THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENTS OF BIOLOGY AND NUTRITIONAL SCIENCES

THE INFLUENCE OF CHILD WEIGHT STATUS, FOOD-CONSUMING BEHAVIORS, CHILD SEX, AND LOSS OF CONTROL EATING UPON EATING IN THE ABSENCE OF HUNGER IN 7-11 YEAR-OLD CHILDREN

ARIMANI MELINA CAPRIO
SUMMER 2016

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Biology
with interdisciplinary honors in Biology and Nutritional Sciences

Reviewed and approved* by the following:

Kathleen Keller, Ph.D.
Assistant Professor, Department of Nutritional Sciences
Thesis Supervisor

James Marden, Ph.D.
Professor of Biology
Honors Adviser

Rebecca Corwin, Ph.D., RD
Professor of Nutritional Neuroscience
Honors Adviser

* Signatures are on file in the Schreyer Honors College.
ABSTRACT

The purpose of this thesis project was to provide information about the relationship between child weight status, loss of control eating (LOC), and food intake during eating in the absence of hunger (EAH) while at the same time identifying behaviors that may predict EAH in 44, 7-11 year-old children (mean age = 9.00; SD = ±1.31). Twenty of the subjects were boys and twenty-four were girls (healthy weight = 25; overweight/obese = 19). EAH was measured as children’s intake from a selection of highly palatable snack foods served when they were not hungry, after consumption of a multi-item meal to reported satiety. The main outcome was number of calories children consumed during the EAH protocol. The secondary outcome was time spent engaged in eating versus non-eating activities (i.e. playing) during the EAH protocol. Noldus Observer XT 10 software was used to record and analyze behaviors (i.e. sitting versus standing, gazing at food versus gazing elsewhere, eating versus playing with toys) of the subjects during both food intake and nonfood intake intervals of EAH. Noldus allowed for the manual coding of these behaviors in terms of their duration, consistency, and repetition. Children were screened for LOC using the LOC eating disorder questionnaire, developed by Tanofsky-Kraff et al. (2008). Data were analyzed using IBM SPSS Statistics 22 for Windows. Descriptive statistics were generated for subject demographics and Pearson’s two-tailed, bivariate correlations were calculated to examine the independent relationships between EAH intake, BMI z-score, child sex, the food-consuming behaviors, and child-reported LOC. Furthermore, several linear and stepwise multivariate regression analyses were calculated to analyze the effect of BMI z-score, child sex, the food-consuming behaviors, and child-reported LOC on intake. The findings of this thesis demonstrate an association between several food-consuming behaviors and EAH intake. The more time that a child spent sitting versus standing (Sit > Stand), gazing at food versus gazing elsewhere (Gfood > Gelse), and eating versus playing with toys (Eat > Play) were positively associated with amount of food consumed during EAH. Sit > Stand positively predicted 13.0% of the variance in intake, Gfood > Gelse positively predicted 33.7% of the variance in intake, and Eat > Play positively predicted 46.3% of the variance in intake. In addition, child BMI z-score and reported LOC did not predict EAH intake, nor did child sex significantly influence any of the proposed relationships. These findings suggest that specific, food-consuming behaviors observed during EAH (including sitting, gazing at food, and eating) can help us to predict increased energy consumed in the absence of reported hunger. This knowledge may aide in our understanding of the mechanisms that drive increased food intake in children.
# TABLE OF CONTENTS

List of Figures ...................................................................................................................... iii

List of Tables ........................................................................................................................ iv

Acknowledgements ........................................................................................................... v

Introduction .......................................................................................................................... 1

  Purpose ............................................................................................................................... 11

  Hypotheses ......................................................................................................................... 12

Methods ................................................................................................................................. 12

Results .................................................................................................................................. 20

Discussion ............................................................................................................................. 38

  Future Directions .............................................................................................................. 44

Appendix ............................................................................................................................... 45

References ............................................................................................................................. 49
LIST OF FIGURES

Figure 1. Meal preload................................................................. 16

Figure 2. Eating in the absence of hunger (EAH).......................... 17

Figure 3. EAH intake as a function of child BMI z-score in 7-11 year-old children........ 22

Figure 4. EAH intake as a function of the total amount of time that a child spent sitting versus standing (Sit > Stand). ................................................................. 24

Figure 5. EAH intake as a function of the total amount of time that a child spent gazing at food versus gazing elsewhere (Gfood > Gelse). .................................................. 24

Figure 6. EAH intake as a function of the total amount of time that a child spent eating versus playing with toys (Eat > Play). ............................................................... 25

Figure 7. EAH intake as a function of Eat > Play in girls.............................. 29

Figure 8. EAH intake (kcal) as a function of Sit > Stand in boys......................... 31

Figure 9. EAH intake as a function of Gfood > Gelse in boys.......................... 31

Figure 10. EAH intake as a function of Eat > Play in boys............................ 32

Figure 11. Unstandardized residual plots of EAH intake as a function of Eat > Play and loss of control eating (LOC). ................................................................. 35

Figure A-1. Meal preload and EAH liking scales........................................ 45

Figure A-2. Fullness doll .................................................................... 48
LIST OF TABLES

Table 1. Participant demographics ................................................................. 14
Table 2. Foods served and serving sizes provided during a meal preload ........... 16
Table 3. Foods served and serving sizes provided during EAH ..................... 18
Table 4. Fullness ratings .............................................................................. 20
Table 5. Bivariate correlations of EAH intake, child sex, BMI z-score, LOC, and food-consuming behaviors .......................................................... 21
Table 6. Regression analysis of BMI z-score on EAH intake ....................... 22
Table 7. Regression analysis of BMI z-score and food-consuming behaviors on EAH intake ..................................................................................... 23
Table 8. Regression analysis of BMI z-score and child sex on EAH intake ....... 25
Table 9. Regression analysis of BMI z-score on EAH intake in girls and boys .... 26
Table 10. Regression analysis of BMI z-score, food-consuming behaviors, and child sex on EAH intake ................................................................. 27
Table 11. Regression analysis of BMI z-score and food-consuming behaviors on EAH intake in girls only ............................................................... 28
Table 12. Regression analysis of BMI z-score and food-consuming behaviors on EAH intake in boys only ............................................................... 30
Table 13. Regression analysis of BMI z-score and LOC on EAH intake ......... 33
Table 14. Regression analysis of BMI z-score, food-consuming behaviors, and LOC on EAH intake ................................................................. 34
Table 15. Regression analysis of BMI z-score, LOC, and child sex on EAH intake ...... 36
Table 16. Regression analysis of BMI z-score and LOC on EAH intake in girls and boys ..................................................................................... 37
Table 17. Regression analysis of BMI z-score, food-consuming behaviors, LOC, and child sex on EAH intake ................................................................. 38
ACKNOWLEDGEMENTS

I would like to thank my thesis supervisor, Dr. Kathleen Keller, for her constant guidance and support throughout the difficult and fast-paced process of conducting research. She has been a wonderful source of encouragement, advice, and constructive criticism throughout the entire endeavor and I would never have been able to complete this honors thesis without her. Dr. Keller allowed me to explore a new field of science through my work in her laboratory and, in doing so, made my first research experience a memorable one. She has always taken the time out of her busy schedule to either help explain a misunderstood concept and/or edit one of my many thesis drafts and for that, I am extremely grateful. I would also like to thank both Dr. Corwin and Dr. Marden for taking on the task of being my honors advisors after knowing me for only a short while. You have both been so kind and helpful throughout the process of writing my thesis, and I could not have picked a better pair of professors to work with. In addition, I would like to extend a huge thank you to the graduate student working on the ongoing research study that this thesis work is a part of. Shana Adise, words cannot describe how grateful I am for your guidance throughout this entire project. You have taught me so much more than research techniques. Thank you for always checking in on me and for genuinely being concerned about my well-being. You have taught me many life lessons and I truly consider you to be both a mentor and a friend. Furthermore, I want to thank Terri Cravener, the manager of the Metabolic Kitchen and Children’s Eating Behavior Laboratory, as well as the rest of the graduate and undergraduate team in the lab. Your kind words and happy faces made the thesis-writing process much less taxing and my overall experience in the lab one that I will never forget. Lastly, I would like to thank my family and friends for being an unfaltering support system throughout my entire academic career. Without you, I would not be who or where I am today. I am truly grateful for your presence in my life.
**Introductory Comments**

My interest for this thesis project stemmed from my research experience working on a project that assessed how decision-making influences food intake. From the extensive literature review that I conducted, I became more interested in the mechanisms that contribute to overeating in children, such as eating in the absence of hunger. My initial involvement grew to incorporate other responsibilities such as various organizational tasks including creating and maintaining participant binders, calling participants to screen for eligibility, and posting flyers for participant recruitment. I ran clinical visits with the children throughout the duration of this study, conducting all of the methods described in this thesis. In addition, I collected, entered, and analyzed data for significance.

