.2 pounds over the 12 weeks (Levitsky et al., 2004).

Hoffman et al. (2006) examined 217 freshmen students attending Rutgers University. Sixty-seven of the original 217 freshmen completed the study (35 female; 32 male). Each participant had previously participated in a college-wide health assessment during the last three weeks of September during which their weight was assessed. Following this study Hoffman et al. (2006) contacted the participants by e-mail to participate in the “Freshman 15” study. Sixty-seven (53% female) of the participants were scheduled for a second measurement during the last 2 weeks of April. Participant’s weight was measured using a digital scale. On average, college students gain 2.86 pounds during their freshman years. Of the students who gained weight ( $n = 49$ ), on average, men gained 7.7 pounds and women gained 5.9 pounds (Hoffman et al., 2006).

Racette et al. (2008) also examined weight gain in college students. A total of 204 students (68% female; 32% male) enrolled in either the freshmen class of 1999 (Cohort 1), or the freshmen class of 2000 (Cohort 2), completed assessments at two time points. The first assessment was administered during the first two weeks of the participant’s fall semester freshman year. The second assessment was administered

during the last two to three weeks of spring semester senior year. On average, college students gained 5.5 pounds across the four years that they attend college. Men on average, gained 9.26 pounds and women gain 3.8 pounds on average.

Although there have been a few inconsistent studies, the findings from the majority of the research indicate that college students on average gain weight more quickly than members of the general population. Additionally, men, on average, gain more weight than women. One consistent limitation across the literature is the size and demographics of the analytical samples. Most of the studies use very small samples, consisting entirely of females, or primarily of females with a very small percentage of male participants. We hypothesize that we will be able to replicate these findings using a larger more diverse sample size. Additionally, we hypothesize that students, in response to their weight gain, may engage in weight management strategies to prevent further weight gain. Two common weight management strategies include changes in the regulation of food consumption, and strength training.

### ***Regulation of Food Consumption***

Self-determination theory (SDT; Deci & Ryan, 2008) has been used in the research on weight gain to understand how individuals regulate their food consumption. SDT is an empirically based theory that has been used to understand human motivation. Deci and Ryan, the originators of SDT identified two types of motivation; autonomous motivation and controlled motivation. They proposed that the type of motivation is more important than the total amount of motivation when determining human behavior, and years of research support this proposition (Deci & Ryan, 2008).

Autonomous motivation, also known as autonomous regulation when referring to behavioral regulation, refers to an individual's behavior that is motivated by personal interest, values, or physical well-being. Controlled motivation, also known as controlled regulation when referring to behavioral regulation, refers to an individual's behavior that is motivated by rewards or punishments from an external source. When applied to an individual's dietary intake, individuals who use autonomous regulation will base their dietary decisions on their personal values and personal well-being. On the other hand, individuals who use controlled regulation will base their dietary decisions on external messages, and their desire to gain approval from others (Deci & Ryan, 2008; Ryan & Deci, 2000).

Pelletier, Dion, Slovinec-D'Angelo, and Reid, (2004) examined autonomous and controlled regulation as it relates to eating behaviors. Pelletier et al. (2004) proposed that autonomous regulation of dietary consumption should be related to healthy eating patterns, and that controlled regulation of dietary consumption should be associated with dysfunctional eating patterns. Healthy eating behaviors were measured using the Healthy Eating Behavior Scale, which asked participants to respond on a 5-point Likert scale to questions such as "I eat vegetables, fruits and grain products," "I eat a variety of foods from each of the four groups recommended by the Canadian Food Guide," and "I drink water." Dysfunctional eating patterns were measured using the Bulimic Symptomatology, which consists of 28 items that are used to identify participants who are most likely to be diagnosed as bulimic. To test this hypothesis a total of 339 female students were recruited from different courses throughout the University of Ottawa. The average age of the participants was 22.5 years old, ranging from 17 to 49 years. The results of this study

confirmed the author's hypothesis; autonomous regulation is positively associated with healthier eating behaviors, and controlled regulation is positively associated with dysfunctional eating behaviors (Pelletier et al., 2004). Although autonomous and controlled eating regulation have been linked to healthy and dysfunctional eating behaviors, there are only a few studies that look at changes in autonomous and controlled regulation of food and weight. The studies that have been conducted focus on understanding weight loss by taking a closer look at both eating regulation and physical activity and how they influence weight loss.

Williams, Grow, Freedman, Ryan, and Deci (1996) followed 128 (73% female) severely obese participants through a 26-week low calorie weight loss program and found that higher autonomous motivation not only predicted higher weight loss, but also predicted maintenance of the weight loss almost two years later (Williams et al., 1996). Autonomous regulation may predict greater weight loss, and maintenance of weight loss by helping individuals make changes to their diets, but it may also enable individuals to increase the amount exercise in their routines.

Mata et al. (2009) examined the interaction of eating regulation and exercise on a motivational and behavioral level. Specifically, they hypothesized that (1) general treatment, and exercise-specific self-determination, and motivation are associated with eating self-regulation, and that (2) physical activity is associated with eating self-regulation, and these effects are mediated by self-determination, treatment motivation, and exercise-specific motivation. To test this hypothesis Mata et al. (2009) conducted a randomized controlled trial of overweight and obese women, focusing on increasing exercise self-motivation, and exercise adherence, in hopes of improving long-term weight

control. A total of 258 women attended weekly or biweekly sessions for approximately one year. The participants were, on average, 38 years old ranging between 23 and 50 years old, and they were overweight or mildly obese. The results of this study confirmed the author's hypothesis. Self-determination and autonomous exercise motivation do predict autonomous eating regulation over one year, and this relationship is mediated by self-determination, treatment motivation, and exercise-specific motivation. This suggests that exercise and eating regulation may equally influence each other, when autonomous and controlled regulation is taken into account (Mata et al., 2009).

The results of these studies indicate that autonomous regulation is associated with healthy eating behaviors, weight loss, and weight maintenance, and controlled regulation is associated with dysfunctional eating behaviors. Additionally, eating regulation and exercise may have a bidirectional relationship. Therefore, an increase in autonomous regulation of food following weight gain may play an important role in college students' ability to manage their weight. However, it will be important in later studies to take a closer look at the possible bidirectional relationship between exercise and eating regulation to determine the effects of autonomous regulation on weight management.

### ***Strength Training***

One important form of exercise highlighted by the American College of Sports Medicine as a significant part of a well rounded exercise program is strength training (Harne & Bixby, 2005). Both psychological and physiological benefits have been associated with regular strength training exercises. The psychological benefits include improved self-esteem, self-concept, and body image. The physiological benefits include increased muscular strength, decreased age-related losses of bone mineral density,

decreased body fat, and lean body mass (Harne & Bixby, 2005). Although strength training has several positive benefits, including weight management, and increased body satisfaction, in 2010 only about 65% of college students reported that they participated in strength training exercises at least twice per week (Mack, Wilson, Lightheart, Oster, & Gunnell, 2009). Additionally, there is a clear sex distinction in the strength training literature. Men are more likely to participate in strength training to gain muscle particularly from the “waist up” (arms, chest, back, and abdomen), whereas women are more likely to participate in strength training to lose weight from the “waist down” (hips, thighs, and buttocks) (Ridgeway & Tylka, 2005). Although men and women participate in strength training exercises for different reasons the benefits are the same.

Williams and Cash (2001) examined the benefits of strength training for both men and women. A total of 39 participants (27 women; 12 men) were recruited from a 6-week strength training class at a large mid-atlantic university. A control group of 64 students from the same population were also recruited for this study. This study found significant increases in physical strength. In fact upper body strength increased by 16%, and lower body strength increased by 29% for the experimental group. Additionally, participants reported improvements in their physical appearance and body satisfaction, a decrease in social physique anxiety, and an increase in self-efficacy. These changes were significantly greater in the experimental group than in the control group (Williams & Cash, 2001).

Ahmed, Hilton, and Pituch (2002) also examined the benefits of strength training. A total of 49 female students from a 4-year mid-western college participated in the study. The participants were 20 years old, on average, with an average weight of 139 pounds.

Each participant attended two weekly, 50 minute, strength training classes for 12 weeks. On average, participants increased strength, and 98% of the participants reported feeling healthier with an improved body image (Ahmed et al., 2002).

The results from these studies indicate that men and women engage in strength training exercises for different reasons. Men engage in strength training exercises to gain weight, where women engage in strength training exercises to lose weight. These studies did not demonstrate a direct link between weight management, autonomous and controlled regulation, and strength training, but from the research previously reviewed it may still be a valid hypothesis. It was surprising, however, to find all of the studies linked strength training to an improved body satisfaction, or body image. Ahmed et al. (2002) defined body image as “the mental picture of the physical self, with feelings about this image being based on cultural ideals” (p.645). This is important because American’s cultural ideals, particularly for women, include a very low body weight. Therefore weight gain may contribute to a decrease in college students’ appearance satisfaction. On the other hand positive changes in the regulation of food consumption, and strength training, may lead to an increase in appearance satisfaction over time.

