

The Associations Among Emotions and Food Choices in College Freshmen:  
A Cross-Sectional Study Using Ecological Momentary Assessment

by

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## ABSTRACT

While literature has examined the associations between emotions and overeating, rarely is the relationship between emotions and food choices included. The purpose of this secondary data analysis was to utilize mobile-based ecological momentary assessment (EMA) surveys to determine the associations among negative, positive, apathetic, and mixed emotions and a variety of food choices in college freshmen living in residence halls. A total of 2142 survey responses from 647 college freshmen were included in this analysis (70.3% female, 51.5% non-white). Mixed model logistic regression assessed the cross-sectional association between emotions and food choices adjusting for gender, race/ethnicity, Pell grant status, highest parental education, and the clustering of repeated measures within person and of students within residence hall. There were no significant associations between negative emotions and food choices. Positive emotions were significantly and inversely associated with eating pizza/fast food (OR=0.6; 95% CI=0.5, 0.8) and cereals (OR=0.6; 95% CI=0.4, 1.0), while apathetic emotions were significantly and positively associated with consuming salty snacks/fried foods (OR=1.6; 95% CI=1.1, 2.5) and inversely associated with consuming sandwiches/wraps (OR=0.5; 95% CI=0.3, 0.8) and meats/proteins (OR=0.6; 95% CI=0.4, 1.0). It was also found that there were several instances of surveys with mixed emotions, in which participants reported feeling two conflicting emotions at once (i.e. positive and negative). Mixed emotions were significantly associated with consuming sweets (OR=1.6; 95% CI=1.2, 2.1), meats/proteins (OR=1.6; 95% CI=1.2, 2.0), and cereals (OR=1.9; 95% CI=1.2, 2.9). Understanding the relationships between different types of emotions and food choices is helpful in understanding the motivation behind healthy

versus unhealthy food choices. These findings can be used to develop interventions that encourage positive emotions in college freshmen to better promote healthy food choices and ultimately reduce the risk of weight gain and other health disparities. Future research should examine how college freshmen differ from other college students (i.e. upper classmen and graduate students), particularly related to their emotions and food choices, so that dietary interventions can be better suited to those who are vulnerable.

## DEDICATION

I am proud to dedicate this thesis to my loving parents, Ben and Julie. My father and mother have supported me through my entire college education and have always reminded me how proud they are of me. They have made it possible for me to pursue my goals, and their support, encouragement, and guidance is what has led me to where I am today. I would also like to dedicate this thesis to my boyfriend and best friend, Calvin. He has stuck by my side through this entire experience, always encouraging me to challenge myself and be confident in my abilities. I am utterly grateful to have had such an amazing support system throughout this graduate program.

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# CHAPTER 1

## INTRODUCTION

### **Overview**

Poor dietary intake is a serious public health concern.<sup>1,2</sup> For many people, behaviors related to food consumption are established early in life, especially during the transition into adulthood.<sup>2</sup> A growing body of evidence suggests that the transition from high school to college is a vulnerable period for excess weight gain<sup>1</sup> due to changes in eating behaviors<sup>3</sup> which ultimately influence food choices. Approximately one third of college students are either overweight or obese.<sup>4,5</sup> Given these high rates, young adults are at greater risk for developing chronic diseases such as cardiovascular disease and diabetes, for example.<sup>6</sup> This statistic suggests that the influence of food choices in college may have an effect on long-term health outcomes.<sup>6,7</sup>

The college transition is often an emotional experience for students.<sup>8</sup> As one progresses into adulthood, greater responsibilities exist with stressful competing demands.<sup>9</sup> This transitional period in a person's life is a crucial time in which they must begin making independent decisions and taking responsibility for their choices regarding diet and health.<sup>10</sup> This is also a time in which stress is at an all-time high due to academic pressures.<sup>11</sup> Failure to make healthful food choices during the college years has been identified by students as a barrier to weight management,<sup>5</sup> and this barrier greatly impacts overall health during the freshman year.<sup>5,12</sup>

Negative emotions, often resulting from stressful demands in college, can be representative of the amount of food eaten by an individual.<sup>9</sup> Research has shown that

when feeling stressed, college students often turn to food for psychological comfort rather than physiological need.<sup>13,14</sup> College students have reported increases in appetite when feeling stressed specifically for sweets and comfort foods.<sup>14</sup> Current research has established an association between constant feelings of stress in the college transition with overeating,<sup>5,13</sup> though outside the realm of stress and overeating there are only a few studies that address a multitude of emotions in relation to several specific types of food that are consumed in response.<sup>13,14</sup> Ultimately, it is important to examine how different emotions relate to different food choices to develop appropriate and effective interventions that will influence healthy lifestyle choices in this vulnerable population.<sup>14</sup>

The current literature that has identified factors influencing college food choices has primarily utilized retrospective methods of data capture including food frequency questionnaires, food records, and health and eating pattern questionnaires.<sup>12</sup> With these retrospective methods, some studies have been able to determine that food choices are quite often influenced by emotions.<sup>12</sup> However, no studies to our knowledge have used ecological momentary assessment (EMA) as an approach to repeatedly assess what college freshmen are eating and feeling in a particular moment.<sup>15</sup>

EMA data are typically captured in multiple assessments using electronic diaries, and this allows researchers to answer a variety of questions<sup>16</sup> without requiring participants to leave their environment.<sup>17</sup> Therefore using EMA can provide real-time, momentary data<sup>15</sup> on the nature of emotions and food choices with mobile technology. Additionally, the multiple assessments allow for a snapshot of how experiences vary across the day.<sup>16</sup> EMA is also able to gather data concerning details that participants would not remember long-term, such as how they were feeling when they chose to

consume a specific type of food.<sup>15</sup> This minimizes recall bias as participants are not required to reflect on past behaviors.<sup>15</sup>

To date, there is insufficient evidence that exists to address health interventions in the college population that can be widely disseminated.<sup>1</sup> While it is known that stress and other negative emotions can influence overeating in this population,<sup>5,8,12-14</sup> it is important that we further examine the types of foods that students are drawn to under different negative, positive, and apathetic emotional circumstances. Further, is it important that research with this population involves innovative approaches<sup>1</sup> to gather the most ecologically-valid dietary data possible, given that college freshman are vulnerable to developing eating behaviors that influence food choices as they transition into adulthood.<sup>2</sup>

### **Purpose of the Study**

This study is a secondary data analysis from the SPARC (Social Impact of Physical Activity and NutRition in College) study, a larger, longitudinal study assessing the nutrition and physical activity choices of college students. The purpose of this analysis is to utilize mobile-based EMA surveys to determine the associations among negative, positive, and apathetic emotions and food choices in college freshmen living in residence halls. The results of this cross-sectional analysis will provide an understanding of these relationships in the context of why the behaviors are occurring so that we can better promote healthy food choices in this vulnerable population.

## Research Aim and Hypotheses

**Study aim:** To determine the associations among emotions and food choices in college freshman living in residence halls on campus.

*Research question 1:* How are negative emotions associated with food choices in college freshmen?

**H<sub>1</sub>:** Students who report negative emotions prior to eating will choose to consume more sweets, salty snacks/fried foods, and pizza/fast food.

*Research question 2:* How are positive emotions associated with food choices in college freshmen?

**H<sub>2</sub>:** Students who report positive emotions prior to eating will choose to consume more fruits/vegetables.

*Research question 3:* How are apathetic emotions associated with food choices in college freshmen?

**H<sub>3</sub>:** Students who report apathetic emotions prior to eating will choose to consume more sweets, salty snacks/fried foods, and pizza/fast food.

## Definition of Terms

**Obese:** Weight that is higher than what is healthy for a given height (in adults), with a BMI  $\geq 30$ .<sup>18,19</sup>

**Transitional Period:** A period of time in which a student transitions from living at home with parents to living independently on a college campus.

**Ecological Momentary Assessment (EMA):** A tool that repeatedly assesses what the participant is doing at a particular moment without requiring them to leave their environment or reflect on past activities.<sup>15</sup>

**Negative Emotions:** Emotions that cause a negative effect. This includes EMA responses of feeling sad, stressed, or tired.

**Positive Emotions:** Emotions that cause a positive effect. This includes EMA responses of feeling happy, energized, or relaxed.

**Apathetic Emotions:** Emotions that cause a neutral or indifferent effect. This includes EMA responses of feeling bored or “meh”.

**Mixed Emotions:** Any combination of positive and negative, negative and apathetic, positive and apathetic, or all three emotion categories.

**Emotional Eating:** Eating in response to emotional stimuli, often to cope with negative emotions.<sup>8,13,14,20</sup>

**Healthy Eating Behaviors:** Making healthful food choices in response to hunger cues rather than emotional cues.

**Unhealthy Eating Behaviors:** Making unhealthy food choices in response to emotional cues.

### **Delimitations and Limitations**

A delimitation to this study is that the participants are freshmen college students living away from home in residence halls at a university in Arizona. The results may not be generalizable to college freshmen living away from home in apartments or rental homes near their university or at other universities throughout the country.

Limitations of this study include self-report bias, as the data are self-reported by the participants through the EMA. It is assumed that all participants will answer the questions accurately and honestly. Additionally, the cross-sectional study design is a limitation as it does not prove causality, only a relationship between variables. It also does not prove any long-term effects, but simply a snapshot of a single time point.



## CHAPTER 2

### REVIEW OF LITERATURE

#### **Overview**

The transition to college is a stressful period for students, and how emotions are regulated during these vulnerable years is critical to developing sustainable, healthful eating behaviors.<sup>8</sup> The college population is at a key crossroads in nutritional health;<sup>2</sup> students who do not learn to control their energy balance have the potential to gain weight, placing them at risk for obesity and other chronic health conditions later in life.<sup>10,21,22</sup> This literature review will briefly summarize overall eating behaviors during the college years, as well as the evidence regarding different emotions and their associations with food choices. This review will also discuss the use of ecological momentary assessment as a novel form of data collection.