**Introduction**

**The Prevalence and Consequences of Obesity**

The prevalence of childhood obesity is concerning due to increased rates of early onset medical consequences including various cardiovascular, neurological, reproductive, and metabolic diseases [1–3]. Data from 2011-2012 showed that 16.9% of 2-19 year-olds and 34.9% of adults aged 20 years or older were diagnosed as obese [4]. Although increases in obesity rates are slowing or even plateauing in some populations in the United States [5,6], the prevalence has not decreased, which is ample cause for concern. Therefore, research is needed to determine strategies to combat any future rise in the incidence of childhood obesity.

The constructs that influence and promote obesity are numerous and multifactorial. However, one key factor associated with obesity is overconsumption of highly palatable, high-energy dense foods [7–9], a risk factor for excess weight gain and increased BMI [10–15]. Supporting this theory is evidence from studies that suggest that excess intake of highly palatable, energy rich foods following a pre-load or appetizer (i.e. eating when not hungry) is positively associated with child weight status [11–13,15]. The Eating in the Absence of Hunger (EAH) protocol is used to measure excess consumption in children when they are not hungry [16]. The mechanisms driving excess intake of highly palatable foods in children are unknown. However, research suggests that individual factors such as age [11,17–19], sex [16,17,20–22], and parental influence [11,16–20,22,23], may lead to EAH. Nevertheless, no research has
examined the differences in behaviors [e.g. sitting - standing (Sit > Stand); gazing at food - gazing elsewhere (G_food > G_else); eating - playing with toys (Eat > Play)] observed during the measurement of EAH and how these individual behaviors may be related to overall food consumption. The identification of various food-consuming behaviors observed during EAH is crucial to provide insight on underlying mechanisms driving excess food intake in children. These observations may be used to identify modifiable behaviors related to overeating.

Limited research suggests that intake during EAH may be influenced by the presence of Loss of Control (LOC) Eating [24] in children [25–29]. LOC eating may be defined as the inability to stop oneself from consuming excess food in a discrete period of time accompanied by a perceived feeling of a loss of control [24]. However, the methods used to assess LOC vary across studies, making it difficult to compare results. Yet, some studies have suggested that LOC is positively related to the development of binge eating disorder in adults [30–32]. In addition, research has shown that LOC is associated with the overconsumption of highly palatable foods in children and adolescents [33–35]. However, only one study has shown a positive relationship between EAH intake and LOC in children [34]. These two measures and their interrelation need to be better understood in order to further understand the forces driving overconsumption in children. Furthermore, to date, no studies have attempted to study the relationship between LOC, food-consuming behaviors observed during the EAH protocol, and child weight status. Therefore, the purpose of this thesis is to fill these gaps in research by directly examining the relationships between food intake during EAH, LOC eating, and child weight status in 7-11 year-old children. To do this, we will first classify and categorize observed, food-consuming behaviors through direct observation of children. We will then examine the relationship between these behaviors, measured food consumption during EAH, child weight status, and LOC. Clarifying these relationships may help to isolate key elements influencing the overconsumption of highly palatable foods in 7-11 year-old children. This review will provide justification for the current study through the analysis of primary literature examining various factors that influence EAH and LOC, and the relationship between the two phenomena.

**Eating in the Absence of Hunger (EAH) Protocol**

The first documentation of the EAH protocol was published by Fisher and Birch in 1999 [16]. Since then, the paradigm has been replicated in children as young as 3 years of age.
and white [11,12,15–19,21–23,25,36,38–43] and Hispanic children [13,44]. The EAH protocol was designed to assess children’s energy intake of palatable, freely available snack foods served when they were not hungry. During the protocol, children consumed a standard lab meal (as a pre-load) until self-reported satiety. Fullness was subjectively assessed after meal completion by having children point to one of three cartoon dolls (empty stomach, half-full stomach, full stomach) to indicate their level of satiety. Only the children who reported no hunger (full stomach) were allowed to participate in the EAH protocol. Following this, children were provided unrestricted access to toys and servings of 10 palatable snack foods. The snack foods served included an array of sweet and savory items that varied in fat content such as popcorn (6 g served), potato chips (58 g served), pretzels (39 g served), nuts (44 g served), fig bars (51 g served), and ice cream (168 g served). Findings from this original study showed that, when given access to palatable foods following a preload, 3-5 year-old girls and boys ate, on average, an additional 216 ± 14 kcal even though they were reportedly not hungry.

**EAH Intake**

EAH is observed following consumption of variety of meal preloads including standardized laboratory test meals [11,16,18,20,21,40,41,44–46], snack arrays [36], and self-selected lunches [19]. Different meal preloads could impact the degree of food intake observed during EAH. Therefore, research should attempt to standardize meal-preload. Consequently, Shomaker et al., (2010) assessed whether the type of meal preload served before EAH modulates future food intake [38]. Seventy-eights adolescents ages 13-17, were randomly assigned to one of two preload conditions: 1) large food-array (with over 10,000 kcal); 2) standardized test meal (designed to provide 50% of the daily estimated energy requirements). Results showed that when served the large-array meal, adolescents consumed 448 kcal more and reported less hunger than the adolescents who consumed the standardized test meal. However, there were no significant differences in food consumption during the free access to snacks (large array meal: 365 ± 20 kcal; standard lab test meal: 295 kcal ± 18 kcal). This suggests that adolescents consume similar amounts during EAH regardless of the size of the meal preload served. Future studies are needed that measure EAH in response to the different preloads in the same participants to see if these findings hold true.
**EAH and Weight Status**

Studies suggest that intake during EAH may be dependent on child weight status, with overweight children consuming more calories than their lean counterparts [11–13,15]. In one hundred-ninety two girls, measured at both 5- and 7-years of age, girls who ate larger amounts of snacks during EAH were 4.6 times as likely to be overweight at both ages compared to those who ate less [11]. Similarly, in forty-seven (53% females), 5-12 year-old, weight-discordant same-sex sibling pairs (categorized as normal weight versus overweight/obese), the obese/overweight siblings consumed 34% more energy (93 kcal) than the normal-weight siblings during EAH [12]. Results from these studies [11,12] show that child weight status is positively related to food consumption during EAH. However, these studies are limited by the fact that they did not examine whether child weight status is also related to the increased consumption of an array of lower-calorie (i.e. healthier) non-snack foods. Investigating this relationship may help to determine whether children of higher weight status only consume more when prompted by highly palatable food cues, as in EAH.

Other studies have further examined the relationship between weight status and EAH intake. Fisher et al., (2007) found that overweight children ages 5-18 years old consumed 14% more energy than non-overweight children during EAH [13]. Similarly, results from a longitudinal study showed that by age 7, overweight girls ate significantly more palatable food in the absence of hunger than did normal weight girls [15]. This longitudinal data shows that EAH tracks with weight status over time in girls, but additional studies are needed to test these relationships in boys. Furthermore, studies have also suggested that increased consumption during EAH may be a risk factor for future weight gain. In 5 year-old children born at high vs. low risk for obesity [47], EAH intake was two times higher in high-risk boys, when compared to low-risk boys [45]. However, this relationship was not observed in girls. Additional studies are needed to follow-up these investigations.

Early studies have also alluded to the role of weight status and child sex on EAH intake. Although not specifically testing for a relationship between child sex and EAH, some studies have shown that boys consume more energy during EAH (8.2%) than girls [17]. Similar results were also found in a separate study (following the same protocol) using 316, 9-12 year old twins (192 girls; 124 boys) [21]. These results suggest that EAH is not specific to overweight children, but instead shows a graded association with adiposity across the weight continuum, specifically
in boys. However, the primary focus of the research analyses performed by Hill et al., (2008) [21] was to study the relationship between EAH intake and child adiposity, and not child sex. Therefore, future examinations should aim to directly analyze the degree to which child sex influences intake during EAH.

**Possible Mechanisms to Explain Overconsumption**

Overconsumption during EAH may be explained by physiological symptoms. A study assessing the relationship between adrenocortical regulation, energy intake during EAH, and BMI in 5-9 year-old children provoked the possibility that age may mediate differences in disinhibited eating through an elevated response to stress-related hormones [41]. In order to analyze the effect of age upon this relationship, participants were categorized into two groups: younger (5-7-years-old) or older (8-9-years-old). A positive relationship between elevated stress-related cortisol, child BMI z-score, and greater energy intake during EAH was only observed in older children. This study suggests a potential link between biological markers of stress, EAH, and obesity that may be observed as children develop. However, what causes this elevated response has yet to be determined.