### ***Appearance Satisfaction***

As previously discussed, Williams and Cash, (2001) and Ahmed et al. (2002) identified a positive association between strength training and body satisfaction. Sira and White, (2010) defined body satisfaction and body image as “a multifaceted, structural concept that is dependent upon inner biological and psychological components and established as an important aspect of self-esteem and mental health across the lifespan” (Sira & White, 2010). They have also been able to link body dissatisfaction and

psychological problems such as, depression, low self-esteem, and eating disorders, has been well documented (Sira & White, 2010). Sira and White, (2010) found in a sample of 299 (52% female) college students, that underweight females reported higher body satisfaction, and underweight and overweight men reported lower body satisfaction. When women have body dissatisfaction they are more likely to try to lose weight. In contrast, men with body dissatisfaction want to bulk up by increasing muscle (Sira & White, 2010). This could explain why women may be more likely to use strength training to lose weight, and why men are more likely to use strength training to gain weight.

Additionally, Autonomous regulation of eating has also been found to have a positive impact on body dissatisfaction. Pelletier and Dion (2007) hypothesized that autonomous regulation of eating behaviors is associated with healthy eating behaviors, and body satisfaction. A total of 447 female students, with an average age of 22.5, participated in this study. Like Pelletier et al. (2004), this study used the Healthy Eating Habits Scale to measure healthy eating behaviors, and the Dysfunctional Eating scale to measure dysfunctional eating behaviors. Autonomous regulation was positively associated with healthy eating behaviors ( $\beta = .82, p = .01$ ) and controlled regulation was positively associated with dysfunctional eating behaviors ( $\beta = -.14, p = .01$ ). Also, both autonomous regulation ( $\beta = .14, p = .01$ ,) and controlled regulation ( $\beta = .74, p = .01$ ) of eating behaviors were associated with body satisfaction (Pelletier & Dion, 2007).

As previously discussed appearance satisfaction is associated with strength training, and the results of these studies indicate that it is also associated with autonomous and controlled regulation of food. Specifically increased autonomous

regulation and strength training are associated with an increase in appearance satisfaction. Weight is also associated with appearance satisfaction for women. Therefore, college students' response to weight gain may have a significant impact on their appearance satisfaction.

If college students are unable to make changes to their eating and exercising patterns following weight gain, and instead continue to gain weight across their lifespan, they will not only be at risk for the problems associated with obesity but they may also be at risk for low body satisfaction and the problems associated with low body satisfaction.

### ***This Study***

Previous research has demonstrated that, on average, college students gain weight more quickly than non-college students of the same age group (Mihalopoulos et al., 2008). In attempts to manage their weight college students may increase their autonomous regulation of diet which is associated with healthy eating behaviors, weight loss, and weight maintenance, and decrease their controlled regulation of diet that is associated with dysfunctional eating behaviors. Additionally, female college students may increase their strength training exercises which may lead to an improved body satisfaction, or body image, where male college students may decrease their strength training exercises.

For the current study, our goal is to examine college student's response to weight gain. Specifically, are the changes that college students make in the regulation of food consumption, strength training, and appearance satisfaction related to the level of weight gain during their first semester? If an association does exist between weight gain and changes in the regulation of food consumption, strength training, and appearance

satisfaction, we will assess whether this association is moderated by sex. Our central goal is to contribute to the existing research on weight gain in college students by identifying college students' response to weight gain.

### ***Research Questions***

The research questions for the current study are as follows: (1) Is weight gain during 1<sup>st</sup> semester freshmen year related to changes in autonomous and controlled regulation of food consumption, strength training, or appearance satisfaction during the second semester? And (2) are these relationships moderated by sex?

## **Method**

### ***Sample***

A total of five hundred and forty-two (191 males; 350 females) freshmen students were recruited each August for two years in a four year sequential cohort longitudinal design. Each cohort was recruited from the freshman class at Auburn University. Participants were recruited by an advertisement that was distributed to students during orientation (Camp War Eagle) for incoming students and their parents. To encourage participation a stipend of \$70 to \$85 per year was given to each participant. Entering freshmen between the ages of 17 and 19 were eligible to participate. Exclusion criteria included being pregnant, married, having children, and having a diagnosed eating disorder. For this study, the analytic sample is the 340 students (123 males; 217 females) who gained weight during the first semester in college.

### ***Procedure***

After participants agreed to participate in the study, they received an email with details for scheduling and preparing for their appointment. Following data collection at each time point, an email was sent thanking each participant for his/her participation, and detailing when they could expect to be contacted again for further participation.

Each year data were collected at three time points (August, December, and May). Physical assessments were collected during lab sessions, and the demographic, behavioral, environmental, and psychological measures were collected using [www.surveymonkey.com](http://www.surveymonkey.com). The surveys were accessible to each participant from either a personal or a university computer.

## ***Measures***

Weight Change is defined as the difference in a participant's weight in August (T1) and December (T2). Weight was measured using either a HealthoMeter, Model 500KL, or the Pelstar LLC, Bridgeview, IL, scale. Participants were weighed wearing light clothing (shorts and t-shirt) without shoes.

Change in Regulation of Food is defined as the difference in a participant's response to the Regulation of Eating Behavior Scale (REBS) (Pelletier et al., 2004) in December (T2) and May (T3). REBS was used to measure autonomous regulation and controlled regulation of food. A series of 23 statements were answered on a 7-point Likert scale with responses ranging from, (1) "Does not correspond at all" to (7) "Corresponds exactly." To measure autonomous regulation, participants will respond to statements such as "I take pleasure in fixing healthy meals," "Eating healthy is an integral part of my life." This scale has a Cronbach Alpha of  $\alpha = .89$ . To measure controlled regulation, participants responded to statements such as, "I would be humiliated if I was not in control of my eating behaviors," and "I don't want to be ashamed of how I look" (see Appendix A). The Cronbach's alpha for this scale is  $\alpha = .79$  (Pelletier et al., 2004).

Change in Strength Training is defined as the difference in a participant's response to the strength training items on the behavioral and environmental assessment in December (T2) and May (T3). Strengthening exercises include activities such as push-ups, sit-ups, or weight lifting. Participants were asked to report: "How many days per week do you participate in strengthening exercises?" and "On days that you do strengthening exercises, how many minutes per day do you spend doing the strengthening exercises." From these questions the strength training measure was calculated by

multiplying the minutes per day the participant spent doing strength training exercises by the days per week the participant spent doing strength training exercises. This allowed each participant to have a score that represented how many minutes per week that they spent doing strength training exercises (see Appendix B).

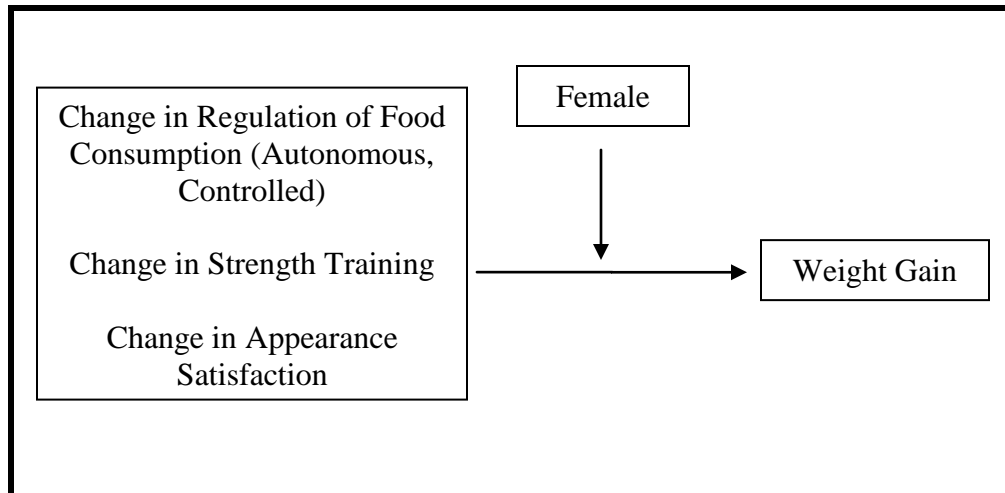
Change in Appearance Satisfaction is defined as the difference in a participant's response to the overall appearance item on the Multidimensional Body-Self Relations Questionnaire (MBSRQ; Cash, 2000), in December (T2) and May (T3). Participants were asked to indicate how satisfied they were with their appearance using a 5-point Likert scale ranging from (1) "Very Dissatisfied" to (5) "Very Satisfied" (see Appendix C).