#### **College Eating Behaviors and Food Choices**

The transition to the college environment promotes change in a person's life, especially when it comes to eating behaviors.<sup>22</sup> Freshman college students are faced with trying to adapt to changes in their new environment, and they have greater freedom and control over their lifestyle choices than ever before.<sup>23</sup> Because more independent food choices are made as one moves through young adulthood, the transition to college can be a significant event in a person's life.<sup>2</sup>

The *Dietary Guidelines for Americans* recommend eating a variety of fruits and vegetables, limiting added sugars, saturated fats, and sodium to less than 2,300

milligrams per day.<sup>24</sup> Quite a few studies have indicated that college students make poor food choices<sup>2,9,12,22,25</sup> that typically do not meet these recommendations.<sup>22,25</sup> Therefore, it is critical to understand the factors that contribute to food choices<sup>26</sup> in the context of why people are choosing to consume certain foods<sup>27</sup> to ultimately prevent weight gain and other unwanted health consequences.<sup>22,26</sup>

The phenomenon of gaining weight during the freshman year of college is familiar to most students.<sup>21</sup> For decades, the notion that the first year of college is accompanied by a weight gain of fifteen pounds (known as the “Freshman Fifteen”) has been passed through college campuses all across the country.<sup>10</sup> Though this notion has been disproved in several studies that show weight gain is typically around 3 to 7 pounds in the first year,<sup>10,12,22,28-30</sup> it compounds the many stresses that college freshmen face as they learn to manage life independent of their families.<sup>10</sup> Even small weight changes are important during this transition as the weight gain may remain stable through adulthood, and the pattern may continue across the lifespan.<sup>12</sup>

Some of the factors that are known to affect college weight gain include behaviors that contribute to excess energy intake<sup>10,12</sup> such as overeating, eating without hunger, and making unhealthful food choices when eating.<sup>4,9</sup> For example, Levitsky et al<sup>28</sup> found that during the first twelve weeks of the freshman year, the mean weight gain among 68 students was about 4 pounds. Consumption of high-fat foods and “junk” foods (term was not defined), as well as all-you-can-eat dining, explained almost half (40%) of the variance for weight change.<sup>28</sup> The researchers reported that the increase in body weight observed in this study is equivalent to consuming approximately 174 additional calories per day.<sup>28</sup> Another study reported that women, though not men, were more likely to have

an increased BMI in the first year of college.<sup>31</sup> These women were more likely to consume alcohol, caffeine, and foods low in fiber, and were less likely to eat vegetables.<sup>31</sup>

Furthermore, a group of studies have stated that in freshman university students, changes in unhealthy eating behaviors (such as emotional eating) and eating patterns (food choices and diet quality) during the freshman year of college is a significant predictor of weight gain.<sup>28,32-35</sup> A meta-analysis also reported that increased junk food consumption in freshmen college students tends to be a predictor of weight gain.<sup>36</sup> Other observational studies have reported changes in eating behaviors as a significant predictor of freshman weight gain as well.<sup>22,25,33</sup>

It is important to note that many college students neither consume adequate fruits and vegetables nor limit their consumption of fried, high-fat, and fast foods.<sup>25</sup> According to longitudinal findings from a sample of 204 college students, Racette et al<sup>25</sup> reported that more than 50% of the students consumed high-fat, fried, or fast foods at least twice per week, and only about 29% consumed at least five servings of fruits and vegetables per day. Of the students who reported consuming less than five servings of fruits and vegetables per day as freshmen, 71% continued to eat fewer than the recommended serving as seniors in college.<sup>25</sup> Similar studies have also shown that during the transitional period after high school, young adults tend to consume less fruits and vegetables,<sup>9,33</sup> more sweetened beverages, salty snacks, cheese, and beef,<sup>9,33,37</sup> and consume fast food at least three times per week.<sup>22</sup> These trends fail to meet the recommendations set forth by the *Dietary Guidelines for Americans*.<sup>22,24</sup>

Additionally, another study by Racette et al<sup>22</sup> longitudinally assessed eating changes over the freshman and sophomore years of college in 290 students. They found that consumption of fruit and vegetables and high-fat fast foods did not appear to change throughout the freshman and sophomore year.<sup>22</sup> Similarly, Driskell et al<sup>38</sup> determined that there are very few differences among lower-level students (first and second year) and upper-level students (third and fourth year) in their food choices. Of 261 students, the majority of both lower- (95%) and upper-level (92%) students self-reported eating fast food 6 to 8 times weekly.<sup>38</sup> There were also similar reports between groups for several other types of foods consumed such as fruits, vegetables, and salty snacks.<sup>38</sup> These data suggest that habits established in the freshman year of college may be likely to carry forward through the entire college experience,<sup>22,38</sup> making this vulnerable group an important target for health promotion. Research is needed to further our understanding of potential interventions that support the establishment of healthy food choices, and ultimately a healthy lifestyle in college.<sup>26</sup>

### **Emotions and Food Choices**

Emotional eating is defined as overeating in response to a negative emotional stimuli.<sup>8,13,14,20</sup> Research has shown a relationship between emotional eating and weight gain in the college population.<sup>8</sup> It is also commonly believed that a person's emotions may determine the foods chosen to consume.<sup>39</sup> It has been theorized that college students make food choices under the notion that certain types of foods will alleviate negative emotions.<sup>14</sup> Though, outside the realm of overeating, evidence is limited regarding

specific types of food choices that are made with different types of emotions, including those that are negative, positive, and apathetic.<sup>14</sup>

## **Emotion Background**

Negativity and positivity are generally considered two separate types of experiences,<sup>40</sup> and apathy (sometimes referred to as ambivalence) is typically thought to be a slight mix between the two.<sup>41</sup> However, psychology literature actually states that an individual's entire emotional state is technically considered one single event that can be further broken down into separate states.<sup>42</sup> In other words, positive and negative emotions are end-points of the same spectrum.<sup>41</sup> One article explains the Emotion Spectrum Analysis Method (ESAM), a technique used for analyzing the magnitude of emotional states.<sup>42</sup> ESAM breaks down emotion into four basic states which are anger, sadness, joy, and relaxation because these emotional states seem to span the subspace of emotion that can be measured within the brain.<sup>42</sup> Thus, ESAM has provided researchers with a foundation for determining how to group emotions.<sup>43</sup>

In general, most studies that assess emotion consider negative emotions to be any feelings that cause a negative effect to the individual. This generally includes any mix of stressed, sad, tired, bored, unhappy, upset, annoyed, angry, anxious, nervous, or frustrated.<sup>41,44-47</sup> Though it is also important to note, however, that some researchers argue that boredom should not be considered a negative emotion, but rather an emotional state distinct of others.<sup>48,49</sup> Studies that assess positive emotions typically include a mix of happy, proud, loved, contented, joyful, amused, or pleased.<sup>41,44-47</sup> By definition, each emotion within these two different groups (i.e. negative and positive) differs in

magnitude of negativity or positivity,<sup>41</sup> though based on the literature for eating and food choices, the emotions grouped within each category tend to have very similar relationships with eating and food choices.

## **Stress**

The Centers for Disease Control and Prevention states that stress is extremely prevalent in college from trying to balance school, jobs, friends, athletics, and leadership positions.<sup>50</sup> Other sources have associated college stress with academic performance, intellectual confidence (or lack thereof), or perception of increased workload.<sup>11</sup> Stress is one of the most commonly cited negative emotions in college students<sup>8,11,14,51</sup> and is significantly associated with emotional eating.<sup>8,11,13,14,51</sup> When individuals respond to stress by eating more food or more calories, there is only limited evidence regarding the types of foods that are consumed from various food groups. A small body of literature suggests that the foods chosen with stress may be energy-dense, specifically high in sugar and fat.<sup>14,52,53</sup>

For instance, Kandiah et al<sup>14</sup> examined the effects of stress on appetite and food choices related to comfort foods in a female college population. Among 272 subjects, they found that 63% experienced an increase in appetite with stress.<sup>14</sup> Additionally, 80% of subjects said that they typically try to make healthy eating choices on a regular basis, but only 34% can actually succeed at eating healthy with stress.<sup>14</sup> Subjects also reported the types of comfort foods that they typically eat under stressful conditions.<sup>14</sup> Those with an increased appetite from stress chose significantly more types of sweet foods and

mixed dishes (which would include high-fat items like casseroles, burgers, pizza, fast food).<sup>14</sup>

These findings are quite similar to another study that reported sweets and salty/crunchy foods to be chosen in wider varieties under stressful conditions than under normal conditions.<sup>54</sup> This sample included both males and females who were not college students.<sup>54</sup> Despite the difference in populations amongst these two studies, it is important to note that this observed desire for sweet, salty, and high-fat tastes can translate into consumption of energy-dense, nutrient-poor foods with stress,<sup>14</sup> and these poor food choices may contribute to morbidity.<sup>14</sup>

An important limitation of these studies is that they only examined comfort foods rather than all different food groups, and this limitation exists for other studies that have also reported similar results.<sup>53,55</sup> However, other studies that assess stress and eating do not examine food choices at all. A group of literature found that college students reported stress as being a major barrier to maintaining a healthy lifestyle in college.<sup>5,8,51</sup> More specifically, females claimed that stress was the emotion that most frequently caused them to eat more than they normally would.<sup>8</sup> Males stated that stress caused them to disregard their hunger during the day and then binge eat at night.<sup>8</sup>

Additionally, some other studies have reported females mentioning stress as being associated with emotional eating, but not males,<sup>5</sup> females reporting more overall stress in college than males,<sup>51</sup> and a stronger association between stress and unhealthy weight change in females than males.<sup>11</sup> Furthermore, a study in the younger adolescent population also reported slight gender differences in emotional eating, in which stress

was more correlated with girls than boys.<sup>13</sup> These data suggests that females may be more vulnerable than males when it comes to stress and eating.

### **Negative Emotions**

The emotions seen in the literature that are typically classified as negative include a mix of stressed, sad, tired, bored, unhappy, upset, annoyed, angry, anxious, nervous, or frustrated.<sup>41,44-47</sup> Studies that assess eating have found that people eat more, or eat differently, while experiencing some of these negative emotions. For instance, Arnold et al.<sup>4</sup> reported that among 457 college students, negative emotions including sadness, anger, and anxiety were strongly associated with eating in the absence of hunger. In another study, anger and anxiety were reported as significant contributors to overeating, specifically in males.<sup>8</sup>

Impulsive eating is quite similar to overeating. This refers to fast, careless eating directed at any type of food available.<sup>56,57</sup> With negative emotions, primarily anger, subjects have reported greater impulsive eating behaviors.<sup>57</sup> Specifically, women have reported experiencing higher tendencies of impulsive eating than men during feelings of anger.<sup>57</sup> Again, these data suggest that females may be more vulnerable than males when it comes to negative emotions and eating. It also suggests that with negative emotions, people have a greater tendency to eat in an unhealthful manner. Thus it may be beneficial to explore the associations with negative emotions and food choices to better understand the complexity of these observed unhealthful eating behaviors.