Continued research has indicated that developmental differences may also influence the degree of EAH intake in young children [36]. In 3-6 year-old children, lower cognitive development (evaluated by delay of gratification [48], children’s gambling [49], flanker [50], and dots [51] tasks) is associated with higher total and sweet calories consumed during EAH. Additionally, increased emotional arousal (measured via skin conductance) was also associated with higher total and sweet caloric intake during EAH in a subgroup of children with lower cognitive development [36]. These findings indicate that increased emotional arousal and decreased cognitive development are associated with increased intake during EAH in young children. Nevertheless, identifying what provokes the onset of these developmental differences in children requires additional analysis.

**Loss of Control (LOC) Eating Disorder and the Relationship to Food Intake**

Research suggests that there might be a relationship between EAH intake and reported Loss of Control Eating (LOC) [25–29]. However, it is hard to generalize findings across studies due to a lack of consistency of LOC measurement. The majority of studies designed to assess
LOC have used either the Eating Disorder Examination (EDE) [52] or the Children’s Eating Disorder Examination (ChEDE) [53]. Typically, LOC eating has been identified in conjunction with Binge Eating Disorder in children. Yet, Tanofsky-Kraff et al., (2008) extended LOC criteria to allow for the diagnosis of children who may not meet the criteria proposed for binge eating disorder [24]. This new criterion defines LOC as the experience of loss of control while eating, regardless of whether the reported amount of food consumed is unambiguously large. Hence, the LOC eating disorder questionnaire (LOC-ED) was designed to measure episodes of LOC eating in children 12 years of age or younger [24]; development of this criterion was based upon the re-evaluation of criteria established to diagnose binge eating in children [54]. The LOC-ED [24] is still being validated. For this thesis, we decided to use the LOC-ED questionnaire because it is based on well-established criteria for diagnosis of Binge Eating Disorder [55]. Since few studies have used this questionnaire, we will examine the literature related to the broader construct of loss of control.

**The Relationship Between EAH and LOC**

Only one study has evaluated the relationship between LOC and measured food intake from a protocol similar to EAH. In this study, LOC (determined via the ChEDE [53]) showed a positive relationship with consumption of more energy, fat, and protein during EAH in 120, 8-13-year-old children [39]. One caveat of this study is that they did not use the LOC screener as previously described [24]. Therefore, the results gained from our study may not agree with those of a study using the ChEDE [53] to assess LOC. In addition, the authors note that their study design was similar to designs assessing EAH but that their test meal procedure was not aimed at ensuring satiety or absence of hunger. Therefore, snack food intake following this test meal cannot truly be considered EAH. Yet, it is the only attempted study to look at any relationship between LOC and a protocol similar to EAH. Moreover, the context and strength of the proposed relationship between EAH and LOC is an area of study that needs more attention.

When analyzed together, several studies imply that a relationship may exist between EAH and LOC. Separate studies have shown a positive relationship between FTO, an obesity-related gene, and EAH in 4-5 year old children [25], and the FTO gene and LOC in 289, 6-19 year-old youth [26]. Not only are carriers of the at-risk genotype two times more prone to report LOC (determined via the EDE [52]), they also have significantly larger BMI z-score and fat mass
compared to non-carriers. The fact that both EAH and LOC share similar relationships to genotypes associated with obesity suggests that there might be an underlying biological mechanism of both phenotypes.

Similar to the positive relationship between EAH and child BMI, the literature also shows that there is a positive relationship between child BMI and LOC eating [27,28]. In a study using 1,643 adolescents, ages 12-20 years old, those with recurrent LOC eating (determined via the Eating Disorder Examination questionnaire [56]) had significantly higher BMI z-score when compared to adolescents who either reported non-recurrent LOC eating or no LOC eating [28]. Similarly, longitudinal data shows that, in 6-12 year-old children, those who reported LOC eating (determined via the ChEDE [53]) experienced significantly greater rate of BMI z-score growth over time [29]. Over 4.5 years, compared to children without LOC, those who reported LOC gained an average of 1.7 kg/m² compared to 1.1 kg/m² for children without LOC eating. Multiple analyses have suggested that BMI is associated with EAH [11–13,15] and LOC [27,28], which suggests there might be a relationship between EAH and LOC. However, a major limitation is that LOC is assessed by different measures, which may bias results.

**Food Intake in LOC Children**

Children who report LOC consume more high energy-dense foods during laboratory test meals. Hilbert et al., (2009) compared the eating behaviors of 59, 8-13 year-old children who had reported experiencing at least one episode of LOC eating [53] to children who had no history of loss of control eating [33]. Over a period of 4 days, children were interviewed about their daily eating behaviors on cell phones specifically given to the children by the researchers. Findings revealed that children reported consuming a significantly higher amount of energy (mostly from carbohydrates) during LOC episodes than children who did not experience LOC. These results suggest that LOC eating may lead to the overconsumption of high energy-dense foods in children. However, this study did not test actual food consumption in the laboratory as energy consumption was measured via self-report, which is prone to error [57–60]. Future studies should evaluate the relationship between LOC and actual observed energy intake during a laboratory meal.

Some postulate that children who report LOC eating may consume more foods during LOC episodes due to a lack of awareness and an under-estimation of the amount of foods
consumed [61]. One hundred fifty-six, 8-17 year-old children were assessed for LOC eating [53] and were interviewed following consumption of a multi-item, laboratory buffet test meal [61]. Children with LOC did not significantly differ from children without LOC in their accuracy of reporting total food intake, but children with LOC were less accurate in reporting the percentage of energy intake from carbohydrates and desserts. In conjunction with these findings, children with LOC [53] consumed more calories from carbohydrates, snacks, and dessert-type foods in both a normal and a binge laboratory meal compared to children without LOC [35]. This study only chose to analyze the energy intake of children with LOC following a laboratory meal. It would be useful to examine actual food intake of LOC children during EAH to see if the same trends exist. Furthermore, both Hilbert et al., (2009) [33] and Wolkoff et al., (2011) [61] use self-report to measure food intake in LOC children. These measures may not be accurate in LOC children, therefore making the findings of these studies [33,61] unreliable. This, in turn, further justifies the methods being used in this thesis project.

**Types of Foods Consumed by LOC Children**

The literature has also focused on studying the quantities and types of foods consumed during LOC eating episodes. For example, when asked about the type and quantity of foods eaten during a LOC episode versus an overeating episode in the absence of LOC, Theim et al., (2007) showed that 81 children, 6-8 years old, reported consuming similar amounts on both episodes [62]. However, those children with LOC [53] reported that during LOC episodes, energy intake was higher from carbohydrates while lower from protein. Moreover, children who reported LOC self-reported the consumption of a higher percentage of calories from snack foods. Nevertheless, previous research has shown that children with LOC are less accurate in reporting the percentage of energy intake from carbohydrates and desserts [35]. Therefore, the results of Theim et al., (2007) [62] may not be valid due to the inability of children with LOC to accurately report food consumption during a LOC episode. Instead of interviewing the children, objective measurements of intake in children are needed to fully understand the relationship between LOC and EAH.

Not all studies have indicated that children who report LOC eating consume more calories during meals. However, literature has suggested that children with LOC prefer to consume specific patterns of macronutrient selection during eating episodes. One such study
required normal weight and overweight boys and girls, ages 8-17, to either binge eat or eat normally at an ad libitum, multi-item test meal [35]. Food intake at this test meal was measured. All children consumed more calories at the binge meal than at the normal meal. However, children who reported LOC [53] consumed a greater percentage of calories from carbohydrates and a smaller percentage from protein than children who did not report LOC. Children with LOC also ate more snack and dessert-type foods and less meats and dairy. These findings suggest that LOC eating may not prompt a difference in total energy intake, but that it may influence the types of macronutrients being consumed.

As previous literature suggests, LOC eating is often associated with overeating [33] and furthermore, weight gain [29] in children. Studies have suggested that this relationship may be influenced by a child's attentional sensitivity to the presence of highly palatable foods. To test this assumption, 76, 8-17 year-olds and their parents were recruited to determine whether children who report LOC eating [53] exhibit an attentional bias to highly palatable foods [27]. Following a breakfast designed to control for hunger, attentional bias to foods was assessed via a computer task that measured reaction time to pairs of various pictures such as highly palatable foods, less palatable foods, and neutral household objects. Findings show that, compared to children who did not report LOC, those who reported LOC eating exhibited an attentional bias toward highly palatable foods versus neutral objects. Furthermore, this was associated with higher BMI z-scores. These findings suggest that children with LOC may have a cognitive bias toward highly palatable food cues. Future research should test whether this attentional bias to highly palatable foods drives increased consumption of these foods in children who report LOC.