Sex is defined as the participant's biological sex. Females were coded as 1 and males were coded as 0 to create the variable female.

### ***Analysis Plan***

First we conducted the appropriate univariate and bivariate preliminary analyses to examine the distributions and central tendencies of each variable, and the relationships among them. Next, to test the proposed hypotheses, we fit a series of nested multiple regression models that regressed weight gain on change in regulation of food consumption (autonomous and controlled), change in appearance satisfaction, change in strength training, and female (see Figure 1). In addition, we examined differences between those who gained weight and those who did not, by examining univariate, bivariate, and multivariate analyses for those who did not gain weight or lost weight, and for the entire sample.

Figure 1. Conceptual Model: Weight gain related to changes in regulation of food consumption, strength training and appearance satisfaction: female as a moderating variable.



## Results

We used the Statistical Analysis System (SAS) for analysis. First we created the analytical sample, which included all of the participants who had weight gain greater than zero from time 1 (August) to time 2 (December). Three hundred and forty participants gained an average of 4.28 pounds, ranging from 0.20 pounds to 19.58 pounds ( $SD = 3.23$ ). Inspection of the schematic plot shows that the distribution was skewed. Therefore the outcome variable, weight gain, was logged to create a symmetric distribution. Next we created the predictor variables as change score by subtracting time 3 (May) scores from time 2 (December) scores. On average, autonomous regulation increased ( $M = .03$ ,  $SD = 2.24$ ), controlled regulation decreased ( $M = -.04$ ,  $SD = 2.40$ ), strength training increased ( $M = 5.57$ ,  $SD = 66.34$ ), and appearance satisfaction decreased ( $M = -.01$ ,  $SD = .61$ ) (see Table 1).

Table 1. Univariate statistics for the study variables: weight gain, and changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female, for the subset of college students who gained weight.

Variables	N	Mean	SD	Range
Weight Gain	340	4.28	3.23	.20 – 19.58
Weight Gain (logged)	340	1.11	0.93	-1.61 – 2.97
Autonomous Regulation	297	.03	2.24	-7.5 – 6.5
Controlled Regulation	297	-0.04	2.40	-7.25 – 8.42
Strength Training	303	5.57	66.34	-270 – 240
Appearance Satisfaction	296	-.01	.61	-3 – 3
Female	340	.64	.48	0 - 1

\* $p \leq .05$ . \*\* $p \leq .01$ . \*\*\* $p \leq .001$ .

Next, correlational analyses were conducted to examine the relationship between variables. This analysis uncovered three significant relationships. First, changes in autonomous regulation and weight gain (logged) are positively related ( $r = 0.13, p \leq .05$ ). This means that students who gained more of weight during their first semester, selected ways of regulating their eating during the second semester that were more consistent with their personal interest, values, and physical well-being, whereas those who gained less weight, did not. Second, changes in controlled regulation and weight gain (logged) are negatively related ( $r = -0.13, p \leq .05$ ). This means that students who gained more weight during their first semester, did not select ways of regulating their eating during the second semester, based on external messages received from family, peers, or the media, while those who gained less weight, did, and vice versa. Third, female and weight gain (logged) are negatively related ( $r = -0.12, p \leq .05$ ). This means that on average, males gained more weight than females.

This analysis also revealed that neither strength training nor appearance satisfaction was significantly related to weight gain. This means that college students who gained weight during their first semester, did not increase or decrease their strength training exercises or appearance satisfaction during the second semester (see Table 2).

Table 2. Pearson correlation coefficients for the study variables: weight gain, and changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female, for college students who gained weight. ( $N = 293$ )

Variables	Weight Gain	Autonomous Regulation	Controlled Regulation	Strength Training	Appearance Satisfaction	Female
-----------	-------------	-----------------------	-----------------------	-------------------	-------------------------	--------

	(logged)					
Weight Gain (logged)	-					
Autonomous Regulation	.13*	-				
Controlled Regulation	-.13*	.05	-			
Strength Training	-.07	.02	-.03	-		
Appearance Satisfaction	.01	-.03	-.09	.03	-	
Female	-.12*	.00	.07	.11	-.00	-

\* $p \leq .05$ .

Following the univariate and bivariate analyses, we fit a series of 6 nested multiple regression models. Hypothesis 1 is tested in models 1-4, in which weight gain (logged) first semester is regressed on changes in the regulation of food consumption (autonomous and controlled), strength training, and appearance satisfaction, during the second semester. Hypothesis 2 is tested in models 5 and 6, in which weight gain (logged) first semester, is regressed on changes in the regulation of food consumption (autonomous and controlled), strength training, appearance satisfaction, female, and the interaction between female and strength training, during the second semester (see Table 3).

In model 1 a statistically significant linear relationship exists between weight gain (logged) during the 1<sup>st</sup> semester and changes in autonomous regulation during the 2<sup>nd</sup> semester, ( $\beta = .06$ ,  $t = 2.32$ ,  $p = .02$ ). For every one unit difference in change in autonomous regulation during the 2<sup>nd</sup> semester, a .06 increase existed in weight gain. Autonomous regulation predicts 2% of the variability in weight gain (see Table 3). This means that students who gained more weight during the first semester, selected ways of

regulating their eating during the second semester that coincide with their own interest, values, and physical well-being, while those who gained less weight, did not.

In model 2 a statistically significant linear relationship exists between weight gain (logged) during the 1<sup>st</sup> semester and changes in controlled regulation during the 2<sup>nd</sup> semester, ( $\beta = -.05$ ,  $t = -2.46$ ,  $p = .01$ ), controlling for changes in autonomous regulation. For every one unit difference in change in controlled regulation a .05 decrease in weight gain exists, controlling for changes in autonomous regulation. Taken together, changes in autonomous regulation and controlled regulation, predict 4% of the variability in weight gain (see Table 3). This means that on average, college students who gain more weight during their first semester of college showed a greater decline in the amount that external messages received from family, peers, or the media, influenced their dietary decisions, while those who gained less weight, showed less decline, controlling for changes in autonomous regulation.

In model 3 changes in strength training was not significantly related to weight gain ( $\beta = -.001$ ,  $t = -1.36$ ,  $p = .18$ ), controlling for changes in autonomous regulation and controlled regulation. However, change in strength training was retained in the model because it is a significant component of the research questions for this study. Taken together changes in autonomous regulation, controlled regulation, and strength training, predict 4% of the variability in weight gain (see Table 3).

In model 4 change in appearance satisfaction was not significantly related to weight gain ( $\beta = -.001$ ,  $t = -.01$ ,  $p = .99$ ), controlling for changes in autonomous regulation, controlled regulation, and strength training. However, change in appearance satisfaction was retained in the model because it is a significant component of the

research questions for this study. Taken together changes in autonomous regulation, controlled regulation, strength training, and appearance satisfaction predict 4% of the variability in weight gain (see Table 3).

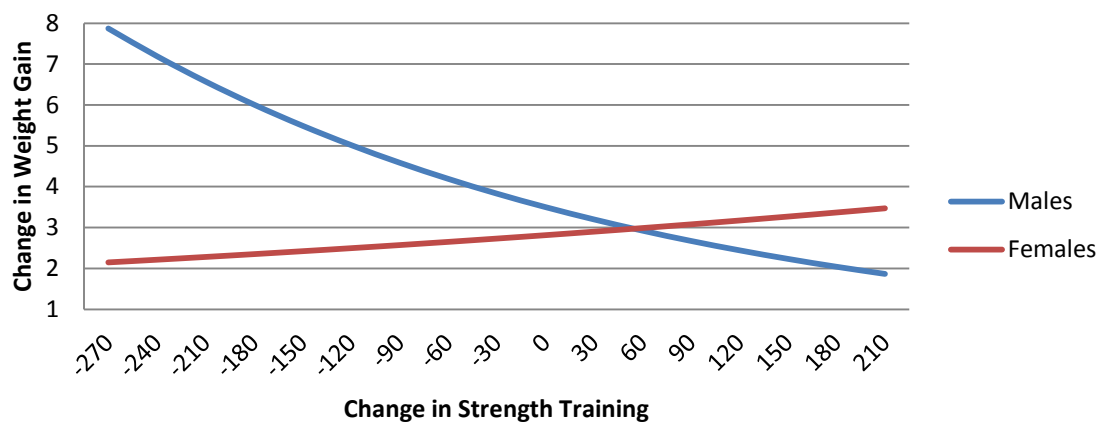
In model 5 female was not significantly related to weight gain ( $\beta = -.20$ ,  $t = -1.84$ ,  $p = .07$ ), controlling for changes in autonomous regulation, controlled regulation, strength training, and appearance satisfaction. However, female was retained in the model because it is a significant component of the research questions for this study. Taken together autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female, predict 6% of the variability in weight gain (see Table 3).