## **Negative and Positive Emotions**

Seldom do we see positive emotions mentioned in eating literature, so it is difficult to make strong conclusions about how negative and positive emotions compare to one another. A small group of studies have shown, however, that positive and negative emotions do differ in their associations with eating.<sup>8,39,56,57</sup> For example, one study found that with negative emotions of anger and tension, participants' motivation to eat was rated higher than it was for positive emotions of joy and relaxation.<sup>56</sup> Another study reported that scores for impulsive eating were higher during negative emotions like fear and sadness than for positive emotions like joy.<sup>57</sup> In a population of college students, it has been reported that only negative emotions like anger adversely affecting eating behaviors, while happiness allows for normal eating.<sup>8</sup> Though these studies do not assess food choices, the findings indicate that there must be differences between negative and positive emotions in their relation to eating.<sup>56,57</sup> Further, the findings suggest that negative emotions must have a more adverse effect on eating than do positive emotions.

There is one study that examines various negative and positive emotions and their relationship with different types of food. This study was published in 1982 and included a sample of 100 college students who were surveyed and instructed to imagine themselves experiencing 22 different emotions.<sup>39</sup> The participants were then asked to open-endedly record the foods that they would choose to consume during each emotional experience.<sup>39</sup> The food choices reported were categorized as either healthful or junk food (in addition to other categories that are unrelated), and the findings show that junk foods tended to be more often preferred with negative emotions like depression and guilt, while

healthful food choices were often preferred with positive emotions like happiness and confidence.<sup>39</sup>

This particular study was unique as it demonstrated that the frequencies of individuals preferring different healthy versus unhealthy foods varied based on different types of emotions.<sup>39</sup> The findings imply that negative emotions are related to unhealthy food choices while positive emotions are related to healthful food choices. However, there are major limitations, the first being that this study is 34 years old to date. In the 1980s when this study was published, a much lower number of individuals enrolled in college after high school,<sup>58</sup> so the sample in this study may consist of individuals who are not representative of the general college population today. Additionally, participant's imaginations were used to measure associations between variables.<sup>39</sup> Though it was mentioned in the article that the use of imagination in lieu of direct emotional stimulation has been found to be an effective method,<sup>39</sup> there are currently more reliable methods to collect data that minimize error and bias. A study with similar, but more reliable and ecologically-valid measures would be useful to determine associations among emotions and food choices in college freshmen.

### **Apathetic Emotions**

Eating literature has recognized that boredom is an emotion that is an important contributor to overeating.<sup>48,49</sup> This emotion has never been assessed with food choices. Psychology literature typically considers boredom to be a negative emotion,<sup>41</sup> though some sources have speculated that it may have its own unique emotional influence that is separate from that of negative emotions.<sup>48,49</sup> In fact, recent literature on boredom has

reported that people more often eat in response to boredom than in response to other negative emotions.<sup>49</sup> Another study that assessed eating did not even include boredom as an emotion, but rather as its own separate influence on eating.<sup>59</sup>

Apathy and boredom have similar motivational components.<sup>60</sup> Apathy is considered having a lack of interest, lack of motivation, or lack of enthusiasm.<sup>61,62</sup> This is not to be confused with sadness.<sup>62</sup> Given that some literature has found that boredom is different from other negative emotions<sup>49,60</sup> and seems to have its own unique influence on eating behaviors,<sup>49</sup> it may be important to group boredom separately from negative emotions in future studies,<sup>49,60</sup> perhaps as apathetic. This will allow for further comparison between boredom and negative emotions, and will help to determine whether they have similar or different associations with food choices, provided that both types of emotions correlate with overeating.

### **Emotion and Food Choice Conclusion**

With all things considered, the bulk of research related to emotions and eating does not assess food choices. Conclusively, literature shows that negative emotions like stress, anger, anxiety, sadness, depression, and guilt are associated with overeating. More importantly, literature suggests that stress is associated with food choices that are high in sugar, salt, and fat, and negative emotions like guilt and depression are associated with junk food choices. Additionally, literature shows that positive emotions like joy, relaxation, and happiness are not associated with overeating, and that positive emotions like happiness and confidence are associated with more healthful food choices like fruits and vegetables.

Finally, some literature shows that people more often eat in response to boredom than in response to other negative emotions, therefore this emotion may be better classified as apathetic rather than negative. There is no literature that exists on boredom and food choices.

### **Ecological Momentary Assessment**

Most behavioral observational research mainly involves reflective questionnaires and surveys to obtain data.<sup>15</sup> Consequently, behavioral assessments are typically reliant on retrospective self-reports.<sup>16</sup> Though convenient, these types of data collection are subject to recall bias due to the potential for error as a result of unreliable memory.<sup>16</sup> Human recollections are not only inaccurate, but they are often biased as well.<sup>16</sup> As a result, memory is not always accurate at addressing a person's true behavior.<sup>16</sup> A retrospective questionnaire, for example, will conceptualize what a person was doing and how they were feeling in the past week, month, or year.<sup>63,64</sup> Because of this frequent reliance on global retrospective reports that are subject to such bias, research often fails to capture the dynamics of how life is truly lived which limits the ability to truly understand how to promote behavior change.<sup>16</sup>

Ecological momentary assessment, or EMA, is a tool which recognizes that many behaviors and experiences are affected by context.<sup>16</sup> EMA repeatedly assesses what a participant is doing at a particular moment, providing investigators with real-time behavioral data using technology that does not require participants to leave their environment or reflect on their past behaviors.<sup>15</sup> In other words, EMA emphasizes

ecologically-valid observations,<sup>16</sup> simultaneously capturing behavior as well as the factors that influence behavior.<sup>65</sup>

The most common EMA tools in recent health research involve palmtop computers<sup>17,66</sup> or mobile phones.<sup>15,67</sup> Advances in mobile technology have created opportunities for real-time, self-reported assessment of behavior in naturalistic settings.<sup>67</sup> Some of today's most common mobile phones are capable of running applications that trigger electronic surveys and then store the responses for future download.<sup>67</sup> Mobile phones are user-friendly and quite universal, and therefore have the capacity to collect data from large groups of people.<sup>67</sup>

In general, EMA studies often consist of one or more “waves” of data collection, often separated by weeks or months in order to examine the longitudinal effects and/or changes in behavior over time.<sup>47,65</sup> These waves have lasted anywhere from 4 to 14 days,<sup>47,65,68</sup> and participants can be prompted several times throughout the day at appropriate times<sup>16</sup> to complete short assessments. Specifically, some studies have prompted participants 7 times per day,<sup>47</sup> 30 times per day,<sup>65</sup> and some up to 44 times per day, and even more on weekends.<sup>68</sup> Assessments typically take about 1-3 minutes to complete<sup>47,65</sup> though times vary among studies. This design allows investigators to answer a variety of research questions<sup>16</sup> without overwhelming participants.

### **EMA Feasibility**

Studies by Dunton and colleagues<sup>65,67</sup> have determined that electronic EMA appears to be a feasible and acceptable strategy for measuring physical activity behaviors. In particular, EMA data have provided information about walking patterns in adolescents

that was not available prior to the study, and this is due to EMA's momentary and repeated assessments rather than the common recall-based assessments.<sup>65</sup> Other sources have commented on the general feasibility of EMA stating that using EMA with mobile phones is particularly beneficial for researchers because mobile phones can date and time stamp responses, which increases confidence in verifying compliance.<sup>69</sup> Also, EMA is easy for participants to use since mobile phone are so ubiquitous, thus EMA can be easily integrated into participants daily lives.<sup>69</sup> Participants in a feasibility study reported that an EMA mobile phone app worked well for them and was relatively easy to use.<sup>70</sup>

It is important to consider that every method of data collection has its limitations. EMA poses the challenge of the potential for distorted data due to reactivity.<sup>16,71</sup> In other words, it has been speculated that EMA data could be biased from a reactive effect, meaning that the frequency of a target variable could change more when it is being observed in this manner.<sup>71</sup> Evidence has shown this to be true; that in general, simply measuring behavior could impact subsequent behaviors.<sup>72</sup> However, Hufford et al<sup>71</sup> found this effect to be quite minimal with EMA. In this study, EMA reactivity was examined by looking at college students' drinking habits. Specifically, within-participant changes over the course of a 2-week EMA monitoring period were assessed by comparing pre- and post-monitoring self-reports of drinking, and they found no evidence for significant overall reactivity.<sup>71</sup> Also, EMA studies rely heavily on subject compliance for their data.<sup>16</sup> If EMA assessments become too burdensome, missing data could bias the sample.<sup>16</sup>

## **EMA, Emotions, and Food Choices**

Though EMA has yet to be used to assess emotions with food choices in college students, these two variables have been assessed together in one study of adolescents. This particular study assessed the relationship between interpersonal cues and eating unhealthy snacks and sweetened beverages in low socioeconomic status adolescents.<sup>73</sup> The findings show that consuming both sweet and salty snacks and sweetened beverages is associated with feeling lonely or bored in adolescents.<sup>73</sup>

These ecological findings related to emotions and food choices have important implications for adolescent health. Given that these data were collected from adolescents in their natural state, researchers were more easily able to examine how emotional cues truly correlate with food choices because they did not have to rely on the children's memory.<sup>73</sup> Thus, having identified these associations with real-time data as opposed to retrospective data can help to develop more effective and appropriate dietary interventions.<sup>73</sup>

## **EMA and Other Health Behaviors**

Outside the scope of emotions and food choices, EMA has also been used to assess eating behaviors in different populations as well as physical activity behaviors. In eating-disordered individuals for example, EMA was used to determine how emotions affect binge-eating episodes. One study found that subjects would experience more negative emotions, like anger and stress, on binge-eating days.<sup>66</sup> Another found that negative moods and cravings for sweets often precede binge eating episodes.<sup>74</sup> Similarly in adolescents, EMA was used to determine that negative affect is related to loss of

control while eating in young girls,<sup>75</sup> which can be a precursor to the development of disordered eating.<sup>76</sup> Without EMA in these types of studies, investigators would otherwise be reliant on subject's memory, which could be inaccurate or untruthful and potentially bias the results.

In addition, EMA has been used to study both adult and adolescent populations to assess affect and physical activity.<sup>44,47</sup> For example, one finding suggests that in adults over 50, variability in positive and negative affect can have an impact on subsequent levels of physical activity throughout the day.<sup>44</sup> In adolescents, more specifically, higher ratings of feeling energetic and lower ratings of feeling tired have been associated with more subsequent physical activity.<sup>47</sup> These findings help to elucidate our understanding of how affect, or emotions, can relate to subsequent physical activity patterns in adults and children. A retrospective method of data capture would not be equipped to assess variability in affect because it cannot employ repeated measures. Thus it cannot conclusively assess behavior in the same way as EMA.