**Psychosocial Pressures**

Psychosocial influences on LOC eating may promote the overconsumption of highly palatable foods in these children and subsequently, weight gain. For example, negative affective states among girls who report LOC eating may be a driving factor for increased consumption of high energy-dense food intake and furthermore, excess weight gain in girls. In a study of 12-17 year-old girls with LOC [53], pre-meal state negative affect (evaluated via the Brunel mood rating scale [63]) was associated with greater, measured intake of carbohydrates and less consumption of proteins during a laboratory test meal [64]. In addition, pre-meal state negative affect was also associated with greater snack and dessert intake, as well as less fruit and dairy
consumption. It would be beneficial to test whether negative affect also promotes the overconsumption of similar, high energy-dense foods during EAH. Should this be true, psychosocial influences may be responsible for mediating the proposed relationship between EAH and LOC.

Additional research has suggested that LOC eating is related to negative affective state in children. Furthermore, some studies have examined how this relationship maps onto more general concerns about body image and familial relationships. Children who reported LOC [53] and had high dietary restraint and negative affect had increased shape and weight concerns, more frequent LOC episodes, and higher rates of parent-reported problems than the children with just dietary restraint [65]. Others have shown that 10-16 year-old children with LOC [53] express more concern about eating, weight, and shape, than children who did not report LOC [66]. Furthermore, in children 8-11 years-old, LOC [53] was associated with lower self-esteem and less secure attachment toward both of their parents [67]. This relationship between self-esteem and LOC was completely mediated by attachment toward the mother and partially mediated by attachment toward the father. Ultimately, this literature supports the idea that various psychological traits may be defining characteristics of children with LOC eating. Whether these psychological symptoms influence actual food intake in LOC children has not been studied. Should such a relationship exist, attempting to combat these negative, psychological attitudes in LOC children may be an effective way to decrease food intake and LOC episodes in these children.

**Physiological Implications**

Similar to EAH, the literature has found a relationship between physiological symptoms and the presence of LOC eating in children. LOC eating is associated with metabolic characteristics. In a sample of 329, treatment-seeking and non-treatment-seeking adolescents ages 12-18, children who reported LOC eating [52] had higher systolic blood pressure and higher LDL cholesterol levels compared to those without LOC eating (beyond the normal contribution of body weight) [68]. This study concluded that youth who reported LOC were more likely to have metabolic dysfunctions that are characteristic of weight gain, which has also been shown to be a symptom of LOC eating [29]. Accompanying this research, a study has also suggested that an adipocyte-derived hormone, leptin, is present in larger quantities in LOC children [69];
insufficient quantities leptin and leptin resistance have been shown to promote hunger, increase food intake, and are related to greater body weight [70][71]. Youth who reported LOC eating [53] had higher serum leptin levels (beyond the normal contribution of body weight) [69]. The associations between physiological characteristics and LOC eating in children presented in these studies are novel findings. However, the researchers did not determine whether these metabolic characteristics developed as a result of genetics, prior to the onset of LOC eating, or if they evolved as a consequence of weight gain through LOC eating. Ultimately, the presence of these metabolic changes at such a young age is alarming due to the early-onset medical problems that could result. Therefore, it is imperative that research continues to decipher the underlying causes of these metabolic dysfunctions in children.

**Purpose**

Several studies have examined the relationship between weight status, intake during EAH, and LOC separately. However, no studies have analyzed how these two phenomena directly interact. In addition, fewer studies use the research criteria proposed by Tanofsky-Kraff et al., (2008) to evaluate LOC [24]. Furthermore, no studies have attempted to analyze the relationship between EAH food intake, child weight status, food-consuming behavior contrasts (including $S_{it} > S_{tand}$; $G_{food} > G_{else}$; $E_{at} > P_{lay}$) observed during EAH, and child-reported LOC. Therefore, the purpose of this thesis project is to directly examine these relationships and identify child behaviors that may drive increased food consumption during EAH. These findings may help to isolate key elements influencing the overconsumption of highly palatable foods in 7-11 year-old children. Studies of this nature are important in order to help figure out the driving factors of increased food intake. Findings can be used to help tailor intervention and prevention programs geared at minimizing these behaviors that lead to excess calorie consumption.

**Study Aims**

The overall goal of this project is to understand the mechanisms driving increased intake when children are not hungry in children ages 7-11 years old. We will do this by testing the following aims:

**Aim 1.1:** We will investigate the relationship between child BMI, EAH intake, and food-consuming behaviors observed during EAH.
Aim 1.2 We will establish whether child sex influences the relationship between child weight status and EAH intake and food-consuming behaviors.

Aim 2.1: We will investigate the relationship between EAH intake, child weight status, food-consuming behaviors observed during EAH, and child-reported LOC.

Aim 2.2 We will determine whether child sex influences the relationships between child BMI, EAH intake, food-consuming behaviors observed during EAH, and child-reported LOC.

Hypotheses

The main outcome from the EAH procedure is energy intake from the snacks and the secondary outcome is time spent engaged in eating versus non-eating activities (i.e. playing). We hypothesized that child BMI z-score and food-consuming behaviors including sitting, gazing at food, and eating would predict increased EAH intake compared to food-consuming behaviors such as standing, gazing elsewhere, and playing with toys. We further postulated that the relationship between EAH intake and child weight status as well as the relationship between EAH intake, child weight status, and each of the food-consuming behaviors would be observed to a greater extent in boys than in girls, as previous research has shown [17,21,45]. Additionally, it was expected that child BMI z-score, child-reported LOC, and the following food-consuming behaviors: $S_{it} > S_{tand}$, $G_{food} > G_{else}$, $E_{at} > P_{lay}$ would predict increased food intake. Furthermore, we expected that child sex would positively influence the relationship between EAH, child weight status, and child-reported LOC as well as the relationship between EAH, child weight status, food-consuming behaviors observed during EAH, and child-reported LOC.

Methods

Participants and Recruitment

Children (n = 44) between 7 and 11 years old (mean age = 9.00; SD = ±1.31; see Table 1 for participant demographics) were enrolled in this study. Recruitment was balanced by sex and body weight. One participant was dropped from analyses due to a failure to follow procedures. Nine participants were excluded from EAH intake analysis due to reporting fullness ratings of less than 75% (112.5 mm) (see Table 4 for fullness ratings). An additional, seven children were excluded from the behavioral analysis because they were not facing the camera. Thirty-four
children were included in the analysis of EAH intake and child BMI. However, only 27 children had complete data sets and therefore were included in the analyses of EAH intake, food-consuming behaviors, and LOC.

All children were recruited from a larger ongoing study that looks at how children make food-based decisions. Individuals were excluded from this study if they had food allergies (e.g., lactose intolerance), dietary restrictions (e.g., vegetarian, vegan, or fasting for religious reasons), were currently taking medications that could affect taste, body weight, or appetite, or had learning disabilities. Any use of psychotropic medications, or Axis I psychiatric disorder in the past year (including depression, anxiety, or bipolar disorder) also resulted in exclusion from the study.

This study was approved by the Institutional Review Board of The Pennsylvania State University. Parents provided written informed consent and children provided verbal assent. Children were recruited from the State College area through advertisements, which were posted on bulletin boards in academic buildings, on school websites, and in private businesses throughout State College and the surrounding areas. The sample consisted of 2.27% Asian, 2.27% Black, 2.27% mixed, and 93.18% white children, which was indicated by parental self-report of the race of their children. Children had an average BMI $z$-score of $0.74 \pm 0.90$, which corresponds to a BMI-for-age percentile of the 70th percentile.
Table 1. Participant demographics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>± S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>9.00</td>
<td>1.31</td>
</tr>
<tr>
<td>BMI z-score (kg/m²)</td>
<td>0.74</td>
<td>0.90</td>
</tr>
<tr>
<td>BMI-for-age %</td>
<td>70.50</td>
<td>24.30</td>
</tr>
<tr>
<td>% Body Fat</td>
<td>22.74</td>
<td>10.09</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>20</td>
<td>45.5</td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
<td>54.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Race</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian</td>
<td>1</td>
<td>2.27</td>
</tr>
<tr>
<td>Black</td>
<td>1</td>
<td>2.27</td>
</tr>
<tr>
<td>White</td>
<td>41</td>
<td>93.18</td>
</tr>
<tr>
<td>Mixed</td>
<td>1</td>
<td>2.27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BMI Class (CDC)</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy Weight (HW)</td>
<td>25</td>
<td>56.8</td>
</tr>
<tr>
<td>Overweight/Obese (OW/OB)</td>
<td>19</td>
<td>43.2</td>
</tr>
</tbody>
</table>

Study design

The children and at least one parent/guardian came to the Metabolic Kitchen and Children’s Eating Behavior Laboratory at The Pennsylvania State University in Chandlee Laboratory at either lunch or dinnertime for four, randomized visits. This thesis will focus on data collected on two of these four visits. Data collection occurred between April 2015 and May 2016. Children were fed a standardized laboratory test meal as a preload before the eating in the absence of hunger protocol [16]. The foods served and portion sizes provided for this preload are listed in Table 2. Hunger and fullness as well as liking for all study foods were also assessed. Children were able to ask for additional servings of food served in the meal preload. Foods were weighed before and after consumption in order to assess intake. Loss of control eating was assessed via an interview-like questionnaire on a separate visit in which no food was served [24]. The total time in the laboratory lasted no longer than two hours for each visit.