In model 6 a statistically significant linear relationship exists between weight gain (logged), and the interaction between female and changes in strength training ( $\beta = .004$ ,  $t = -2.02$ ,  $p = .04$ ), controlling for female and changes in autonomous regulation, controlled regulation, strength training, and appearance satisfaction. Taken together, changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, female, and the interaction between female and changes in strength training, predict 8% of the variability in weight gain (see Table 3).

Examination of the plot looking at the relationship of weight gain with changes in strength training moderated by sex, controlling for their main effects and changes in autonomous regulation, controlled regulation, and appearance satisfaction (held at their mean), shows that sex influences which college students increase strength training exercises following weight gain, and which students decrease strength training exercises following weight gain. Males who gained more weight during their first semester decreased the amount of time they spent participating in strength training exercises,

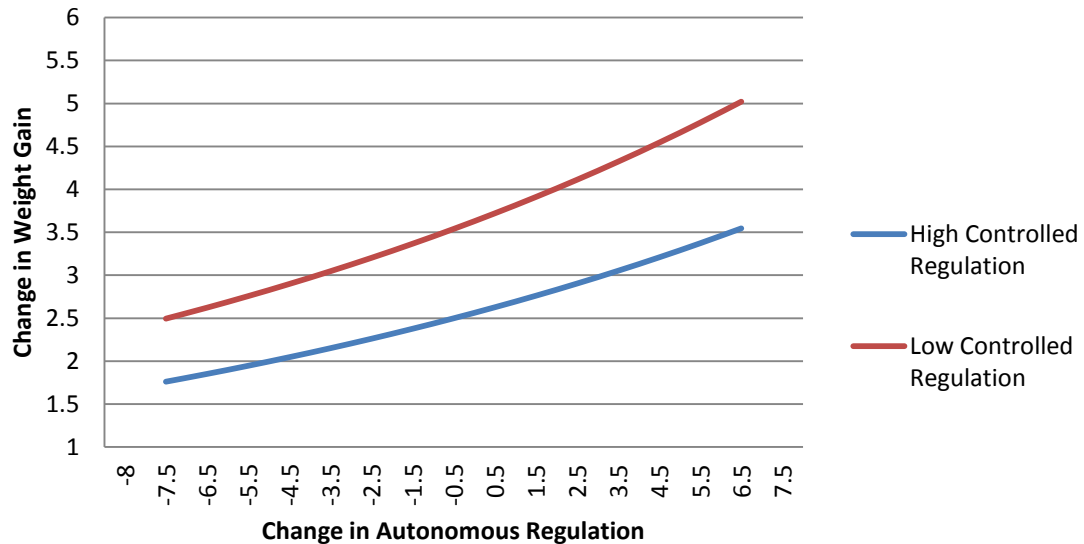
where females who gained higher amounts of weight during their first semester increased the amount of time that they spent participating in strength training exercises (see Figure 2).

Figure 2. Relationship of weight gain with changes in strength training moderated by sex, controlling for their main effects and changes in autonomous regulation, controlled regulation, and appearance satisfaction (held at their mean).



Examination of the plot looking at weight gain related to change in autonomous regulation, at high and low values of controlled regulation from the final fitted model, shows that students who gained a lot of weight during the first semester selected ways of regulating their eating during the second semester that coincide with their own interest, values, and physical well-being. Those who gained less weight were less likely to select ways of regulating their eating during the second semester that coincide with their own interest, values, and physical well-being (see Figure 3). But, those with low levels of controlled regulation had gained, on average, a larger amount of weight during the first semester than did those with high levels of controlled regulation.

Figure 3. Plot of weight gain related to change in autonomous regulation, at high and low values of controlled regulation, holding changes in strength training, appearance satisfaction, and sex at their mean.



Examination of the plot looking at weight gain related to change in controlled regulation, at high and low values of autonomous regulation, shows that students who gained more weight during the first semester, were less likely to select ways of regulating their eating during the second semester based on external messages received from family, peers, or the media. In contrast, those who gained less weight were more likely to select ways of regulating their eating during the second semester, based on external messages received from family, peers, or the media (see Figure 4). However, recall that those with higher autonomous regulation had gained more weight during the 1<sup>st</sup> semester, than had those with low autonomous regulation.

Figure 4. Plot of weight gain related to change in controlled regulation, at high and low values of autonomous regulation, holding changes in strength training, appearance satisfaction, and sex at their mean.

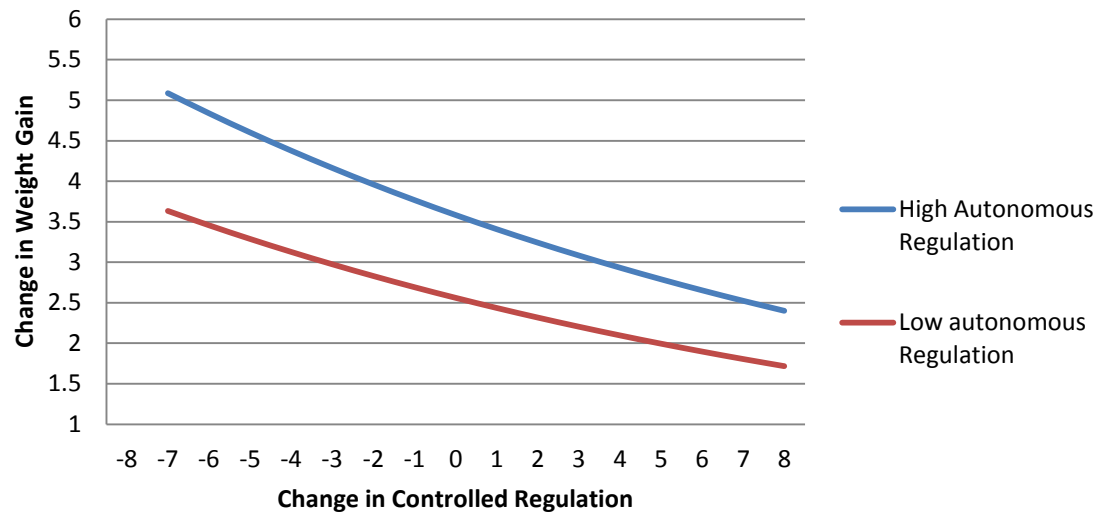


Table 3. A taxonomy of fitted multiple regression models in which college freshman students' level of weight gain in the 1<sup>st</sup> semester is related to changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, female, and the interaction between female and strength training, for college students who gained weight during the 2<sup>nd</sup> semester. ( $N = 293$ )

Model	Intercept (se)	Predictors					R <sup>2</sup>	
		Main Effects			Two-Way Interaction			
		Change in Autonomous Regulation (se)	Change in Controlled Regulation (se)	Change in Strength Training (se)	Change in Appearance Satisfaction (se)	Female (se)  Female and Change in Strength Training (se)		
M1	1.12*** (.05)	.06* (.02)						.02
M2	1.12*** (.05)	.06** (.02)	-.05** (.02)					.04
M3	1.12*** (.05)	.06** (.02)	-.06** (.02)	-.001 (.001)				.04
M4	1.12*** (.05)	.06** (.02)	-.06** (.02)	-.001 (.001)	-.001 (.09)			.04
M5	1.25*** (.09)	.06** (.02)	-.05** (.02)	-.001 (.001)	-.0004 (.09)	-.20 (.11)		.06
M6	1.25*** (.09)	.05* (.02)	-.05** (.02)	-.003** (.001)	-.01 (.09)	-.22* (.11)	.004** (.002)	.08

\* $p \leq .05$ ; \*\* $p \leq .01$ ; \*\*\* $p \leq .001$ .

To ensure these findings accurately reflected college students who gain weight, t-test were conducted to examine differences between the students who gained weight and the students who lost weight or had no weight change at Time 1 (August). In addition, univariate, and bivariate analysis was conducted and multiple regression models were fit, to ensure that the findings of this study are unique to college students who gained weight.

The results from the t-test found three statistically significant differences between college student who gained weight and college students who lost weight or had no weight change at Time 1. These included changes in appearance satisfaction ( $t = -2.63$   $p = .01$ ), changes in moderate activity ( $t = 2.08$   $p = .04$ ), and changes in self-evaluative salience ( $t = 2.27$   $p = .02$ ). Each of these variables may have contributed to the reason why some of the college students had no weight change during their first semester. But two of these variables were not part of this study, therefore, and the additional analysis below showed no differences (see Appendix D).