### **EMA Conclusion**

Because EMA results show promising relationships between emotion/affect and important health behaviors like food choices, eating habits, and physical activity, it is important that we continue using EMA to fill the literature gaps related to emotions and food choices in college freshmen. This innovative technique for collecting data can be used to better understand why college freshmen make unhealthy food choices so that we can more effectively promote healthy lifestyle choices in our most vulnerable populations.



## **Summary**

This review of literature has examined the existing research related to eating during the college years, including the limited evidence regarding emotions and their association with food choices in college freshmen. It has also examined the literature on EMA, conceptualizing how real-time data minimize retrospective recall bias and reduces the risk of environmental error. More ecologically-valid research is necessary to fill the gaps related to different emotional experiences and their associated food choices, rather than just emotional overeating. Understanding how emotions associate with food choices will allow for a better determination of why the behaviors are occurring, so that healthy dietary practices can be better promoted in this population during their transition.

## CHAPTER 3

### METHODS

#### **Study Design**

This study was a secondary data analysis from the SPARC study, a larger, longitudinal study assessing the social impact of nutrition and physical activity in college freshmen. The longitudinal study consisted of an opportunistic sample of 1,500 college students living in residence halls on Arizona State University's (ASU) Tempe campus, Downtown Phoenix campus, and West campus. All students, both males and females, were recruited for the study in August and September 2015. Inclusion criteria were ASU-enrolled students during the fall 2015 semester who lived in one of the targeted residence halls. iPhone or Android smartphones were required for students to participate in the mobile EMA questionnaires. Interested students who did not own an iPhone or Android but met all other criteria were provided loaner phones to use for the study.

Recruitment took place at each of the residence halls on each floor during their weekly floor meetings. All participants who chose to participate in the study provided written informed consent during recruitment. The EMA data collection consisted of four separate time points throughout the school year between August 2015 and April 2016; the data for this analysis was collected during time point #1 in October 2015. Participants were able to earn up to \$15 in Amazon gift cards at each EMA time point, in addition to other incentives that were offered through the longitudinal study including more gift cards and devilSPARC "swag" which consisted of t-shirts, tote bags, and water bottles. Participants who reported eating on the EMA surveys were included for this analysis. At

time point #1 there were a total of 13,066 EMA surveys from 837 participants; after excluding surveys that did not include eating, a total of 2,142 surveys remained from 647 participants. All study protocols were approved by the Arizona State University Institutional Review Board.

### **Measures**

The instrument used for data collection in this analysis was the devilSPARC mobile application (app) EMA (mEMA). Participants were asked to download the devilSPARC app onto their smartphone and then “opt in” to a text messaging service provider. Once these tasks were complete, participants were ready to receive text messages which prompted them to open the devilSPARC app at random times through the day to complete short surveys (<1 minute each) about what they were doing in the moment before receiving the prompt.

Participants received prompts to complete the surveys during four random days throughout the week (three weekdays and one weekend day), eight times per day, between 9am and 10pm (totaling 32 prompts per week). An interval contingent design was used to disperse the prompts to participants; prompts were sent twice at random during the following designated windows: 9am to 12pm, 12pm to 3pm, 3pm to 7pm, and 7pm to 10pm. When a prompt was received, participants had up to 30 minutes to respond. Otherwise, the prompt was missed.

Once a prompt was received to the participant’s phone, a link was provided in the text message to open the devilSPARC app. Once the app was opened, a personalized welcome screen appeared with the participant’s name advising them to begin their

survey. Once they began, the first question they received was, “What were you doing right before you got this text? (please check all that apply).” Their answer choices included eating, drinking, being physically active, or none of the above. Only those who reported “eating” in their responses were used for this analysis.

The next question asked, “What are you eating? (please check all that apply).” Participants made their selection based on food group categories which included the following: cookies, sweetened baked goods, candy and frozen desserts; salty snacks and fried dishes; fruits and vegetables (including salads); pizza and fast food; sandwiches, wraps, breads, pitas, and tortillas; meat, poultry, fish, eggs, and meat alternatives; pasta, noodles, rice, and other grains; and hot and cold cereals. Participants were able to select more than one food choice. An information button was available for participants to use if they were unsure of which category to choose, and this provided them with a more detailed description of the food category (ex. *Salty snacks including potato chips, veggie straws, cheese-flavored crackers, beef jerky, popcorn, pretzels, nachos, or string, sliced, shredded, or wedged cheese.*). Each food group was analyzed separately for this analysis.

Once the participant chose one or more food choices, the next question was, “Just before I started eating, I was feeling...” They answered from the following: happy, hungry/thirsty, tired, bored, meh, energized, relaxed, sad, stressed/nervous/anxious, sick, none of the above, or other. Participants were able to select more than one emotion. If a participant’s emotion was not included in the list, they were able to choose “other” and manually write what they were feeling. Non-emotional feelings were excluded from this analysis (hungry/thirsty and sick). Those who reported feeling negative emotions (sad,

stressed/nervous/anxious, or tired), positive emotions (happy, energized, or relaxed), or apathetic emotions (bored or “meh”) were included in this analysis.

### **Statistical Analysis**

Data are expressed as mean  $\pm$  standard deviation and was checked for normality. Bivariate analysis (chi-square) was used to examine the relationship between emotions, food choices, and sociodemographics. Mixed model logistic regression assessed the cross-sectional association between emotions and food choices adjusting for gender, race/ethnicity, Pell grant status, highest parental education, and the clustering of repeated measures within person and of students within residence hall. Models were run with surveys in which participants responded with one or more emotions from a single category (positive only, negative only, or apathetic only) and were analyzed with each food choice separately. Statistical significance was fixed at  $p < 0.05$ . SAS software version 9.4 (SAS Institute Inc., Cary, NC) was used for all analyses.

## CHAPTER 4

### DATA AND RESULTS

#### **Descriptive Characteristics**

A total of 647 participants were included in this analysis. Due to the repeated measures of the EMA, a total of 2142 EMA surveys were included. There were more females (70.3%) than males in the sample and there were slightly more non-white (51.5%) than white participants. The mean age was 17.5 years. More than half of the participants (71.7%) reported that their parents had an education level greater than high school. Sociodemographics are presented in Table 1.

The two food choices that had the greatest number of instances included meats/proteins (28.7%) and fruits/vegetables (28.3%) (see Table 1). The food choices with the lowest prevalence included pizza/fast food (13.8%) and cereals (6.0%). Of the reported emotions following food choices, 16.6% reported feeling negative emotions, 33.7% reported feeling positive emotions, and 8.0% reported feeling apathetic emotions. It is important to note that these percentages do not add up to 100 because the EMA surveys allow for participants to select more than one response. Participants were able to choose more than one emotion and more than one food choice on each survey. Additionally, some unrelated responses were not included in this analysis. All key variables are presented in Table 1.

**Table 1: Sociodemographics and Key Variables**  
(n=647 participants, 2142 surveys)

<b>Sociodemographics (n=647)</b>	
<b>Age</b> <i>mean±SD</i>	17.5±0.44
<b>Gender</b> % (n)	
Female	70.3 (455)
<b>Race/ethnicity</b> % (n)	
White	48.5 (314)
Non-white	51.5 (333)
<b>Pell grant status</b> % yes (n)	34.6 (224)
<b>Highest parental education</b> % (n)	
Trade or higher	71.7 (464)
High school or less	28.3 (183)
<b>Key Variables (n=2142)</b>	
<b>Food Choices</b> % (n)	
Sweets	18.8 (402)
Salty snacks/fried foods	14.5 (311)
Fruits/vegetables	28.3 (607)
Pizza/fast food	13.8 (296)
Sandwiches/wraps	21.1 (451)
Meats/proteins	28.7 (614)
Pasta/rice	19.1 (410)
Cereals	6.0 (129)
<b>Emotions</b> % (n)	
Sad	1.9 (41)
Stressed	8.3 (177)
Tired	25.8 (553)
Happy	30.6 (656)
Energized	8.8 (188)
Relaxed	17.9 (384)
Bored	7.9 (169)
Meh	12.4 (266)
<b>Emotions by Group</b> % (n)	
Negative: sad, stressed, tired	16.6 (356)
Positive: happy, energized, relaxed	33.7 (722)
Apathetic: bored, meh	8.0 (171)

\*Participants were given the option to choose one or more emotions and one or more food choices

### **Unadjusted Relationship between Emotions and Food Choices**

The results of the unadjusted bivariate analysis of the relationship between individual emotions and food choices are included in Table 2. Participants who reported feeling happy were 10.3% more likely to eat sweets and 4.4% more likely to eat fruits/vegetables than those who did not report feeling happy. Participants who reported feeling energized were 15.6% more likely to eat fruits/vegetables than those who did not report feeling energized. Additionally, participants who were feeling bored were 6.6% more likely to eat sweets and 8.7% more likely to eat salty snacks/fried foods, while participants who were feeling meh were 6.9% more likely to eat pizza/fast food.