Anthropometrics

Height and weight were taken by trained research assistants using a standard balance scale and stadiometer, respectively. Children were measured in stocking feet and light clothing.
These measurements were taken twice and averaged. Height and weight were used to determine BMI and BMI z-scores using the CDC’s growth charts conversion [71]. Body fat percent was analyzed using a Tanita Body Composition Analyzer BF-350 Scale. This procedure was repeated for the accompanying parent. The second parent’s weight was self-reported by the parent in attendance at the visit.

**Liking for Study Foods**

Liking for the foods served in the meal preload and EAH was assessed using a 5-point smiley face scale (see Figure A-1). This 5-point scale has been previously used in children ages 4-11 [72–74]. Using a tablet, children were asked to rate their perceived liking of a small sample of each food to be served. Samples were served in a 2-ounce soufflé cup. Scores were recorded using Qualtrics software.

**Hunger and Fullness Assessment**

Hunger ratings and fullness ratings were measured before and after all meals using Freddy Fullness (see Figure A-2). This 150mm scale is a child-friendly, paper doll that allows children to articulate how full their stomach feels using a self-adjustable tab that corresponds to the level of filling in the doll’s stomach [42].

**Meal Preload**

In order to control complete fullness and to assess eating in the absence of hunger, the meal preload (see Figure 1) was served before the EAH protocol. During a 30-minute duration, children were instructed to eat until they were full. Foods served were commonly eaten foods such as macaroni and cheese, garlic bread, tomatoes, broccoli and angel food cake (see Table 2 for calories and grams served). All children were familiar with these foods, which was assessed over the phone during recruitment screening with the parent.
**Figure 1.** Meal preload

**Table 2.** Foods served and serving sizes provided during a meal preload

<table>
<thead>
<tr>
<th>Food</th>
<th>Energy Density (kcal/gram)</th>
<th>Weight (g)</th>
<th>Energy (kcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High-energy density</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macaroni and Cheese</td>
<td>1.05</td>
<td>400</td>
<td>420</td>
</tr>
<tr>
<td>Garlic Bread</td>
<td>3.44</td>
<td>100</td>
<td>344</td>
</tr>
<tr>
<td>Angel Food Cake</td>
<td>2.31</td>
<td>80</td>
<td>185</td>
</tr>
<tr>
<td><strong>Low-energy density</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broccoli</td>
<td>0.31</td>
<td>180</td>
<td>56</td>
</tr>
<tr>
<td>Cherry Tomatoes</td>
<td>0.21</td>
<td>100</td>
<td>21</td>
</tr>
<tr>
<td>Red Grapes</td>
<td>0.77</td>
<td>200</td>
<td>154</td>
</tr>
<tr>
<td>Water</td>
<td>0</td>
<td>1000</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Food Served</strong></td>
<td><strong>1.35</strong></td>
<td><strong>1060</strong></td>
<td><strong>1180</strong></td>
</tr>
<tr>
<td><strong>Total Food and Water Served</strong></td>
<td><strong>1.15</strong></td>
<td><strong>2060</strong></td>
<td><strong>1180</strong></td>
</tr>
</tbody>
</table>
**Eating in the Absence of Hunger**

Eating in the absence of hunger (EAH) [16] was measured following consumption of the meal preload to satiety. Following the consumption of the meal preload, children engaged in a brief activity (i.e. playing a board game with the researcher) for 20 minutes. This wait period was used to re-stage the observation room for the EAH protocol (i.e. toys, games, and books were displayed throughout the room). Children then sampled and rated their liking of ten highly palatable, high-energy dense, low nutrient-dense food items (see **Figure 2**). Preference rankings for the foods were also obtained (data not shown) by having children rank most to least preferred foods. Next, the child was shown various toys and bowls holding generous, pre-weighed portions of the ten snack foods (see **Table 3** for calories and grams served). The foods and serving sizes used for this portion of the project were similar to the EAH snack foods used by Rollins et al., (2014) [19]. The child was instructed that he/she could play with the toys or eat any of the foods while the experimenter did some work in the adjacent room. The experimenter then left the room for 15 minutes. Behaviors were monitored using the Noldus software. While all participants completed the EAH procedure, we excluded those who did not report that they were full (defined by a rating on the visual analog scale of 75% or greater). The main outcome from the EAH procedure was energy intake from the snacks and a secondary outcome was time spent engaged in eating versus non-eating activities (i.e. playing).

![Figure 2](image.png)

**Figure 2.** Foods used in the eating of the absence of hunger protocol (from top left to bottom right): Hershey’s Kisses, Chester’s butter-flavored popcorn, Rold Gold tiny twists pretzels, Little Bites fudge brownies, Doritos, Lay’s potato chips, Starbursts, Chips A’Hoy chocolate chip cookies, Skittles, Ritz Bits
Table 3. Foods served and serving sizes provided during EAH

<table>
<thead>
<tr>
<th>Food</th>
<th>ED (kcal/g)</th>
<th>Weight (g)</th>
<th>Energy (kcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Savory-fats</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Popcorn</td>
<td>5.28</td>
<td>15</td>
<td>79</td>
</tr>
<tr>
<td>Potato Chips</td>
<td>5.64</td>
<td>58</td>
<td>327</td>
</tr>
<tr>
<td>Pretzels</td>
<td>5.89</td>
<td>39</td>
<td>230</td>
</tr>
<tr>
<td>Ritz Bitz</td>
<td>5.37</td>
<td>6 crackers (~44)</td>
<td>236</td>
</tr>
<tr>
<td>Doritos</td>
<td>5.14</td>
<td>58</td>
<td>298</td>
</tr>
<tr>
<td><strong>Sweet-fats</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chocolate Chip Cookies</td>
<td>4.97</td>
<td>6 cookies (~66)</td>
<td>327</td>
</tr>
<tr>
<td>Hershey’s Chocolate Kisses</td>
<td>5.37</td>
<td>66</td>
<td>354</td>
</tr>
<tr>
<td>M &amp; M’s</td>
<td>4.86</td>
<td>66</td>
<td>321</td>
</tr>
<tr>
<td>Brownies</td>
<td>4.36</td>
<td>4 mini brownies (~51)</td>
<td>222</td>
</tr>
<tr>
<td><strong>Sweets</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starburst</td>
<td>4.08</td>
<td>66</td>
<td>269</td>
</tr>
<tr>
<td><strong>Total Food Served</strong></td>
<td><strong>4.89</strong></td>
<td><strong>529</strong></td>
<td><strong>2663</strong></td>
</tr>
</tbody>
</table>

_Noldus_

Noldus Observer XT 10 software was used to record and analyze the behaviors of the subjects during both food intake and nonfood intake intervals. The variables studied included $S_{it} > S_{stand}$; $G_{food} > G_{else}$; $E_{at} > P_{lay}$. An experimenter manually coded these variables; data was recorded after collection. Each behavior was classified as either start/stop or continuous behaviors. Eating was defined as putting food in the mouth and chewing. Gazing was defined as staring at an object/place for longer than a few seconds. Noldus software allowed for the coding of these behaviors in terms of their duration, consistency, and repetition.

_Child Questionnaires_

The Loss of Control Eating questionnaire [24] was administered to children on a separate visit in which no food was served. This interview was designed to screen for and assess
loss of control eating episodes over the past 3 months in children under 12 years old. Children were initially asked to answer a “yes” or “no” question indicating whether or not they have exhibited loss of control eating behavior in the past 3 months. If the child responded, “yes” to loss of control eating, the questionnaire continued to investigate the nature and duration of the loss of control behavior. If the child answered, “no” to loss of control eating, the questionnaire finished. As a psychological protection, children who reported LOC were asked for permission to discuss the child’s self-reported LOC eating and possible avenues for help with their parents. Parents of children who reported LOC were given literature on eating disorders. This thesis project will only focus on the children’s answers to the initial yes or no question and will not be looking at the types of behaviors reported if the child answered “yes”. Reporting LOC (answering, “yes”) was coded as “1”, while not reporting LOC (answering, “no”) was coded as “2”.