The results of the bivariate analysis found no significant relationship between changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, or female in college students who lost weight or had no weight change and the whole sample. In addition, the multiple regression models that were fit using the sample of college students who lost weight or had no weight change, were not significant. However, the multiple regression models that were fit using the full sample of college students found one significant relationship. In model 6 a statistically significant linear relationship existed between weight gain (logged) and the interaction between sex and changes in strength training ( $\beta = .01$ ,  $t = 2.04$ ,  $p = .04$ ), controlling for changes in

autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female (see Appendix D).

## ***Summary of Results***

*Hypothesis 1: Is weight gain during 1<sup>st</sup> semester freshman year related to changes in autonomous and controlled regulation of food consumption, strength training, or appearance satisfaction?* Results from Model 4 indicate that this hypothesis was partially supported. Weight gain during college students first semester was shown to be significantly associated with an increase in autonomous regulation of food and a decrease in controlled regulation of food. This means that on average, college students who gain more weight during their first semester of college were more likely to make dietary decisions based on their personal values and well being rather than external messages received from family, peers, or the media during their second semester of college, whereas those who gain weight, but less amounts of weight are more likely to make dietary decisions based on external messages received from family, peers, or the media, than their personal values and well being.

However, weight gain during college students' first semester was not significantly associated with a change in appearance satisfaction during their second semester of college, controlling for changes in autonomous regulation, controlled regulation, the interaction of sex and change in strength training, and sex. This means that on average, college students who gained weight during their second semester of college did not report any change in their appearance satisfaction following weight gain.

*Hypothesis 2: Are these relationships moderated by sex?* Model 6 indicates that this hypothesis was partially supported. As in Model 4, weight gain during college students first semester was shown to be significantly associated with an increase in changes in autonomous regulation of food, and a decrease in changes in controlled

regulation of food, during college students second semester of college, controlling for all else in the model. Additionally, as shown in figure 4, a statistically significant interaction between sex and changes in strength training was found in predicting weight gain, controlling for changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, female, and the interaction between changes in strength training and female. This means that on average, female college students who gain more weight during their first semester in college, increase their strength training exercises during their second semester of college. On the other hand, male college students who gain weight during their first semester in college, on average, decrease their strength training exercises during their second semester of college.

## **Discussion**

The first important finding of this study was that college students who gain more weight during their first semester of college are more likely to increase their autonomous regulation of food and decrease their controlled regulation of food. This means that following weight gain, college students who gain more weight change their dietary choices based on their personal values and well being, rather than on external messages received from family, peers, or the media, during their second semester of college. On the other hand, those who gain weight, but not that much weight are more likely to make dietary decisions based on external messages received from family, peers, or the media, than their personal values and well being. This is important because previous literature has been able to link autonomous regulation with healthy eating behavior and controlled regulation with dysfunctional eating behaviors (Pelletier et al., 2004). Autonomous regulation has also been linked with weight loss and maintenance of the weight loss for up to two years (Williams et al., 1996). This means that increasing autonomous regulation in response to weight gain may lead to healthier eating behaviors, weight loss, and the maintenance of the weight loss. Future research should examine the link between the increase in autonomous regulation and changes in dietary decisions and weight loss. Once this link has been clearly identified interventionist can begin researching ways to encourage autonomous regulation in college students.

The second important finding in this study found that men and women respond to unwanted weight gain differently. Specifically, female college students who gain a lot of weight during their first semester in college, increase their strength training exercises during their second semester of college where male college students who gain weight

during their first semester in college, on average, decrease their strength training exercises during their second semester of college. These findings are consistent with Ridgeway and Tylka (2005) who reported that men are more likely to participate in strength training exercises to gain muscle, whereas women are more likely to participate in strength training to lose weight (Ridgeway & Tylka, 2005). Therefore if college students experienced unwanted weight gain, men are more likely to reduce their strength training exercises, and women are more likely to increase their strength training exercises. It is clear that men and women respond to weight gain differently; therefore future research and interventionist should develop separate strategies for each gender.

### ***Limitations***

The data for this study was collected in August, December, and May. This is a limitation, because it is possible that weight gain and responses to weight gain, particularly appearance satisfaction change more rapidly than every four to five months. Additionally, the data for this study is unable to assess if the positive changes continued beyond the participants first year of school.

A second limitation of this study is all of the participants are traditional students. Non-traditional students who began school when they are older than 19, or those who are married, pregnant, or have children were excluded from this study. Therefore the results of this study are only generalizable to traditional students.

A third limitation of this study is that the final model only predicts 8% of the variability in weight gain. This means that while changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, female, and the interaction between female and changes in strength training, are significant predictors of

weight gain, there may be additional predictors that will need to be taken into account to achieve an accurate understanding of changes that college students make second semester in response to weight gain.

### ***Strengths***

The current study adds to the current literature on weight gain in three ways. First, it goes beyond determining how much weight college students gain, and identifies changes that college student make in response to weight gain. This is important because it is the first step in going beyond identifying the problem and identifying the best way to solve the problem.

Secondly, this study used a large sample that included both males and females. Many of the studies in the current literature have small samples that consist mostly of females. Without a significant number of males in the sample it would have been impossible to detect the interaction between sex and strength training.

Lastly, this study included extensive sensitivity analysis. The results from this analysis made it clear that the results of this study are specific to college student who gained weight during their first semester.

### ***Future Research***

Future research should examine the link between changes in autonomous and controlled regulation of food and changes in diet. Current research can identify the link between autonomous regulation of food and healthy eating behaviors and controlled regulation of food and dysfunctional eating behaviors. However, more research needs to be done to see if changes in an individual's autonomous or controlled regulation results in changes to their actual diet.

Second, if changes in regulation result in changes to diet future research should examine ways to increase autonomous regulation in college students. This will allow interventionist to promote healthy weight in college students, thereby reducing the complications associated with obesity.

Finally, future research should re-examine appearance satisfaction and weight gain. Future researchers could look at this relationship longitudinally beginning during early adolescence and continuing into adulthood. It would be interesting to see if a relationship between appearance satisfaction and weight gain exists at a different developmental period.

## **Conclusion**

In conclusion, it is clear that college students gain a statistically significant amount of weight. The present study goes beyond measuring the amount of weight that college student gain, and identifies college students' responses to weight gain. College students who gain a lot of weight during their first semester of college are more likely to make dietary decisions based on their personal values and well being, than external messages received from family, peers, or the media, during their second semester of college, while those who gain weight, but not that much weight are more likely to make dietary decisions based on external messages received from family, peers, or the media, than their personal values and well being. Furthermore, female college students who gain a lot of weight during their first semester in college, increase their strength training exercises during their second semester of college. On the other hand, male college students who gain weight during their first semester in college, on average, decrease their strength training exercises during their second semester of college. Future research should focus on linking changes in regulation of food to changes in diet, so interventionist can focus their efforts and help students engage in healthy lifestyles that promote healthy weight.

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## Appendix A

### *Regulation of Eating Behavior Scale (REBS)*

#### **Eating Behaviors**

To what extent does each item correspond to your personal motive for regulating your eating behaviors? Please select the number which seems to most appropriately indicate your motivation.

- 1 - Does not correspond at all.
- 2 -
- 3 -
- 4 - Neutral.
- 5 -
- 6 -
- 7 - Corresponds exactly.

**1. It is fun to create meals that are good for my health.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**2. I like to find new ways to create meals that are good for my health.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**3. I take pleasure in fixing healthy meals.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**4. For the satisfaction of eating healthy.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**5. Eating healthy is an integral part of my life.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**6. Eating healthy is part of the way I've chosen to live my life.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**7. Regulating my eating behaviors has become a fundamental part of who I am.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**8. Eating healthy is congruent with other important aspects of my life.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**9. I believe it will eventually allow me to feel better.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

## FR15 End of Fall 2008

**10. I believe it is a good thing I can do to feel better about myself in general.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**11. It is a good idea to try to regulate my eating behaviors.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**12. It is a way to ensure long term health benefits.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**13. I don't want to be ashamed of how I look.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

## FR15 End of Fall 2008

### 14. I feel I must absolutely be thin.

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

### 15. I would feel ashamed of myself if I was not eating healthy.

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

### 16. I would be humiliated if I was not in control of my eating behaviors.

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

### 17. Other people close to me insist that I do.

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

## FR15 End of Fall 2008

### 18. People around me nag me to do it.

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

### 19. It is expected of me.

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

### 20. I don't really know. I truly have the impression I am wasting my time trying to regulate my eating behaviors.

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**21. I don't know why I bother.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**22. I can't really see what I'm getting out of it.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

**23. I don't know. I can't see how my efforts to eat healthy are helping my health situation.**

- ☐ 1 - Does not correspond at all.
- ☐ 2 -
- ☐ 3 -
- ☐ 4 - Neutral.
- ☐ 5 -
- ☐ 6 -
- ☐ 7 - Corresponds exactly.