**Table 2: Bivariate Relationship of Emotions and Food Choices**

<b>Emotion</b>	<b>Food Choice</b>	<b>Yes % (n)</b>	<b>No % (n)</b>	<b>p-value</b>
Stressed (n=2124)	Sweets	20.9 (37)	18.6 (365)	0.510
	Salty snacks/fried food	15.8 (28)	14.4 (283)	0.688
	Fruits/vegetables	34.5 (61)	27.8 (546)	0.072
	Pizza/fast food	16.4 (29)	13.6 (267)	0.358
	Sandwiches/wraps	16.4 (29)	21.5 (422)	0.135
	Meats/proteins	32.2 (57)	28.4 (557)	0.317
	<b>Pasta/rice</b>	<b>25.4 (45)</b>	<b>18.6 (365)</b>	<b>0.034</b>
Sad (n=2124)	Cereals	7.9 (14)	5.8 (115)	0.349
	Sweets	29.3 (12)	18.6 (390)	0.124
	Salty snacks/fried food	24.4 (10)	14.3 (301)	0.112
	Fruits/vegetables	36.6 (15)	28.2 (592)	0.313
	Pizza/fast food	17.1 (7)	13.8 (289)	0.703
	Sandwiches/wraps	22.0 (9)	21.0 (442)	1.000
	Meats/proteins	36.6 (15)	28.5 (599)	0.338
Tired (n=2124)	Pasta/rice	24.4 (10)	19.0 (400)	0.508
	Cereals	9.8 (4)	6.0 (125)	0.494
	Sweets	21.0 (116)	18.0 (286)	0.138
	Salty snacks/fried food	15.4 (85)	14.2 (226)	0.555
	Fruits/vegetables	29.1 (161)	28.1 (446)	0.678
	Pizza/fast food	12.8 (71)	14.2 (225)	0.482
	Sandwiches/wraps	22.8 (126)	20.5 (325)	0.272
Happy (n=2124)	Meats/proteins	31.5 (174)	27.7 (440)	0.102
	Pasta/rice	21.0 (116)	18.5 (294)	0.226
	<b>Cereals</b>	<b>8.9 (49)</b>	<b>5.0 (80)</b>	<b>0.002</b>
	Sweets	25.9 (170)	15.6 (232)	<0.001
	Salty snacks/fried food	14.5 (95)	14.5 (216)	1.000
	<b>Fruits/vegetables</b>	<b>31.4 (206)</b>	<b>27.0 (401)</b>	<b>0.041</b>
	Pizza/fast food	12.2 (80)	14.5 (216)	0.168
Energized (n=2124)	Sandwiches/wraps	20.4 (134)	21.3 (317)	0.677
	<b>Meats/proteins</b>	<b>33.4 (219)</b>	<b>26.6 (395)</b>	<b>0.002</b>
	Pasta/rice	20.0 (131)	18.8 (279)	0.557
	Cereals	4.7 (31)	6.6 (98)	0.115
	Sweets	22.3 (42)	18.4 (360)	0.224
	Salty snacks/fried food	15.4 (29)	14.4 (282)	0.794
	<b>Fruits/vegetables</b>	<b>42.6 (80)</b>	<b>27.0 (527)</b>	<b>&lt;0.001</b>
Relaxed (n=2124)	Pizza/fast food	16.5 (31)	13.6 (265)	0.317
	Sandwiches/wraps	22.9 (43)	20.9 (408)	0.585
	<b>Meats/proteins</b>	<b>35.1 (66)</b>	<b>28.1 (548)</b>	<b>0.050</b>
	<b>Pasta/rice</b>	<b>25.0 (47)</b>	<b>18.6 (363)</b>	<b>0.041</b>
	Cereals	6.4 (12)	6.0 (117)	0.954
	Sweets	16.9 (65)	19.2 (337)	0.343
	Salty snacks/fried food	14.6 (56)	14.5 (255)	1.000
Bored (n=2124)	Fruits/vegetables	32.3 (124)	27.5 (483)	0.066
	Pizza/fast food	12.5 (48)	14.1 (248)	0.456
	Sandwiches/wraps	24.5 (94)	20.3 (357)	0.081
	<b>Meats/proteins</b>	<b>33.6 (129)</b>	<b>27.6 (485)</b>	<b>0.022</b>
	<b>Pasta/rice</b>	<b>23.2 (89)</b>	<b>18.3 (321)</b>	<b>0.032</b>
	<b>Cereals</b>	<b>9.6 (37)</b>	<b>5.2 (92)</b>	<b>0.002</b>
	Sweets	24.9 (42)	18.3 (360)	0.045
Meh (n=2124)	<b>Salty snacks/fried food</b>	<b>22.5 (38)</b>	<b>13.8 (273)</b>	<b>0.003</b>
	Fruits/vegetables	23.7 (40)	28.7 (567)	0.189
	Pizza/fast food	14.8 (25)	13.7 (271)	0.790
	Sandwiches/wraps	16.0 (27)	21.5 (424)	0.112
	<b>Meats/proteins</b>	<b>20.7 (35)</b>	<b>29.4 (579)</b>	<b>0.022</b>
	Pasta/rice	16.0 (27)	19.4 (383)	0.323
	Cereals	7.1 (12)	5.9 (117)	0.656
Meh (n=2124)	Sweets	16.9 (45)	19.0 (357)	0.458
	Salty snacks/fried food	17.3 (46)	14.1 (265)	0.201
	Fruits/vegetables	27.1 (72)	28.5 (535)	0.676
	<b>Pizza/fast food</b>	<b>19.9 (53)</b>	<b>13.0 (243)</b>	<b>0.003</b>
	Sandwiches/wraps	21.4 (57)	21.0 (394)	0.937
	Meats/proteins	26.7 (71)	28.9 (543)	0.491
	Pasta/rice	16.2 (43)	19.6 (367)	0.217
Cereals	8.3 (22)	5.7 (107)	0.131	

## **Unadjusted Relationship between Negative, Positive, and Apathetic Emotions and Food Choices**

The results of the unadjusted bivariate analysis of the relationship between negative, positive, and apathetic emotions and foods choices are included in Table 3. No significant associations were observed among negative emotions and food choices. There were, however, significant associations among positive emotions and certain food choices. For instance, participants who reported feeling positive emotions were 5% less likely to eat pizza/fast food than those who did not report positive emotions. Furthermore, participants who reported feeling positive emotions were 2.4% less likely to eat cereals than those who did not report positive emotions.

Apathetic emotions were also significantly associated with certain food choices. Participants who reported feeling apathetic emotions were 7.7% more likely to eat salty snacks/fried foods than those who did not report apathetic emotions. Additionally, these participants were 10.2% less likely to eat sandwiches/wraps and 8.9% less likely to eat meats/proteins.

**Table 3: Bivariate Relationship of Negative, Positive, and Apathetic Emotions and Food Choices**

<b>Emotion</b>	<b>Food Choice</b>	<b>Yes % (n)</b>	<b>No % (n)</b>	<b>p-value</b>
Negative only (n=2124)	Sweets	16.9 (60)	19.2 (342)	0.348
	Salty snacks/fried foods	14.9 (53)	14.5 (258)	0.894
	Fruits/vegetables	28.7 (102)	28.3 (505)	0.937
	Pizza/fast food	12.4 (44)	14.1 (252)	0.430
	Sandwiches/wraps	20.5 (73)	21.2 (378)	0.836
	Meats/proteins	28.7 (102)	28.7 (512)	1.000
	Pasta/rice	21.4 (76)	18.7 (334)	0.278
	Cereals	6.2 (22)	6.0 (107)	0.988
Positive only (n=2124)	Sweets	21.1 (152)	17.6 (250)	0.061
	Salty snacks/fried foods	14.1 (102)	14.7 (209)	0.763
	Fruits/vegetables	30.5 (220)	27.3 (387)	0.131
	<b>Pizza/fast food</b>	<b>10.5 (76)</b>	<b>15.5 (220)</b>	<b>0.002</b>
	Sandwiches/wraps	19.8 (143)	21.7 (308)	0.340
	Meats/proteins	29.2 (211)	28.4 (403)	0.720
	Pasta/rice	19.1 (138)	19.2 (272)	1.000
	<b>Cereals</b>	<b>4.4 (32)</b>	<b>6.8 (97)</b>	<b>0.035</b>
Apathetic only (n=2124)	Sweets	15.8 (27)	19.0 (375)	0.348
	<b>Salty snacks/fried foods</b>	<b>21.6 (37)</b>	<b>13.9 (274)</b>	<b>0.008</b>
	Fruits/vegetables	28.7 (49)	28.3 (558)	0.994
	Pizza/fast food	18.7 (32)	13.4 (264)	0.069
	<b>Sandwiches/wraps</b>	<b>11.7 (20)</b>	<b>21.9 (431)</b>	<b>0.002</b>
	<b>Meats/proteins</b>	<b>20.5 (35)</b>	<b>29.4 (579)</b>	<b>0.017</b>
	Pasta/rice	13.5 (23)	19.6 (387)	0.061
	Cereals	5.3 (9)	6.1 (120)	0.789

\*negative only group included sad, stressed, and tired; positive only group included happy, energized, and relaxed; apathetic only group included bored and meh

## **Adjusted Relationship between Negative, Positive, and Apathetic Emotions and Food Choices**

Adjusted mixed model logistic regression results can be found in Table 4. After adjustment, there were still no significant associations among negative emotions and food choices. Significant associations remained, however, between positive emotions and pizza/fast food as well as positive emotions and cereals. Participants who reported feeling positive emotions had a 40% lower odds of eating pizza/fast food (OR=0.6; 95% CI=0.5, 0.8) and a 40% lower odds of eating cereals (OR=0.6; 95% CI=0.4, 1.0).

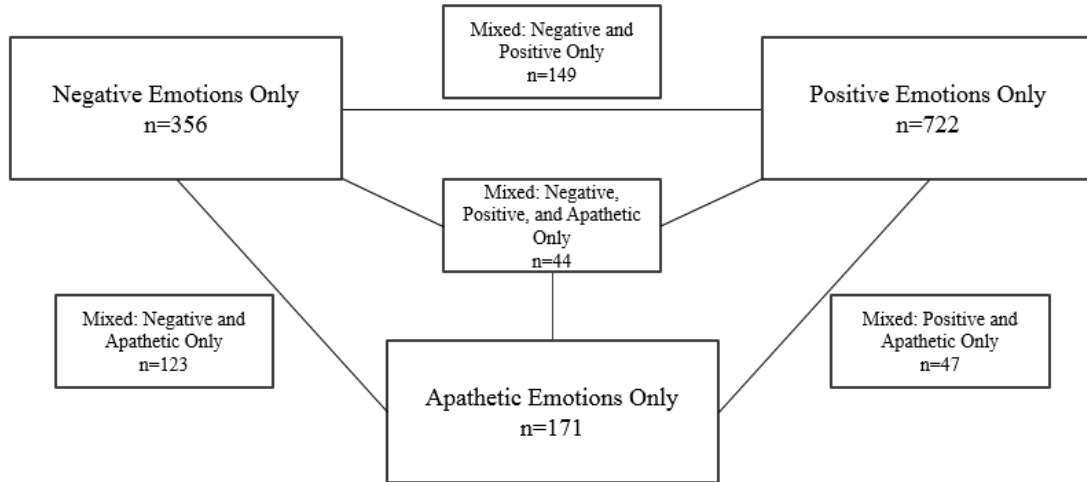
Significant associations between apathetic emotions and food choices remained after adjustment as well. Participants who reported feeling apathetic emotions had a 60% higher odds of eating salty snacks/fried foods (OR=1.6; 95% CI=1.1, 2.5). In addition, apathetic emotions were inversely associated with eating sandwiches/wraps (OR=0.5; 95% CI=0.3, 0.8) and meats/proteins (OR=0.6; 95% CI=0.4, 1.0).

## **Post-Hoc Analysis Assessing the Relationship between Mixed Emotions and Food Choices**

Given that participants were able to select more than one response on the EMA surveys for emotions, there were several instances of conflicting mixed emotions. These included survey responses with combinations of positive and negative, negative and apathetic, positive and apathetic, or all three emotion categories. The number of survey instances for each single emotion category (i.e. negative only, positive only, apathetic only) as well as each emotion combination are presented in Figure 1. As a result, a post-hoc analysis was conducted for this subsample of participants which can be found in

Table 4. The group of participants with mixed emotions had a significant 60% higher odds of eating sweets (OR=1.6; 95% CI=1.2, 2.1), and meats/proteins (OR=1.6; 95% CI=1.2, 2.0), and a 90% higher odds of eating cereals (OR=1.9; 95% CI=1.2, 2.9).