**Statistical Analysis**

Data were analyzed using IBM SPSS Statistics 22 for Windows, (SPSS, Inc., Chicago, IL). Descriptive statistics (means, standard errors, and frequencies) were generated for subject demographics such as age, race, sex, and child BMI z-score. Pearson’s two-tailed, bivariate correlations were calculated to examine the independent relationships between EAH intake, BMI z-score, child sex, the food-consuming behaviors (Sit > Sstand; Gfood > Gelse; Eat > Play), and child-reported LOC. A linear regression analysis was conducted to predict EAH intake (dependent variable) with child BMI z-score as an independent predictor. Next, in order to compare behaviors, we calculated mean difference scores (i.e. contrasts) for the following food consuming behaviors: Sit > Sstand; Gfood > Gelse; Eat > Play. Several stepwise multivariate regression analyses were conducted to predict intake during EAH (dependent variable) based upon child BMI z-score and these mean difference scores. Additional models were run with sex, contrasts for the food consuming behaviors, and child-reported LOC as independent predictors of intake. All statistical tests were computed at a critical value of $p < 0.05$. 

Results

Preload and fullness assessment

Prior to EAH consumption, children (regardless of weight status) consumed an average of 700 ± 193.83 kcals. The average fullness ratings before and after meals are listed in Table 4.

Table 4. Fullness ratings

<table>
<thead>
<tr>
<th>Condition</th>
<th>Mean</th>
<th>± S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before preload</td>
<td>32.00</td>
<td>31.17</td>
</tr>
<tr>
<td>After preload</td>
<td>143.33</td>
<td>6.97</td>
</tr>
<tr>
<td>Before EAH</td>
<td>136.70</td>
<td>10.21</td>
</tr>
<tr>
<td>After EAH</td>
<td>143.08</td>
<td>13.56</td>
</tr>
</tbody>
</table>

Average consumption during EAH was 398.58 ± 220.18 (see Figure 3).

Bivariate correlations

Pearson’s two-tailed, bivariate correlations showed that there were significant, positive correlations between EAH intake and $S_{it} > S_{stand}$ ($r = 0.449$, $p = 0.019$), $G_{food} > G_{else}$ ($r = 0.580$, $p = 0.002$), and $E_{at} > P_{lay}$ ($r = 0.580$, $p = 0.000$) (see Table 5 for all correlation results). In addition, there was a significant, positive correlation between $S_{it} > S_{stand}$ and LOC ($r = 0.505$, $p = 0.007$) as well as $S_{it} > S_{stand}$ and $G_{food} > G_{else}$ ($r = 0.428$, $p = 0.026$). Furthermore, there was a significant, positive correlation between $G_{food} > G_{else}$ and $E_{at} > P_{lay}$ ($r = 0.865$, $p = 0.000$).
Table 5. Bivariate correlations of EAH intake (kcals), child sex (0 = boy, 1 = girl), BMI z-score (kg/m²), LOC (1 = LOC, 0 = no LOC), and food-consuming behaviors (St > Stand; Gfood > Gelse; Eat > Play; seconds) (n = 27).

<table>
<thead>
<tr>
<th></th>
<th>EAH Intake</th>
<th>Child Sex</th>
<th>BMI z-score</th>
<th>LOC</th>
<th>St &gt; Stand</th>
<th>Gfood &gt; Gelse</th>
<th>Eat &gt; Play</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>1</td>
<td>-0.182</td>
<td>-0.190</td>
<td>0.239</td>
<td>0.449</td>
<td>0.580</td>
<td>0.584</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.353</td>
<td>0.342</td>
<td>0.229</td>
<td>0.019*</td>
<td>0.002*</td>
<td>0.000*</td>
<td></td>
</tr>
<tr>
<td>Child Sex</td>
<td>-0.182</td>
<td>1</td>
<td>0.318</td>
<td>-0.063</td>
<td>-0.044</td>
<td>-0.304</td>
<td>-0.216</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.363</td>
<td>0.106</td>
<td>0.756</td>
<td>0.828</td>
<td>0.123</td>
<td>0.279</td>
<td></td>
</tr>
<tr>
<td>BMI z-score</td>
<td>-0.190</td>
<td>0.318</td>
<td>1</td>
<td>-0.185</td>
<td>0.024</td>
<td>-0.232</td>
<td>-0.224</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.342</td>
<td>0.106</td>
<td>0.356</td>
<td>0.906</td>
<td>0.244</td>
<td>0.261</td>
<td></td>
</tr>
<tr>
<td>LOC</td>
<td>0.239</td>
<td>-0.063</td>
<td>-0.185</td>
<td>1</td>
<td>0.505</td>
<td>-0.034</td>
<td>-0.230</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.229</td>
<td>0.756</td>
<td>0.356</td>
<td>0.007*</td>
<td>0.865</td>
<td>0.248</td>
<td></td>
</tr>
<tr>
<td>St &gt; Stand</td>
<td>0.449</td>
<td>-0.044</td>
<td>0.024</td>
<td>0.505</td>
<td>1</td>
<td>0.428</td>
<td>0.326</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.019*</td>
<td>0.828</td>
<td>0.906</td>
<td>0.007*</td>
<td>0.026*</td>
<td>0.097</td>
<td></td>
</tr>
<tr>
<td>Gfood &gt; Gelse</td>
<td>0.580</td>
<td>-0.304</td>
<td>-0.232</td>
<td>-0.034</td>
<td>0.428</td>
<td>1</td>
<td>0.865</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.002*</td>
<td>0.123</td>
<td>0.244</td>
<td>0.865</td>
<td>0.026*</td>
<td>0.000*</td>
<td></td>
</tr>
<tr>
<td>Eat &gt; Play</td>
<td>0.684</td>
<td>-0.216</td>
<td>-0.224</td>
<td>-0.230</td>
<td>0.326</td>
<td>0.865</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.000*</td>
<td>0.279</td>
<td>0.261</td>
<td>0.248</td>
<td>0.097</td>
<td>0.000*</td>
<td></td>
</tr>
</tbody>
</table>

Note: * Significant at $p < 0.05$.

**Aim 1.1:** Relationship between child BMI, EAH intake, and food-consuming behaviors observed during EAH.

A linear regression was calculated to predict intake based upon child BMI $z$-score. Child BMI $z$-score was not a significant predictor of total intake [$\beta = 0.029$, $p = 0.869$; (see Table 6 for regression results)].
Table 6. Regression analysis of BMI z-score (kg/m²) on EAH intake (kcals) (n=34).

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>393.898</td>
<td>47.543</td>
<td></td>
<td>8.285</td>
<td>0.000</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>7.236</td>
<td>43.454</td>
<td>0.029</td>
<td>0.167</td>
<td>0.869</td>
</tr>
</tbody>
</table>

Overall, children consumed 398.58 ± 220.18 kcal during EAH. The relationship between child BMI z-score and EAH is plotted in Figure 3.

![Figure 3](image_url)  
**Figure 3.** EAH intake (kcals) as a function of child BMI z-score (kg/m²) in 7-11 year-old children (β = 0.029, p = 0.869).

To see which behavior was more predictive of intake, multiple linear regressions were calculated to predict intake with independent predictors being BMI z-score and food consuming behaviors for the following contrasts: $S_t > S_{stand}; G_{food} > G_{else}; E_{at} > P_{lay}$ (see Table 7 for regression results). BMI z-score was not a significant predictor of intake, and therefore, it was removed from the models. Results showed that $S_t > S_{stand}$ positively predicted 13.0% of the variance in intake [$F_{(1,32)} = 4.762, p < 0.037$; (see Table 7)]. For every unit increase in $S_t > S_{stand}$, children consumed ~16.5 more calories (see Figure 4). In addition, $G_{food} > G_{else}$ positively predicted 33.7% of the variance in intake [$F_{(1,25)} = 12.692, p < 0.002$; (see Table 7)]. For every
unit increase in $G_{food} > G_{else}$, intake increased by 30.1 calories (see Figure 5). Furthermore, $E_{at} > P_{lay}$ positively predicted 46.3% of the variance in intake [$F_{(1,32)} = 27.536, p < 0.000$; (see Table 7)]. For every unit increase in $E_{at} > P_{lay}$, children consumed 32.2 more calories during EAH (see Figure 6).

Table 7. Regression analysis of BMI $z$-score ($\text{kg/m}^2$) and food-consuming behaviors on EAH intake (kcal) (n=27).