## Appendix B

### *Strength Training Items*

5. How many days per week do you participate in strengthening exercises?  
(Strengthening exercises include activities such as push-ups, sit-ups, or weight lifting.)

6. On days that you do strengthening exercises, how many minutes per day do you spend doing the strengthening exercises?

## Appendix C

### *Appearance Satisfaction Items*

**1. Use this scale to indicate how dissatisfied or satisfied you are with each of the following areas or aspects of your body:**

	Very Dissatisfied	Mostly Dissatisfied	Neither Satisfied Nor Dissatisfied	Mostly Satisfied	Strongly Satisfied
Face (facial features, complexion)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hair (color, thickness, texture)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lower torso (buttocks, hips, thighs, legs)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mid torso (waist, stomach)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Upper torso (chest or breasts, shoulders, arms)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Muscle tone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Weight	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Height	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall appearance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Appendix D

### Tables

Table 4. Statistics for the study variables: weight gain, changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female, for college students who had no weight change or lost weight.

Variables	N	Mean	SD	Range	Wilks-Shapiro (p-value)
Weight Gain	131	-2.49	2.52	-1.58 – 0.00	.81***
Autonomous Regulation	118	-.19	2.13	-10.50 – 4.75	.05***
Controlled Regulation	117	-.38	2.26	-8.5 – 6.00	0.99
Strength Training	119	-6.32	67.16	-360 – 180	.83***
Appearance Satisfaction	113	.06	.51	-2 – 1	.65***
Female	201	.66	.47	0 – 1	.60***

\*\*\* $p \leq .001$ .

Table 5. Pearson correlation coefficients for the study variables: weight gain, and changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female for college students who had no weight gain or lost weight. ( $N = 111$ )

Variables	Weight Gain	Autonomous Regulation	Controlled Regulation	Strength Training	Appearance Satisfaction	Female
Weight Gain	-					
Autonomous Regulation	-.08	-				
Controlled Regulation	-.05	.17	-			
Strength Training	.05	-.04	-.03	-		
Appearance Satisfaction	.02	.01	-.10	-.02	-	
Female	.15	.05	-.18	.03	.12	-

Table 6. A taxonomy of fitted multiple regression models in which college students level of weight gain during the 1<sup>st</sup> semester is related to changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, female, the interaction between female and strength training, for college students who had no weight change or lost weight. ( $N = 111$ )

Model	Intercept (se)	Control Predictors					R <sup>2</sup>	
		Main Effects			Two-Way Interaction			
		Autonomous Regulation (se)	Controlled Regulation (se)	Strength Training (se)	Appearance Satisfaction (se)	Female (se)		Female and Strength Training (se)
M1	-2.34*** (.23)	-.09 (.11)						.01
M2	-2.35*** (.24)	-.11 (.11)	-.03 (.10)					.01
M3	-2.34*** (.24)	-.08 (.11)	-.03 (.10)	0.002 (0.003)				.01
M4	-2.35*** (.24)	-.08 (.11)	-.03 (.11)	0.002 (0.003)	.09 (.46)			.01
M5	-2.92*** (.42)	-.10 (.11)	-.00 (.11)	0.001 (0.003)	.01 (.46)	.83 (.52)		.03
M6	-2.89*** (.43)	-.10 (.11)	.01 (.11)	0.004 (0.005)	.07 (.46)	.80 (.52)	-.01 (.01)	.04

\*\*\* $p \leq .001$ .

Table 7. Univariate statistics for the study variables: weight gain, changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction and female, for the full sample of college students.

Variables	N	Mean	SD	Range	Wilks-Shapiro (p-value)
Weight Gain	471	2.39	4.30	-15.80 – 19.58	.99***
Autonomous Regulation	415	-.03	2.21	-10.50 – 6.50	.98***
Controlled Regulation	414	-.14	2.36	-8.50 – 8.42	.99**
Strength Training	422	2.22	66.71	-360 – 240	.87***
Appearance Satisfaction	409	.01	.56	-3 – 3	.67***
Female	541	.65	.48	0 – 1	.60***

\*\*\* $p \leq .001$ .

Table 8. Pearson correlation coefficients for the study variables: weight gain, and changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, and female for full sample of college students. ( $N = 404$ )

Variables	Weight Gain	Autonomous Regulation	Controlled Regulation	Strength Training	Appearance Satisfaction	Female
Weight Gain	-					
Autonomous Regulation	.07	-				
Controlled Regulation	.004	.08	-			
Strength Training	.03	.003	-.02	-		
Appearance Satisfaction	-.03	-.02	-.09	.02	-	
Female	-.08	.01	.004	.08	.03	-

Table 9. A taxonomy of fitted multiple regression models in which college students levels of weight gain during the 1<sup>st</sup> semester is related to changes in autonomous regulation, controlled regulation, strength training, appearance satisfaction, female, the interaction between female and strength training during the 2<sup>nd</sup> semester, for the full sample of college students. ( $N = 404$ )

Model	Intercept (se)	Control Predictors					R <sup>2</sup>	
		Main Effects			Two-Way Interactions			
		Autonomous Regulation (se)	Controlled Regulation (se)	Strength Training (se)	Appearance Satisfaction (se)	Female (se)  Female and Strength Training (se)		
M1	2.47*** (0.21)	.13 (.09)					.01	
M2	2.47*** (0.21)	.13 (.09)	-.004 (.09)				.01	
M3	2.47*** (0.21)	.13 (.10)	-.003 (.09)	.002 (.003)			.01	
M4	2.47*** (0.21)	.13 (.10)	-.01 (.09)	.002 (.003)	-.21 (.36)		.01	
M5	2.97*** (0.36)	.14 (.09)	-.01 (.09)	.002 (.003)	-.20 (.36)	-.77 (.44)	.01	
M6	2.94*** (0.36)	.11 (.10)	-.01 (.09)	-.004 (.004)	-.23 (.36)	-.78 (.44)	.01* (.01)	.02

\* $p \leq .05$ ; \*\*\* $p \leq .001$ .

Table 10. T-test results comparing college students who gained weight ( $N = 340$ ), and college students who had no weight change or lost weight ( $N = 202$ ), at time 1.

Variable	t-statistic	p-value
Autonomous Regulation	.30	.77
Controlled Regulation	-.23	.82
Strength Training	-.76	.45
Appearance Satisfaction	-2.63	.01
Female	.55	.58
Vigorous Activity	.89	.38
Moderate Activity	2.08	.04
Motivational Salience	.33	.74
Self-Evaluative Salience	2.27	.02
Depression	1.81	.07
Body Satisfaction	.53	.60
Weight Satisfaction	1.62	.11