**Figure 1: Counts of Emotion Combinations by Survey**



\*negative only group included sad, stressed, and tired; positive only group included happy, energized, and relaxed; apathetic only group included bored and meh; mixed only groups included any combination of positive, negative, and apathetic emotions

**Table 4: Mixed Generalized Estimating Equations (odds ratios) of the Relationship between Negative, Positive, Apathetic, and Mixed Emotions and Food Choices**

<b>Emotion</b>	<b>Food Choice</b>	<b>OR (95% CI)</b>	<b>p-value</b>
Negative only (n=2124)	Sweets	0.8 (0.6, 1.2)	0.270
	Salty snacks/fried foods	1.0 (0.7, 1.4)	0.900
	Fruits/vegetables	1.0 (0.8, 1.4)	0.860
	Pizza/fast food	0.9 (0.6, 1.3)	0.530
	Sandwiches/wraps	1.0 (0.8, 1.4)	0.890
	Meats/proteins	1.1 (0.8, 1.4)	0.690
	Pasta/rice	1.2 (0.9, 1.6)	0.200
	Cereals	1.0 (0.6, 1.7)	0.870
Positive only (n=2124)	Sweets	1.2 (1.0, 1.5)	0.130
	Salty snacks/fried foods	1.0 (0.8, 1.3)	0.970
	Fruits/vegetables	1.2 (0.9, 1.5)	0.170
	<b>Pizza/fast food</b>	<b>0.6 (0.5, 0.8)</b>	<b>0.001</b>
	Sandwiches/wraps	0.9 (0.7, 1.1)	0.310
	Meats/proteins	1.0 (0.8, 1.2)	0.840
	Pasta/rice	1.0 (0.8, 1.2)	0.720
	<b>Cereals</b>	<b>0.6 (0.4, 1.0)</b>	<b>0.028</b>
Apathetic only (n=2124)	Sweets	0.8 (0.5, 1.2)	0.270
	<b>Salty snacks/fried foods</b>	<b>1.6 (1.1, 2.5)</b>	<b>0.018</b>
	Fruits/vegetables	1.1 (0.7, 1.5)	0.780
	Pizza/fast food	1.5 (1.0, 2.3)	0.060
	<b>Sandwiches/wraps</b>	<b>0.5 (0.3, 0.8)</b>	<b>0.003</b>
	<b>Meats/proteins</b>	<b>0.6 (0.4, 1.0)</b>	<b>0.027</b>
	Pasta/rice	0.7 (0.4, 1.1)	0.100
	Cereals	0.9 (0.4, 1.7)	0.660
Mixed only (n=2124)	<b>Sweets</b>	<b>1.6 (1.2, 2.1)</b>	<b>0.001</b>
	Salty snacks/fried foods	1.1 (0.8, 1.5)	0.710
	Fruits/vegetables	1.2 (0.9, 1.6)	0.190
	Pizza/fast food	1.1 (0.8, 1.6)	0.520
	Sandwiches/wraps	1.2 (0.9, 1.5)	0.340
	<b>Meats/proteins</b>	<b>1.6 (1.2, 2.0)</b>	<b>0.001</b>
	Pasta/rice	1.3 (1.0, 1.7)	0.100
	<b>Cereals</b>	<b>1.9 (1.2, 2.9)</b>	<b>0.003</b>

\*models adjusted for gender, race/ethnicity, Pell grant status, highest parental education, and clustering of responses among participants and within residence halls

\*negative only group included sad, stressed, and tired; positive only group included happy, energized, and relaxed; apathetic only group included bored and meh; mixed only group included any combination of positive, negative, and apathetic emotions

## CHAPTER 5

### DISCUSSION

#### **Overview**

The purpose of this study was to utilize mobile-based EMA surveys to determine associations among negative, positive, and apathetic emotions and food choices in college freshmen living in residence halls; we also conducted post hoc analyses on students who reported mixed emotions when eating. To our knowledge, this is the first study to collect real-time, ecologically-valid data regarding emotions and food choices in the college population. Existing literature has assessed the phenomenon of overeating related to negative emotions, though rarely is the relationship between other emotions and food choices included in the literature. Studies examining emotions with food choices are often limited to assessing a single emotion, usually related to unhealthy food choices, thus comparisons cannot easily be made. This study sought to address these literature gaps by grouping a variety of common emotions into negative, positive, apathetic, and mixed categories to better understand how different types of emotions compare to one another in their associations with a variety of food choices.

Findings from the current study suggest that emotions are associated with food choices. Some of the observed associations included food choices that have never been examined in the literature such as cereals, meats/proteins, and sandwiches/wraps. Positive emotions were significantly and inversely associated with pizza/fast food and cereals. Apathetic emotions were significantly and positively associated with salty snacks/fried foods and inversely associated with sandwiches/wraps and meats/proteins.

Mixed emotions were significantly and positively associated with sweets, meats/proteins, and cereals. Understanding the relationships between different types of emotions and different food choices is helpful in understanding the motivation behind healthy versus unhealthy food decisions. These findings can be used to guide effective interventions for promoting healthy food choices in populations who are vulnerable to unhealthy lifestyle changes, such as college freshmen.

### **Negative Emotions and Food Choices**

The current study found that there were no significant associations among negative emotions and food choices, rejecting the original hypothesis. When comparing these results to other studies that have assessed the relationship between negative emotions and food choices, we see contradictory findings in the literature. For instance when examining stress, it appears that a group of studies show that there is correlation between stress and food choices that are high in sugar and fat.<sup>14,52,54,77</sup> Also, in a study by Lyman<sup>39</sup> that examined various different negative emotions and food choices, it was found that with some of the negative emotions – most frequently being depression, guilt, jealousy, and worry – participants tended to prefer junk foods, which according to the study were generally high in sugar and fat.<sup>39</sup>

The lack of significant relationships between negative emotions and food choices in the current study may be due to college freshmen having a distinguishably different experience than others in the college population (i.e. upper classmen and graduate students). The literature that has examined stress and food choices consists of studies that include female college students only,<sup>14,53</sup> male college students only,<sup>78</sup> both



male and female college students and faculty,<sup>77</sup> and college faculty only.<sup>54</sup> The study by Lyman<sup>39</sup> that found that negative emotions were associated with unhealthy foods included a sample of both males and females in their sophomore and junior years of college. The conflicting findings between the literature and the present study support the notion that college freshmen may be a unique population apart from other college students. Most college freshmen are living away from home for the first time.<sup>79</sup> College freshmen living in residence halls on campus appear to be more emotionally stressed due to living in tight quarters with new roommates.<sup>79</sup> More research is needed to compare the differences in prevalence and perhaps even the magnitude of emotions experienced by college freshmen versus upper-year college students. This will allow for more population-specific interventions to target emotional regulation during eating occasions. In order to make strong conclusions to produce the most effective interventions, it will be critical to determine whether the college population is a generalizable population, or is a population consisting of smaller sub-populations with unique emotional experiences.

The observed differences in the relationship between negative emotions and food choices in this study compared to others may be a result of the previous literature utilizing retrospective measures for data collection. In the study by Lyman,<sup>39</sup> measures of food choice consisted of participants' imagination of what they believed they would like to consume in lieu of certain emotions. Imagination and memory have similar physiological processes,<sup>80</sup> and most memories are inaccurate to some degree, and thus biased.<sup>16</sup> Additionally, other studies have induced negative emotions in laboratory settings and then observed participants' subsequent food choices.<sup>53,77</sup> Because research in a laboratory setting does not accurately reflect everyday life situations, this type of

research environment has been shown to cause biased responses.<sup>17</sup> The unhealthy food choices that participants have reported making with negative emotions in retrospective and laboratory studies are not consistent with findings for negative emotions in the current, real-time study. We expect that the methodology of the EMA would decrease these biases in the current study with its ability to capture real-time data on emotions and food choices.

Other studies examining negative emotions and food choices utilize surveys in which participants can select from a list of food choices<sup>14,54</sup> that tend to be limited to high sugar and high fat foods.<sup>14</sup> This limits the ability to truly determine whether negative emotions are associated with high sugar and high fat food choices since participants do not have the option to also choose healthier foods like fruits, vegetables, or lean meats. Since so few studies have examined the relationship between negative emotions and healthy food choices as the current study did, more research is needed to confirm our findings.

### **Positive Emotions and Food Choices**

Participants with positive emotions in the current study had a significantly lower odds of consuming pizza/fast food. The limited literature (one study) that has examined positive emotions and food choices showed that healthful food choices are more often preferred with positive emotions.<sup>39</sup> Together with our findings, the research suggests that college students who are feeling positive may have been more motivated to make healthier food choices.

College freshmen are often concerned about gaining weight,<sup>5</sup> but feel that they do not always have easy access to healthful foods like fruits and vegetables.<sup>5</sup> In addition, college students have reported feeling that they do not always have access to grocery stores (due to proximity from campus), nor do they always have transportation to get to a grocery store.<sup>5</sup> Making healthful food choices can be burdensome for college students because of the time and financial costs associated, thus students are attracted to convenient and costly dining<sup>26</sup> and are often reliant on fast food, precooked meals, or unhealthy food served at university cafeterias.<sup>5</sup> As a result, college freshmen may be making healthier food choices with positive emotions by consuming less unhealthy foods like pizza/fast food. Since there is so little research on positive emotions and food choices, more research is needed to confirm these findings.

Other studies examining positive emotions do not assess the relationship between positive emotions and food choices. Rather, they look at the relationship between positive emotions and overeating. Based on the literature, it appears that positive emotions are not associated with overeating, implying that individuals who feel positive are more likely to eat normally.<sup>8,56,57</sup> However, studies that have reported on the normal diet of college freshmen have stated that it is normal for their fruit and vegetable intake to be quite low.<sup>9,33</sup> In fact, less than one-third consume the recommended amount of fruits and vegetables set forth by the *Dietary Guidelines for Americans*.<sup>25</sup> Perhaps in the current study, the participants who were feeling positive were eating “normally” and therefore were not eating enough fruits/vegetables for the results to be significant. It is possible that college freshmen who are feeling positive emotions are interested in making healthier food choices by eating less pizza/fast food. This finding is an important piece of

information that suggests positivity in college freshmen can be used to better promote healthy food choices and ultimately reduce the risk of weight gain and other health disparities. More research should continue to analyze the association between positive emotions and healthy food choices, perhaps longitudinally, to obtain a better overall picture of how positive emotions correlate with various types of healthy food choices.