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MODEL 1:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>364.506</td>
<td>73.527</td>
<td>4.957</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>$BMI_{z}$-score</td>
<td>-21.529</td>
<td>41.114</td>
<td>-0.079</td>
<td>-0.524</td>
<td>0.606</td>
</tr>
<tr>
<td>$S_{it} &gt; S_{stand}$</td>
<td>0.130</td>
<td>0.070</td>
<td>0.299</td>
<td>1.843</td>
<td>0.079</td>
</tr>
<tr>
<td>$G_{food} &gt; G_{else}$</td>
<td>-0.119</td>
<td>0.158</td>
<td>-0.231</td>
<td>-0.757</td>
<td>0.457</td>
</tr>
<tr>
<td>$E_{at} &gt; P_{lay}$</td>
<td>0.359</td>
<td>0.135</td>
<td>0.768</td>
<td>2.655</td>
<td>0.014</td>
</tr>
<tr>
<td><strong>MODEL 2:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>318.276</td>
<td>51.324</td>
<td>6.201</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>$S_{it} &gt; S_{stand}$</td>
<td>0.165</td>
<td>0.076</td>
<td>0.360</td>
<td>2.182</td>
<td>0.037*</td>
</tr>
<tr>
<td><strong>MODEL 3:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>525.459</td>
<td>47.298</td>
<td>11.110</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>$G_{food} &gt; G_{else}$</td>
<td>0.301</td>
<td>0.084</td>
<td>0.580</td>
<td>3.563</td>
<td>0.002*</td>
</tr>
<tr>
<td><strong>MODEL 4:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>446.458</td>
<td>29.556</td>
<td>15.106</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>$E_{at} &gt; P_{lay}$</td>
<td>0.322</td>
<td>0.061</td>
<td>0.680</td>
<td>5.247</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

Note: * Significant at $p < 0.05$. 


Figure 4. EAH intake (kcals) as a function of the total amount of time that a child spent sitting versus standing (S_{it} > S_{stand}) (seconds) ($\beta = 0.360$, $p < 0.037$).

Figure 5. EAH intake (kcals) as a function of the total amount of time that a child spent gazing at food versus gazing elsewhere (G_{food} > G_{else}) (seconds) ($\beta = 0.580$, $p < 0.002$).
Aim 1.2 Relationship between child sex, weight status, EAH intake and food consuming behaviors.

To see how child sex influenced the relationship between intake and child weight status, a stepwise multivariate regression analysis was conducted to predict intake (dependent variable) with child BMI $z$-score and child sex as independent predictors. In this model, child sex was not a significant predictor of intake after adjusting the model for child weight status [$\beta = -0.231$, $p = 0.199$; (see Table 8 for regression results)].

Table 8. Regression analysis of BMI $z$-score (kg/m$^2$) and child sex (0 = boy, 1 = girl) on EAH intake (kcal) (n=34).

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>445.348</td>
<td>61.237</td>
<td></td>
<td>7.273</td>
<td>0.000</td>
</tr>
<tr>
<td>BMI $z$-score</td>
<td>14.992</td>
<td>43.378</td>
<td>0.061</td>
<td>0.346</td>
<td>0.732</td>
</tr>
<tr>
<td>Sex</td>
<td>-101.053</td>
<td>77.059</td>
<td>-0.231</td>
<td>-1.311</td>
<td>0.199</td>
</tr>
</tbody>
</table>
**Girls versus Boys**

Due to the limited sample size for sub-group analyses, we did not include an interaction term of sex by child weight status in the regression model predicting child EAH. However, for exploratory purposes, we analyzed the relationship between child weight status and EAH in boys and girls separately (see Table 9 for regression results). In girls, although child BMI z-score was not a significant predictor of intake ($\beta = 0.449, p = 0.054$), it did meet cut-offs for a non-significant trend at $p < 0.10$. When this same regression analysis was run in boys, child BMI z-score was not a significant predictor of intake ($\beta = -0.361, p = 0.186$).

**Table 9.** Regression analysis of BMI z-score (kg/m$^2$) on EAH intake (kcals) in girls (n=19) and boys (n=15).

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls Only:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>294.791</td>
<td>47.560</td>
<td></td>
<td>6.198</td>
<td>0.000</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>80.629</td>
<td>38.942</td>
<td>0.449</td>
<td>2.071</td>
<td>0.054</td>
</tr>
<tr>
<td>Boys Only:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>515.260</td>
<td>78.993</td>
<td></td>
<td>6.523</td>
<td>0.000</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>-121.555</td>
<td>87.021</td>
<td>-0.361</td>
<td>-1.397</td>
<td>0.186</td>
</tr>
</tbody>
</table>

**Relationship between Child BMI, EAH, Food-Consuming Behaviors, and Child Sex**

A stepwise multivariate regression was calculated to predict intake based upon child BMI z-score, the food-consuming behavior contrasts ($S_{it} > S_{tand}; G_{food} > G_{else}; E_{at} > P_{lay}$), and child sex (see Table 10 for regression results). In this model, child sex was not a significant predictor of EAH after account for child BMI z-score and the food-consuming behaviors ($\beta = -0.058, p = 0.725$).
Table 10. Regression analysis of BMI z-score (kg/m^2), food-consuming behaviors, and child sex (0 = boy, 1 = girl) on EAH intake (kcals) (n=27).

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>369.590</td>
<td>76.369</td>
<td></td>
<td>4.840</td>
<td>0.000</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>-17.466</td>
<td>43.472</td>
<td>-0.064</td>
<td>-0.402</td>
<td>0.692</td>
</tr>
<tr>
<td>S_{sit} &gt; S_{stand}</td>
<td>0.132</td>
<td>0.072</td>
<td>0.303</td>
<td>1.828</td>
<td>0.082</td>
</tr>
<tr>
<td>G_{food} &gt; G_{else}</td>
<td>-0.133</td>
<td>0.166</td>
<td>-0.258</td>
<td>-0.805</td>
<td>0.430</td>
</tr>
<tr>
<td>E_{at} &gt; P_{lay}</td>
<td>0.365</td>
<td>0.139</td>
<td>0.781</td>
<td>2.626</td>
<td>0.016</td>
</tr>
<tr>
<td>Sex</td>
<td>-25.682</td>
<td>71.942</td>
<td>-0.058</td>
<td>-0.357</td>
<td>0.725</td>
</tr>
</tbody>
</table>

**Girls versus Boys**

For exploratory purposes, a stepwise multivariate regression was calculated to predict intake based upon child BMI z-score and the food-consuming behavior contrasts (S_{sit} > S_{stand}; G_{food} > G_{else}; E_{at} > P_{lay}) in boys and girls separately (see Tables 11 and 12 for regression results). In both boys and girls, child BMI z-score was not a significant predictor of intake, so it was removed from the models. In girls only, E_{at} > P_{lay} positively predicted 28.4% of the variance in intake [F(1,17) = 6.755, p < 0.019; (see Table 11)]. For every unit increase in E_{at} > P_{lay}, girls consumed ~25 more calories (see Figure 7).

In boys only, S_{sit} > S_{stand} positively predicted 31.3% of the variance in intake [F(1,13) = 5.915, p < 0.030; (see Table 12)]. For every unit increase in S_{sit} > S_{stand}, boys consumed ~27 more calories (see Figure 8). In addition, G_{food} > G_{else} positively predicted 40.9% of the variance in intake [F(1,11) = 7.599, p < 0.019; (see Table 12)]. For every unit increase in G_{food} > G_{else}, boys consumed ~35 more calories (see Figure 9). Furthermore, E_{at} > P_{lay} positively predicted 55.7% of the variance in intake [F(1,13) = 16.320, p < 0.001; (see Table 12)]. For every unit increase in E_{at} > P_{lay}, boys consumed ~36 more calories (see Figure 10).
Table 11. Regression analysis of BMI z-score (kg/m²) and food-consuming behaviors on EAH intake (kcals) in girls only (n=14).

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MODEL 1:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>337.034</td>
<td>113.800</td>
<td></td>
<td>2.962</td>
<td>0.016</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>48.522</td>
<td>57.629</td>
<td>0.240</td>
<td>0.842</td>
<td>0.422</td>
</tr>
<tr>
<td>Sit &gt; Stand</td>
<td>0.127</td>
<td>0.095</td>
<td>0.369</td>
<td>1.334</td>
<td>0.215</td>
</tr>
<tr>
<td>G_food &gt; G_else</td>
<td>0.023</td>
<td>0.265</td>
<td>0.044</td>
<td>0.086</td>
<td>0.933</td>
</tr>
<tr>
<td>Eat &gt; P_lay</td>
<td>0.244</td>
<td>0.217</td>
<td>0.575</td>
<td>1.123</td>
<td>0.290</td>
</tr>
<tr>
<td><strong>MODEL 2:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>333.469</td>
<td>63.862</td>
<td></td>
<td>5.222</td>
<td>0.000</td>
</tr>
<tr>
<td>Sit &gt; Stand</td>
<td>0.045</td>
<td>0.098</td>
<td>0.110</td>
<td>0.457</td>
<td>0.654</td>
</tr>
<tr>
<td><strong>MODEL 3:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>470.328</td>
<td>80.721</td>
<td></td>
<td>5.827</td>
<td>0.000</td>
</tr>
<tr>
<td>G_food &gt; G_else</td>
<td>0.190</td>
<td>0.140</td>
<td>0.364</td>
<td>1.355</td>
<td>0.200</td>
</tr>
<tr>
<td><strong>MODEL 4:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>412.990</td>
<td>41.732</td>
<td></td>
<td>9.896</td>
<td>0.000</td>
</tr>
<tr>
<td>Eat &gt; P_lay</td>
<td>0.245</td>
<td>0.094</td>
<td>0.533</td>
<td>2.599</td>
<td>0.019*</td>
</tr>
</tbody>
</table>

Note: * Significant at p < 0.05.
Figure 7. EAH intake (kcals) as a function of the total amount of time that girls spent eating versus playing with toys ($E_{at} > P_{lay}$) (seconds) ($\beta = 0.553$, $p < 0.019$).
Table 12. Regression analysis of BMI z-score (kg/m$^2$) and food-consuming behaviors on EAH intake (kcals) in boys only (n=13).