## Appendix E

### Institutional Review Board Approval Form

<b>AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD for RESEARCH INVOLVING HUMAN SUBJECTS</b> <b>RESEARCH PROTOCOL REVIEW FORM</b>			
For Information or help contact <b>THE OFFICE OF RESEARCH COMPLIANCE</b> , 115 Ramsay Hall, Auburn University Phone: 334-844-5966 e-mail: hsubject@auburn.edu Web Address: <a href="http://www.auburn.edu/research/vpr/ohs/">http://www.auburn.edu/research/vpr/ohs/</a>			
Revised 03.26.11 – DO NOT STAPLE, CLIP TOGETHER ONLY.			<input type="button" value="Save a Copy"/>
<b>1. PROPOSED START DATE of STUDY:</b> Sep 1, 2011			
<b>PROPOSED REVIEW CATEGORY (Check one):</b> <input type="checkbox"/> FULL BOARD <input type="checkbox"/> EXPEDITED <input checked="" type="checkbox"/> EXEMPT			
<b>2. PROJECT TITLE:</b> College Freshmen Weight Gain and Change in the Regulation of Food, Strength Training, and Appearance Satisfaction			
<b>3. PRINCIPAL INVESTIGATOR</b>  Margaret K Keiley 203 Spidle Hall MAILING ADDRESS	<b>Professor</b> TITLE  HDFS DEPT	<b>844-2644</b> PHONE  844 4515 FAX	<b>keilemk@auburn.edu</b> AU E-MAIL  <b>ALTERNATE E-MAIL</b>
<b>4. SOURCE OF FUNDING SUPPORT:</b> <input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Internal <input type="checkbox"/> External Agency: _____ <input type="checkbox"/> Pending <input type="checkbox"/> Received			
<b>5. LIST ANY CONTRACTORS, SUB-CONTRACTORS, OTHER ENTITIES OR IRBs ASSOCIATED WITH THIS PROJECT:</b> None			
<b>6. GENERAL RESEARCH PROJECT CHARACTERISTICS</b>			
<b>6A. Mandatory CITI Training</b>  Names of key personnel who have completed CITI: Suzanne Peters ✓ Margaret Keiley ✓  CITI group completed for this study: <input checked="" type="checkbox"/> Social/Behavioral <input type="checkbox"/> Biomedical  <b>PLEASE ATTACH TO HARD COPY ALL CITI CERTIFICATES FOR EACH KEY PERSONNEL</b>		<b>6B. Research Methodology</b>  Please check all descriptors that best apply to the research methodology:  Data Source(s):    New Data <input checked="" type="checkbox"/> Existing Data Will recorded data directly or indirectly identify participants? Yes <input checked="" type="checkbox"/> No Data collection will involve the use of: Educational Tests (cognitive diagnostic, aptitude, etc.) Interview / Observation Physical / Physiological Measures or Specimens (see Section Surveys / Questionnaires Internet / Electronic Audio / Video / Photos Private records or files	
<b>6C. Participant Information</b>  Please check all descriptors that apply to the participant population. <input checked="" type="checkbox"/> Males <input checked="" type="checkbox"/> Females <input checked="" type="checkbox"/> AU students <b>Vulnerable Populations</b> Pregnant Women/Fetuses <input type="checkbox"/> Prisoners Children and/or Adolescents (under age 19 in AL) <b>Persons with:</b> Economic Disadvantages    Physical Disabilities Educational Disadvantages    Intellectual Disabilities <b>Do you plan to compensate your participants?</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		<b>6D. Risks to Participants</b>  Please identify all risks that participants might encounter in this research. <input type="checkbox"/> Breach of Confidentiality* <input type="checkbox"/> Coercion <input type="checkbox"/> Deception <input type="checkbox"/> Physical <input type="checkbox"/> Psychological <input type="checkbox"/> Social <input checked="" type="checkbox"/> None <input type="checkbox"/> Other: Data collection was completed 2 years ago.  *Note that if the investigator is using or accessing confidential or identifiable data, breach of confidentiality is always a risk.	
<b>Do you need IBC Approval for this study?</b> <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes - BUA # _____ Expiration date _____			
<b>FOR OHSR OFFICE USE ONLY</b>			
DATE RECEIVED IN OHSR: 8.17.11 by GB		PROTOCOL # 11-290 EX 1109	
DATE OF IRB REVIEW: 9/11/11 by KIE		APPROVAL CATEGORY: 45 CFR 46.101 (b) (4)	
DATE OF IRB APPROVAL: _____ by _____		INTERVAL FOR CONTINUING REVIEW: 1 year	
COMMENTS:			

## 7. PROJECT ASSURANCES

PROJECT TITLE: College Freshmen Weight Gain and Change in the Regulation of Food, Strength Training, and Appearance Satisfaction

### A. PRINCIPAL INVESTIGATOR'S ASSURANCES

1. I certify that all information provided in this application is complete and correct.
2. I understand that, as Principal Investigator, I have ultimate responsibility for the conduct of this study, the ethical performance this project, the protection of the rights and welfare of human subjects, and strict adherence to any stipulations imposed by the Auburn University IRB.
3. I certify that all individuals involved with the conduct of this project are qualified to carry out their specified roles and responsibilities and are in compliance with Auburn University policies regarding the collection and analysis of the research data.
4. I agree to comply with all Auburn policies and procedures, as well as with all applicable federal, state, and local laws regarding the protection of human subjects, including, but not limited to the following:
  - a. Conducting the project by qualified personnel according to the approved protocol
  - b. Implementing no changes in the approved protocol or consent form without prior approval from the Office of Human Subjects Research
  - c. Obtaining the legally effective informed consent from each participant or their legally responsible representative prior to their participation in this project using only the currently approved, stamped consent form
  - d. Promptly reporting significant adverse events and/or effects to the Office of Human Subjects Research in writing within 5 working days of the occurrence.
5. If I will be unavailable to direct this research personally, I will arrange for a co-investigator to assume direct responsibility in my absence. This person has been named as co-investigator in this application, or I will advise OHSR, by letter, in advance of such arrangements.
6. I agree to conduct this study only during the period approved by the Auburn University IRB.
7. I will prepare and submit a renewal request and supply all supporting documents to the Office of Human Subjects Research before the approval period has expired if it is necessary to continue the research project beyond the time period approved by the Auburn University IRB.
8. I will prepare and submit a final report upon completion of this research project.

My signature indicates that I have read, understand and agree to conduct this research project in accordance with the assurances listed above.

Margaret K Keiley

Printed name of Principal Investigator

Margaret K.  
Keiley

Principal Investigator's Signature  
(SIGN IN BLUE INK ONLY)

Digitally signed by Margaret K. Keiley  
DN: c=US, o=Auburn University,  
ou=College of Education and Early Studies,  
email=mkkeiley@auburn.edu, cn=MK  
Date: 2011.08.18 11:33:42 -0500

July 18, 2011

Date

### B. FACULTY ADVISOR/SPONSOR'S ASSURANCES

1. By my signature as faculty advisor/sponsor on this research application, I certify that the student or guest investigator is knowledgeable about the regulations and policies governing research with human subjects and has sufficient training and experience to conduct this particular study in accord with the approved protocol.
2. I certify that the project will be performed by qualified personnel according to the approved protocol using conventional or experimental methodology.
3. I agree to meet with the investigator on a regular basis to monitor study progress.
4. Should problems arise during the course of the study, I agree to be available, personally, to supervise the investigator in solving them.
5. I assure that the investigator will promptly report significant adverse events and/or effects to the OHSR in writing within 5 working days of the occurrence.
6. If I will be unavailable, I will arrange for an alternate faculty sponsor to assume responsibility during my absence, and I will advise the OHSR by letter of such arrangements. If the investigator is unable to fulfill requirements for submission of renewals, modifications or the final report, I will assume that responsibility.
7. I have read the protocol submitted for this project for content, clarity, and methodology

Printed name of Faculty Advisor / Sponsor

Signature (SIGN IN BLUE INK ONLY)

Date

### C. DEPARTMENT HEAD'S ASSURANCE

By my signature as department head, I certify that I will cooperate with the administration in the application and enforcement of all Auburn University policies and procedures, as well as all applicable federal, state, and local laws regarding the protection and ethical treatment of human participants by researchers in my department.

Joe Pittman

Printed name of Department Head

Signature (SIGN IN BLUE INK ONLY)

Date

Sept 8 11

8. **PROJECT OVERVIEW: Prepare an abstract that includes:**  
(400 word maximum, in language understandable to someone who is not familiar with your area of study):

I.) **A summary of relevant research findings leading to this research proposal:**  
(Cite sources; include a "Reference List" as Appendix A.)

II.) **A brief description of the methodology,**

III.) **Expected and/or possible outcomes, and,**

IV.) **A statement regarding the potential significance of this research project.**

Obesity has become a leading national public health concern due to the mounting evidence that it increases both morbidity and mortality (Pi-Sunyer, 1993). On average, college students gain a statistically significant amount of weight across their college careers (Economos, Hildebrandt, & Hyatt, 2008; Hajhosseini et al., 2006; Jung, Bray, & Ginis, 2008; Levitsky, Halbmaier, & Midjenovic, 2004). Mihalopoulos et al. (2008) reported that weight gain in the general population is, on average, .07 pounds per month; however, college students gain approximately 6 times this amount, which is equal to approximately .39 pounds per month. Current studies suggest that autonomous and controlled regulation of eating, strength training, appearance satisfaction, and sex (Ahmed et al., 2002; Mata et al., 2009; Pelletier & Dion, 2007; Williams & Cash, 2001; Williams et al., 1996) can each be linked to weight management. The present study will examine whether or not college students make changes to their behaviors following weight gain in attempts to manage their weight and prevent obesity. We hypothesize that weight gain during a college student's first semester will encourage changes during the second semester, specifically, changes in autonomous and controlled regulation of food, strength training, and appearance satisfaction. If an association does exist we will assess whether this association is moderated by sex. The Statistical Analysis System (SAS) will be used to fit multiple regression models to analyze these hypothesis. The information gathered for the current study may lead to an increased understanding of college student weight gain, and college students response to weight gain.

9. **PURPOSE.**

a. **Clearly state all of the objectives, goals, or aims of this project.**

- (1) Is weight gain during 1st semester freshmen year related to changes in autonomous and controlled regulation of food consumption, strength training, or appearance satisfaction during the second semester?  
(2) Are these relationships moderated by sex?

b. **How will the results of this project be used? (e.g., Presentation? Publication? Thesis? Dissertation?)**  
Thesis

10a. **KEY PERSONNEL.** Describe responsibilities. Include information on research training or certifications related to this project. CITI is required. Be as specific as possible. (Attach extra page if needed.) All non AU-affiliated key personnel must attach CITI certificates of completion.