### **Apathetic Emotions and Food Choices**

The current study found that participants who reported feeling apathetic emotions had a higher odds of eating salty snacks/fried food, and this was statistically significant. However, there were no significant associations between apathetic emotions and sweets or pizza/fast food as predicted, rejecting the original hypothesis for this research question. Boredom is the only apathetic emotion in the present study that has been previously examined in the literature with eating,<sup>48,49</sup> though not with food choices. Meh is an apathetic emotion that has never been examined in the literature with eating nor with food choices. It is possible that meh has yet to be studied because it is a relatively new slang term; it is typically used to express disinterest or apathetic feelings. Given that apathy and boredom have similar motivational and affective components<sup>60</sup> and apathy is defined as having a lack of interest or enthusiasm<sup>61,62</sup> such like meh, with the absence of literature it was logical to group both boredom and meh as apathetic emotions in the current study.

Some literature has shown that boredom predicts overeating to the same extent that negative emotions like depression, anger, and anxiety predict overeating.<sup>48</sup> Other literature has shown that boredom actually results in more overeating than that

which occurs with negative emotions,<sup>49</sup> which suggests that apathetic emotions may be a separate but significant contributor to overeating. In the current study, we found that apathetic emotions did have separate and significant associations with food choices than negative emotions had with food choices.

In addition to apathetic emotions being associated with a higher odds of eating salty snacks/fried foods in the current study, apathetic emotions were also associated with a lower odds of choosing sandwiches/wraps and meats/proteins. This finding may imply that college freshmen feeling apathetic are less likely to eat meal-type foods and more likely to eat snack-type foods. Boredom has been reported as a frequent reason for snacking in college students.<sup>59</sup> Snacks contribute significantly to the daily caloric intake of adolescents and young adults,<sup>81</sup> so it may be possible that the evidence related to apathetic emotions and overeating is constituted by snacks foods (i.e. salty snacks/fried foods).

### **Mixed Emotions and Food Choices**

Psychology literature states that it is common for people to experience instances in which they feel two conflicting emotions at once.<sup>41</sup> For example, this sort of confliction could happen when some factor induces both strong negative and strong positive feelings among an individual.<sup>41</sup> In the current study, we found that a large proportion of surveys included responses with more than one emotion from a conflicting group, or mixed emotions. In particular, we observed that feeling any combination of mixed emotions (negative/positive, negative/apathetic, positive/apathetic) was significantly associated with a greater odds of eating sweets, meats/proteins, and cereals.

Literature examining different emotions only reports results on single types of emotions. To our knowledge, there is no previous literature that assesses the associations among mixed emotions and eating or food choices. It is possible that investigators in these studies choose not report on participants with mixed emotions, or do not allow participants the opportunity to respond with more than one emotion. Limiting participants from responding with more than emotion may actually result in biased results since it is quite possible that people could be feeling multiple different emotions at once.<sup>41</sup> Our findings suggest that mixed emotions certainly are associated with food choices, therefore future research should allow participants to respond with more than one emotion and these participants should be included in analyses.

Mixed emotions in this population of college students may be a common result of a major life transition<sup>14</sup> that is emotionally-intense.<sup>8,46</sup> Perhaps college students turn to comfort foods when they have mixed emotions. Comfort foods are foods that induce a psychologically pleasurable state<sup>82</sup> and typically consist of high sugar and/or high fat foods such as sweets like ice cream, candy, cookies, and chocolate, as well as meal-type foods like burgers, steaks, and casseroles.<sup>14,82</sup> In the present study, we observed a significant association between mixed emotions and a higher odds of choosing sweets and meats/proteins, suggesting that college freshmen with mixed emotions may be drawn to comfort foods, though more research is needed to justify these new findings.

Given that mixed emotions were quite prevalent in our sample, more research should give special consideration to college freshmen with mixed emotions. Particularly, future studies should examine the magnitude of the conflicting emotions to determine whether one emotion may be more influential than the other, or whether all present

emotions have equal influences on food choices. It may also be important to compare different combinations of mixed emotions (i.e. negative/positive versus positive/apathetic) and compare their relationships with food choices.

### **Strengths and Limitations**

There are a number of strengths that should be taken into account when considering the findings of this study. First of all, this study is the first to examine the associations among negative, positive, apathetic, and mixed emotions and a relatively large variety of food choices (including healthy food choices). Other studies have not analyzed such a wide range of food choices in relation to different types of emotions. Another strength is that this study utilized EMA to collect data. Using EMA instead of traditional retrospective surveys allowed for multiple, repeated, real-time assessments within the participant's natural environment. This reduces the risk of retrospective recall bias and ultimately provided ecologically-valid data for this study. Additionally, the large sample size and diversity of the sample was another major strength, enhancing the generalizability of our findings.

One of the major limitations in this study was the cross-sectional design. This design can result in associations between variables but cannot predict causality and cannot show how variables would change over time. Additionally, the data came from a convenience sample of college freshmen at Arizona State University, therefore the findings may not generalize to other college freshmen in Arizona or at other universities in other states. Finally, the measures in this study were self-reported under the assumption that participants responded to surveys accurately and honestly, which could

cause bias to some degree; however, we expect that the EMA methodology minimized these biases.

### **Summary**

This is the first study to collect real-time, ecologically-valid data regarding emotions and food choices in college freshmen. The results from this study indicate that different types of emotions are associated with different food choices in college freshmen. Positive emotions were significantly and inversely associated with choosing pizza/fast food, and apathetic emotions were significantly and positively associated with choosing salty snacks/fried food and inversely associated with choosing sandwiches/wraps and meats/proteins. Additionally, this study demonstrated that mixed emotions are prevalent in college freshmen and are significantly associated with choosing sweets, meats/proteins, and cereals.

Previous literature has not used EMA to examine emotions and food choices. Rather, it has used retrospective surveys and laboratories to collect data.<sup>53,77</sup> Given that the current study's results are based on momentary data findings with no manipulation to the participant's natural environment, this could be a reason why some of our findings are contradictory to the literature's findings on emotions and food choices. Observing behavior in a person's natural environment at the moment the behavior occurs is what makes EMA ecologically-valid. Since EMA data are collected within a person's naturalistic environment, the data should be generalizable to their real-life experiences,<sup>16</sup> whereas laboratory or retrospective data would not be generalizable to the same extent. The difference in findings between the previous literature and the current study imply



that retrospective self-report and laboratory research among emotions and food choices yield different results than momentary, real-time self-report using EMA.

Our data suggest that positive emotions may contribute to healthy food choices in college freshmen. Additionally, the data presents a similar trend with apathetic and mixed emotions, both of which may contribute to unhealthy food choices in college freshmen. However, given that there is no previous literature examining the associations among apathetic or mixed emotions and food choices, more research is needed to justify these trends. Future research should continue to expand the literature base related to positive emotions and food choices, as the relationship between these variables appears to be promising for health promotion. More research should focus on mixed emotions in college freshmen and attempt to understand how and why feeling more than one type of emotion correlates with respective food choices. Finally, research should assess the differences between college freshmen and upper-year college students to allow for more tailored interventions, as these two populations seem to differ in their findings related to emotions and food choices. The findings from this study provide a better understanding of why college freshmen make certain food choices, and this understanding will aid in the promotion of healthy dietary practices for college freshmen during their transition.

## CHAPTER 6

### CONCLUSION

The transition to college is an emotional experience. This is a period in which a young adult must begin taking responsibility for their health and making independent food choices. Very little is known about how emotions are associated with food choices, especially in college freshmen. This secondary data analysis examined the associations among negative, positive, apathetic, and mixed emotions and food choices in college freshmen using EMA.

None of the hypotheses for this study were upheld. The findings of this study show that there was an inverse association between positive emotions and pizza/fast food, suggesting that college freshmen may make healthier food choices when feeling positive. Further, our findings show that apathetic emotions were significantly associated with salty snacks/fried foods, suggesting that college freshmen may make unhealthy food choices when feeling apathetic. Additionally, we found that there was a large proportion of our sample of college freshmen that indicated feelings of mixed emotions. Mixed emotions were significantly associated with a variety of different food choices.

This is the first study to collect real-time, ecologically-valid data regarding emotions and food choices in college freshmen. Previous literature has assessed the phenomenon of overeating related to negative emotions, though rarely is the relationship between other emotions and a variety food choices included in these studies. More research is needed to understand how college freshmen differ from upper-level college students, particularly related to their emotions and food choices, so that dietary

interventions can be better suited to those who are vulnerable. The findings from this study add to the small body of literature that exists regarding emotions and food choices, providing a better understanding of why college freshmen make certain food choices.

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APPENDIX A  
INSTITUTIONAL REVIEW BOARD APPROVAL



APPROVAL: MODIFICATION

Meredith Bruening  
 SNHP: Nutrition  
 602/827-2266  
 Meg.Bruening@asu.edu

Dear Meredith Bruening:

On 9/17/2015 the ASU IRB reviewed the following protocol:

Type of Review:	Modification
Title:	The Role of Friendship Networks on BMI and Behaviors among College Freshmen
Investigator:	Meredith Bruening
IRB ID:	1309009596
Funding:	Name: HHS-National Institutes of Health (NIH), Funding Source ID: HHS-NIH-National Institutes of Health
Grant Title:	None
Grant ID:	None
Documents Reviewed:	<ul style="list-style-type: none"> <li>• waist_hip_circumference_form.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);</li> <li>• devilWASTE Female Participant Data Collection Sheet 2015.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);</li> <li>• Response to 9/23 modification request, Dr.docx, Category: IRB Protocol;</li> <li>• RecruitQuestionFlyer.pdf, Category: Recruitment Materials;</li> <li>• ReminderFlyers.pdf, Category: Recruitment materials/advertisements /verbal scripts/phone scripts;</li> <li>• RefusalResponseSheet.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);</li> <li>• DidYouMissUs RecruitmentFlyer.pdf, Category:</li> </ul>

	<p>Recruitment materials/advertisements /verbal scripts/phone scripts;</p> <ul style="list-style-type: none"> <li>• Participant ID card and reminders, Category: Participant materials (specific directions for them);</li> <li>• App_Description.pdf, Category: Participant materials (specific directions for them);</li> <li>• Changes in app survey questions, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);</li> <li>• devilSPARC messages_072115.pdf, Category: Recruitment materials/advertisements /verbal scripts/phone scripts;</li> <li>• Microbiome pilot consent form, Category: Consent Form;</li> <li>•</li> </ul> <p>UpdatedProtocol_MergedWithdevilWASTE_082115.doc, Category: IRB Protocol;</p> <ul style="list-style-type: none"> <li>• Updated longitudinal survey plan, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);</li> <li>• GetInvolvedinScienceRecruitFlyer.pdf, Category: Recruitment Materials;</li> <li>• devilWASTE Screening Form 2015.pdf, Category: Screening forms;</li> <li>• devilWASTE Male Participant Data Collection Sheet 2015.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);</li> <li>• height_weight_form.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);</li> <li>• IRB Protocol for Microbiome Sub-Study, Category: IRB Protocol;</li> <li>• Response to 9/23 modification request, Dr.pdf, Category: Other (to reflect anything not captured above);</li> <li>• Microbiome pilot flyer, Category: Recruitment Materials;</li> <li>• script just devilSPARC, Category: Consent Form;</li> <li>• devilWASTE Study Enroll Form 2015.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);</li> <li>• devilWASTE script, Category: Consent Form;</li> <li>• devilSPARC_2015ConsentForm_082115.pdf, Category: Consent Form;</li> <li>• ExtraMoneyRecruit.pdf, Category: Recruitment</li> </ul>
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	<p>Materials;</p> <ul style="list-style-type: none"> <li>• Script explaining the app (goes with the AppdescriptionPDF), Category: Participant materials (specific directions for them);</li> <li>• Tentative devlSPARC data collection schedule.pdf Category: Other (to reflect anything not captured above);</li> </ul>
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The IRB approved the modification.

When consent is appropriate, you must use final, watermarked versions available under the "Documents" tab in ERA-IRB.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Tiffany Dunning  
 Tristan Thibodeau  
 Andrea Golfen  
 Jesus Villa  
 Rosa Krajmalnik-Brown  
 Yvonne Cirtino  
 Megan Dzurka  
 Alexandra Hauser  
 Hannah Metcalf  
 Juan Maldonado Ortiz  
 Abigail McGrath  
 Niki Lynn Bates  
 Makenna Baum  
 Michael Todd  
 Brett Gruberg  
 Corrie Whisner  
 Tsung-Yen Yu  
 Gregory Berghorst  
 Teresa Fisher  
 Eva Sanchez  
 Ashley vanStratum  
 Syed Umer  
 Jessica King  
 Ashley Vasos-Aust

Carole Matadamas  
Alexis Nazzaro  
Stacy Simmons  
Stephanie Nelson  
Kevin Hollingshead  
Anna Gianpetro  
Punam Ohri-Vachaspati  
Sarah Appleby  
Daniel Hruschka  
Charlotte Bone  
Mariya Voytyuk  
Melinda Barnum  
Kara Robertson  
Justin Norris  
Sarah Alyea  
Kalah Walden  
Selicia Mayra  
Melissa Lyczynski  
Irene van Woerden  
Alexandra Brewis Slade  
Almarie Rivera  
Jose Rosales Chavez  
Sha Charley  
David Schaefer  
Gavin Mack  
Rebecca Bender  
Bethany McClure  
Sydney Ferreira

APPENDIX B  
CONSENT FORM



**CONSENT/ASSENT FORM**  
**devilSPARC, Fall 2015**



**INTRODUCTION:** The purpose of this form is to provide you information about our study that may affect your decision to participate in this research, and to record the consent of those who agree to be involved in the study.

**RESEARCHER(S):** Professor Meg Bruening, PhD, MPH, RD from the College of Health Solutions is partnering with the College of Liberal Arts and Sciences to invite you to participate in a research study.

**STUDY PURPOSE:** The purpose of this study is to assess eating and physical activity among college students.

**DESCRIPTION OF RESEARCH STUDY:** If you decide to be a part of this study, you will be asked to complete the following related to eating, physical activity behaviors and weight:

STUDY ACTIVITIES	PARTICIPANT'S INITIALS INDICATING UNDERSTANDING
Check-in survey (4 times throughout the year)	_____
Height, weight, waist, hip measurements (4 times throughout the year)	_____
<b>devilSPARC app surveys</b> (4 times throughout the year. App will be downloaded to your phone) <i>The mobile app will prompt you to complete a short (3-minute) questionnaire about your current activities. You will be asked to complete these brief surveys randomly 8 times per day (between 9am and 11pm) for a total of 4 days at each time point.</i>	_____
<b>SunCard</b> <i>Researchers will have limited access to view your SunCard activity throughout the year, including entrance/exit of ASU's dining halls, food receipt data, and on-campus gym facilities.</i>	_____
<b>Friends</b> <i>Researchers will ask you to provide the names and contact information of our friends so that we can invite them to participate in the study.</i>	_____

**Participation in this study is voluntary.** You can choose to stop at any time. Your survey responses will be kept **strictly confidential**, and will only be compiled as a group, not individually. Your decision to participate and your responses, should you choose to participate, will not affect your enrollment status at Arizona State University in any way. If you agree to participate, your time spent participating will total around 5-6 hours.

**We may have additional opportunities to participate in other studies. If you are willing to be contacted about these opportunities, please initial here:** \_\_\_\_\_ *(participant's initials indicating willingness)*

**RISKS:** Once installed, the mobile app will run in the background on your phone. This may lead to battery drain, and will capture some information about your location during participation. We are working with an outside vendor, Twilio, to send you text messages for you to complete the devilSPARC app surveys; we have an agreement to maintain your confidentiality with this company. You should only receive messages from us from this company unless you have signed up for other services through other vendors. Your SunCard activity may also include information about your location. Additionally, you may feel uncomfortable providing personal information about yourself in the study questionnaires. At every point, the researcher will de-identify data so that your questionnaire responses and information about your location will not be linked to you personally. However, as in any research, there is some possibility that you may be subject to risks that have not yet been identified.

**BENEFITS:** There are no direct benefits to participation. However, indirect benefits of your participation include helping the researcher understand ways to promote nutrition and physical activity. These data will also add to the general scientific knowledge about college students' contextual factors related to nutrition and physical activity behaviors among friendship networks over time.

**CONFIDENTIALITY:** All information obtained in this study is strictly confidential. The results of this research study may be used in reports, presentations, and publications, but the researchers will not identify you by name. In order to maintain confidentiality of your records, Dr. Bruening will assure that your name will only appear on this consent form and the intake form. Study data will not be transmitted via the Internet. Study data will be stored on a password protected server. To these extents, confidentiality is not absolute.

**WITHDRAWAL PRIVILEGE:** Participation in this study is completely voluntary. It is ok for you to say no at any time. Even if you say yes now, you are free to say no later, and withdraw from the study at any time.



APPENDIX C

ECOLOGICAL MOMENTARY ASSESSMENT SURVEY

**EMA Questionnaire Construct Table**

Construct	Item	Responses	Information/hover button text	Variable name (code)	Source
Current behavior	What were you doing right before you got this text? (please check all that apply)	1	Eating	behav	Developed for this project
		2	Drinking	eat (0/1)	
		3	Being physically active	bev (0/1)	
		4	None of the above	pa (0/1)	
			Any activity involving movement, including things like walking to the bus, walking to class or grocery shopping.		

Eating		Are you eating any of the following items? (please check all that apply)		eat_type		Adapted from: Laska MN, Graham D, Moe SG, Lytle L, Fulkerson J. Situational characteristics of young adults' eating occasions: a real-time data collection using Personal Digital Assistants. Public Health Nutr. 2011 Mar;14(3):472-479.
1	Cookies, sweetened baked goods, candy and frozen desserts	1. Cookies including BaVita breakfast cookies, cereal/granola bars, protein or energy bars. Sweetened baked goods/doughnuts, cinnamon rolls, muffins/scones, cakes/cupcakes, or pies. Candy including fruit snacks, candy bars, or milk or dark chocolate. Frozen desserts including popsicles, Italian ice, ice cream, ice-cream sandwiches, frozen yogurt/sorbet/sherbet, or frozen fruit juices.	sweets (0/1)			
2	Salty snacks/fried side dishes	2. Salty snacks including potato chips, Veggie straws, cheese crackers, beef jerky, popcorn, pretzels, nachos, or string, sliced, shredded, or wedge cheese. Fried side dishes including French fries, tater tots, hash browns, potato skins, fried mozzarella sticks, onion rings.	slyv_snk (0/1)			
3	Fruits and vegetables (including salads)	3. Fresh, canned, pureed, dried or frozen fruits including bananas, peaches in light or heavy syrup, apple sauce, dried or frozen mixed berries. Fresh, canned or frozen vegetables including spinach, kale, green beans, carrots, or garden salads	fr (0/1)			
4	Pizza and fast food	4. Pizza ordered from Dominos, Pizza Hut, or Papa John's, etc. Frozen pizza including options from Digiorno, Totino's, or Red Baron. Fast food including hamburgers, cheeseburgers, hotdogs, chicken nuggets, fried chicken, hot wings, tacos, chili, fried rice, or lo-mein.	Pz_ff (0/1)			
5	Sandwiches (hot and cold), wraps, breads, pitas, and tortillas	5. Sandwiches (hot and cold) including chicken sandwiches, deli-meat sandwiches and wraps including burritos, quesadillas, Gyros, or turkey wraps. Breads including dinner rolls, naan/pita, or bagels or bagel thins.	sd_wp_bd (0/1)			

	6	Meat, poultry, fish, eggs, and meat alternatives	6. <b>Meat, poultry, fish and eggs</b> including beef, chicken, turkey pork, salmon, shrimp, scrambled, fried or poached eggs. <b>Meat alternatives</b> including tofu of any type, beans including kidney, black, or pinto beans, or hummus and tempeh.	mt_alt (0/1)	
	7	Pasta, noodles, rice, and other grains	7. <b>Pastas</b> including spaghetti, linguine, lasagna, fettucine, or macaroni and cheese. <b>Rice</b> such as white, brown, or wild. <b>Other grains</b> such as quinoa, barley, corn, or karnati.	pa_no_gr (0/1)	
	8	Hot and cold cereals	8. <b>Cereals (hot and cold)</b> including oatmeal/granola, Cream of Wheat, Frosted flakes, Raisin Bran, Froot Loops, or Honey Bunches of Oats.	ht_cd_cer (0/1)	
	9	Other(specify): _____		eat_other (string)	

Emotion	Just before I started eating/drinking/being active/being inactive. I was feeling ... (Please check all that apply.)		Developed for this project
1	Happy		happy (0/1)
2	Hungry/thirsty		hungry (0/1)
3	Tired		tired (0/1)
5	Bored		bored (0/1)
5	Meh		meh (0/1)
6	Energized		energy (0/1)
7	Relaxed		relaxed (0/1)
8	Sad		sad (0/1)
9	Stressed/nervous/anxious		stress (0/1)
10	Sick		sick (0/1)
11	None of the above		emot_none (0/1)
12	Other (specify): _____		emot_other (string)
			influence