Principle Investigator Margaret K. Keiley Title: Professor E-mail address Keilemk@auburn.edu  
 Dept / Affiliation: Human Development and Family Studies

Roles / Responsibilities:

Individual: Suzanne Peters Title: Graduate Student E-mail address coopesc@auburn.edu  
 Dept / Affiliation: Human Development and Family Studies

Roles / Responsibilities:

Individual: \_\_\_\_\_ Title: \_\_\_\_\_ E-mail address \_\_\_\_\_  
 Dept / Affiliation: \_\_\_\_\_

Roles / Responsibilities:

Individual: \_\_\_\_\_ Title: \_\_\_\_\_ E-mail address \_\_\_\_\_  
 Dept / Affiliation: \_\_\_\_\_

Roles / Responsibilities:

Individual: \_\_\_\_\_ Title: \_\_\_\_\_ E-mail address \_\_\_\_\_  
 Dept / Affiliation: \_\_\_\_\_

Roles / Responsibilities:

Individual: \_\_\_\_\_ Title: \_\_\_\_\_ E-mail address \_\_\_\_\_  
 Dept / Affiliation: \_\_\_\_\_

Roles / Responsibilities:

11. **LOCATION OF RESEARCH.** List all locations where data collection will take place. (School systems, organizations, businesses, buildings and room numbers, servers for web surveys, etc.) Be as specific as possible. Attach permission letters in Appendix E.  
 (See sample letters at <http://www.auburn.edu/research/vpr/ohs/sample.htm>)  
 N/A

12. PARTICIPANTS.

- a. Describe the participant population you have chosen for this project.

☒ Check here if there is existing data; describe the population from whom data was collected & include the # of data files.

This project will be using secondary data from the project titled "Longitudinal Collegiate Study of Body Composition/Size and Related Environmental Behavioral and Psychological Factors" (IRB File#:07-153 EP 0707). Data was collected over two years and three time points (August, December, and May) from five hundred and forty-two (191 males; 350 females) freshmen students at Auburn University. For this study, the analytic sample will be the 340 students (123 males; 217 females) who gained weight during the first semester in college. Physical assessments were collected during lab sessions, and the demographic, behavioral, environmental, and psychological measures were collected using [www.surveymonkey.com](http://www.surveymonkey.com). The surveys were accessible to each participant from either a personal or a university computer.

- b. Describe why is this participant population is appropriate for inclusion in this research project. (Include criteria for selection.)  
This sample contains freshmen college students, who are the focus of the current study.

- c. Describe, step-by-step, all procedures you will use to recruit participants. Include in Appendix B a copy of all e-mails, flyers, advertisements, recruiting scripts, invitations, etc., that will be used to invite people to participate.  
(See sample documents at <http://www.auburn.edu/research/vpr/ohs/sample.htm>.)  
N/A

What is the minimum number of participants you need to validate the study? <sup>340</sup> \_\_\_\_\_

Is there a limit on the number of participants you will recruit? ☒ No ☐ Yes – the number is \_\_\_\_\_

Is there a limit on the number of participants you will include in the study? ☒ No ☐ Yes – the number is \_\_\_\_\_

- d. Describe the type, amount and method of compensation and/or incentives for participants.

(If no compensation will be given, check here ☒.)

Select the type of compensation: ☐ Monetary ☐ Incentives

- ☐ Raffle or Drawing incentive (Include the chances of winning.)
- ☐ Extra Credit (State the value)
- ☐ Other

Description:

13. PROJECT DESIGN & METHODS.

- a. Describe step-by-step, all procedures and methods that will be used to consent participants.  
( ☒ Check here if this is "not applicable"; you are using existing data.)

- b. Describe the procedures you will use in order to address your purpose. Provide a step-by-step description of how you will carry out this research project. Include specific information about the participants' time and effort commitment. (NOTE: Use language that would be understandable to someone who is not familiar with your area of study. Without a complete description of all procedures, the Auburn University IRB will not be able to review this protocol. If additional space is needed for this section, save the information as a .PDF file and insert after page 6 of this form. )  
The current project will use secondary data analysis, and no contact with participants will occur. The Statistical Analysis System (SAS) will be used for the analysis. First we will conduct the appropriate univariate and bivariate preliminary analyses to examine the distributions and central tendencies of each variable, and the relationships among them. Next, to test the proposed hypotheses, we will fit series of nested multiple regression models that will regress weight gain on change in regulation of food consumption (autonomous and controlled), change in appearance satisfaction, change in strength training, and sex.

13c. List all data collection instruments used in this project, in the order they appear in Appendix C.

(e.g., surveys and questionnaires in the format that will be presented to participants, educational tests, data collection sheets, interview questions, audio/video taping methods etc.)

N/A

d. Data analysis: Explain how the data will be analyzed.

First we will conduct the appropriate univariate and bivariate preliminary analyses to examine the distributions and central tendencies of each variable, and the relationships among them. Next, to test the proposed hypotheses, we will fit series of nested multiple regression models that will regress weight gain on change in regulation of food consumption (autonomous and controlled), change in appearance satisfaction, change in strength training, and sex.

14. RISKS & DISCOMFORTS: List and describe all of the risks that participants might encounter in this research. If you are using deception in this study, please justify the use of deception and be sure to attach a copy of the debriefing form you plan to use in Appendix D. (Examples of possible risks are in section #6D on page 1.)

Identifiable data is not included with the current data. Only participant numbers are available. No contact with participants will be made.

15. **PRECAUTIONS.** Identify and describe all precautions you have taken to eliminate or reduce risks as listed in #14. If the participants can be classified as a "vulnerable" population, please describe additional safeguards that you will use to assure the ethical treatment of these individuals. Provide a copy of any emergency plans/procedures and medical referral lists in Appendix D.

N/A

If using the Internet to collect data, what confidentiality or security precautions are in place to protect (or not collect) identifiable data? Include protections used during both the collection and transfer of data.  
(These are likely listed on the server's website.)

Identifiable data is not included with the current data. Only participant numbers are available.

16. **BENEFITS.**

- a. List all realistic direct benefits participants can expect by participating in this specific study.  
(Do not include "compensation" listed in #12d.) Check here if there are no direct benefits to participants. ✓

- b. List all realistic benefits for the general population that may be generated from this study.

The information gathered for the current study may lead to an increased understanding of college student weight gain, and college students response to weight gain.

17. PROTECTION OF DATA.

- a. Will data be collected as anonymous? ☒ Yes ☐ No If "YES", skip to part "g".  
(*"Anonymous" means that you will not collect any identifiable data.*)
- b. Will data be collected as confidential? ☐ Yes ☐ No  
(*"Confidential" means that you will collect and protect identifiable data.*)
- c. If data are collected as confidential, will the participants' data be coded or linked to identifying information?  
☒ Yes (If so, describe how linked.) No ☐

d. Justify your need to code participants' data or link the data with identifying information.

e. Where will code lists be stored? (Building, room number?)

- f. Will data collected as "confidential" be recorded and analyzed as "anonymous"? ☒ Yes ☐ No  
(If you will maintain identifiable data, protections should have been described in #15.)
- g. Describe how and where the data will be stored (e.g., hard copy, audio cassette, electronic data, etc.), and how the location where data is stored will be secured in your absence. For electronic data, describe security. If applicable, state specifically where any IRB-approved and participant-signed consent documents will be kept on campus for 3 years after the study ends.  
The data will be stored on a secure departmental drive, but no identifying information is included in the data file.

h. Who will have access to participants' data?  
(The faculty advisor should have full access and be able to produce the data in the case of a federal or institutional audit.)  
Suzanne Peters  
Margaret Keiley

i. When is the latest date that confidential data will be retained? (Check here if only anonymous data will be retained. ✓)

j. How will the confidential data be destroyed? (NOTE: Data recorded and analyzed as "anonymous" may be retained indefinitely.)

### ***IRB Appendix***

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- Hajhosseini, L., Holmes, T., Mohamadi, P., Goudarzi, V., McProud, L., Hollenbeck, C.B. (2006). Changes in body weight, body composition and resting metabolic rate (RMR) in first-year university freshman students. *Journal of American College of Nutrition*, 25, 123-127.
- Jung, M. E., Bray, S. R., Ginis, K. (2008). Behavior change and the freshman 15: tracking physical activity and dietary patterns in 1st-year university women. *Journal of American College Health*, 56, 523-530.
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