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MODEL 1:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>498.418</td>
<td>140.186</td>
<td></td>
<td>3.555</td>
<td>0.007</td>
</tr>
<tr>
<td>BMI $z$-score</td>
<td>-114.815</td>
<td>70.448</td>
<td>-0.319</td>
<td>-1.630</td>
<td>0.142</td>
</tr>
<tr>
<td>$S_{it} &gt; S_{stand}$</td>
<td>-0.024</td>
<td>0.165</td>
<td>-0.049</td>
<td>-0.143</td>
<td>0.889</td>
</tr>
<tr>
<td>$G_{food} &gt; G_{else}$</td>
<td>-0.054</td>
<td>0.252</td>
<td>-0.101</td>
<td>-0.216</td>
<td>0.835</td>
</tr>
<tr>
<td>$E_{at} &gt; P_{lay}$</td>
<td>0.443</td>
<td>0.183</td>
<td>0.898</td>
<td>2.421</td>
<td>0.042</td>
</tr>
<tr>
<td><strong>MODEL 2:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>324.578</td>
<td>78.439</td>
<td></td>
<td>4.138</td>
<td>0.001</td>
</tr>
<tr>
<td>$S_{it} &gt; S_{stand}$</td>
<td>0.266</td>
<td>0.109</td>
<td>0.559</td>
<td>2.432</td>
<td>0.030*</td>
</tr>
<tr>
<td><strong>MODEL 3:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>536.897</td>
<td>68.074</td>
<td></td>
<td>7.887</td>
<td>0.000</td>
</tr>
<tr>
<td>$G_{food} &gt; G_{else}$</td>
<td>0.345</td>
<td>0.125</td>
<td>0.639</td>
<td>2.757</td>
<td>0.019*</td>
</tr>
<tr>
<td><strong>MODEL 4:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>467.344</td>
<td>46.714</td>
<td></td>
<td>10.004</td>
<td>0.000</td>
</tr>
<tr>
<td>$E_{at} &gt; P_{lay}$</td>
<td>0.358</td>
<td>0.089</td>
<td>0.746</td>
<td>4.040</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

Note: * Significant at $p < 0.05$. 
Figure 8. EAH intake (kcals) as a function of the total amount of time that boys spent sitting versus standing ($S_{\text{it}} > S_{\text{stand}}$) (seconds) ($\beta = 0.559$, $p < 0.030$).

Figure 9. EAH intake (kcals) as a function of the total amount of time that boys spent gazing at food versus gazing elsewhere ($G_{\text{food}} > G_{\text{else}}$) (seconds) ($\beta = 0.639$, $p < 0.019$).
Figure 10. EAH intake (kcals) as a function of the total amount of time that boys spent eating versus playing with toys ($E_{at} > P_{lay}$) (seconds) ($\beta = 0.746$, $p < 0.001$).

**Aim 2.1: Relationship between EAH intake, child weight status, food-consuming behaviors observed during EAH, and child-reported LOC.**

To determine how intake may be affected by child-reported LOC, a stepwise multivariate regression analysis was conducted to predict intake (dependent variable) with child BMI z-score and LOC as independent predictors. BMI z-score was not a significant predictor of intake, so it was removed from the model. LOC was not a significant predictor of intake [$\beta = 0.154$, $p = 0.401$; (see Table 13 for regression results)].
Table 13. Regression analysis of BMI z-score (kg/m$^2$) and LOC (1 = LOC, 2 = no LOC) on EAH intake (kcals) (n=27).

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODEL 1:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>230.258</td>
<td>191.788</td>
<td></td>
<td>1.201</td>
<td>0.240</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>10.248</td>
<td>48.304</td>
<td>0.040</td>
<td>0.212</td>
<td>0.833</td>
</tr>
<tr>
<td>LOC</td>
<td>86.989</td>
<td>100.561</td>
<td>0.162</td>
<td>0.865</td>
<td>0.394</td>
</tr>
<tr>
<td>MODEL 2:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>244.485</td>
<td>176.800</td>
<td></td>
<td>1.383</td>
<td>0.177</td>
</tr>
<tr>
<td>LOC</td>
<td>82.455</td>
<td>96.686</td>
<td>0.154</td>
<td>0.853</td>
<td>0.401</td>
</tr>
</tbody>
</table>

Relationship between Child BMI, EAH, Food-Consuming Behaviors, and LOC

To see which behavior was more predictive of intake when child-reported LOC was included in the model, stepwise multivariate regressions were calculated to predict intake based upon child BMI z-score, food consuming behavior contrasts (S-it > S-tand, G-food > G-else; E-at > P-lay), and child-reported LOC (see Table 14 for regression results). BMI z-score was not a significant predictor of intake, so it was removed from the models. Only E-at > P-lay and LOC were significant predictors of intake, so we re-ran the model with only these variables as independent predictors. Together, E-at > P-lay and child-reported LOC explained 63.5% of the variability in overall intake ($F_{(2,24)} = 20.834, p < 0.000$; (see Table 14)). For every unit increase in E-at > P-lay, children consumed ~37 more calories. In addition, children who did not report LOC consumed ~212.2 more calories than children who did report LOC (see Figure 11).
Table 14. Regression analysis of BMI $z$-score (kg/m$^2$), food-consuming behaviors, and LOC (1 = LOC, 2 = no LOC) on EAH intake (kcal) (n=27).

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODEL 1:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>79.941</td>
<td>113.970</td>
<td>0.701</td>
<td>0.490</td>
<td></td>
</tr>
<tr>
<td>BMI $z$-score</td>
<td>0.070</td>
<td>0.526</td>
<td>0.604</td>
<td>0.109</td>
<td>0.891</td>
</tr>
<tr>
<td>Sit &gt; Stand</td>
<td>-0.033</td>
<td>-0.192</td>
<td>0.849</td>
<td>-0.040</td>
<td>0.537</td>
</tr>
<tr>
<td>G food &gt; G else</td>
<td>-0.362</td>
<td>-1.413</td>
<td>0.171</td>
<td>-0.283</td>
<td>0.223</td>
</tr>
<tr>
<td>Eat &gt; Lay</td>
<td>0.365</td>
<td>0.059</td>
<td>0.781</td>
<td>6.157</td>
<td>0.000*</td>
</tr>
<tr>
<td>LOC</td>
<td>212.212</td>
<td>64.188</td>
<td>0.419</td>
<td>3.306</td>
<td>0.003*</td>
</tr>
</tbody>
</table>

| MODEL 2: |         |            |       |       |       |
| (Constant) | 85.853  | 113.512    | 0.756 | 0.456 |       |
| Eat > Lay | 0.387   | 0.057      | 0.809 | 6.851 | 0.000* |
| LOC | 204.171 | 63.315     | 0.381 | 3.225 | 0.003* |

Note: * Significant at $p < 0.05$. 
Figure 11. Unstandardized residual plots of EAH intake (kcal) as a function of a) the total amount of time that children spent eating versus playing with toys ($E_{at} > P_{lay}$) [(seconds); $\beta = 0.809, p < 0.000$] and b) loss of control eating (LOC) [(1 = LOC, 2 = no LOC); $\beta = 0.381, p < 0.003$].
Relationship between Child BMI, EAH, LOC, and Child Sex

A stepwise multivariate analyses was calculated to predict intake (dependent variable) with child BMI z-score, child-reported LOC, and child sex as independent predictors. In this model, child sex was not a significant predictor of intake when controlling for child BMI z-score and child-reported LOC [β = -0.228, p= 0.222; (see Table 15 for regression results)].

Table 15. Regression analysis of BMI z-score (kg/m²), LOC (1 = LOC, 2 = no LOC), and child sex (0 = boy, 1 = girl) on EAH intake (kcals) (n=27).

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>281.907</td>
<td>194.419</td>
<td></td>
<td>1.450</td>
<td>0.158</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>15.741</td>
<td>48.047</td>
<td>0.061</td>
<td>0.328</td>
<td>0.746</td>
</tr>
<tr>
<td>LOC</td>
<td>88.258</td>
<td>99.611</td>
<td>0.165</td>
<td>0.886</td>
<td>0.383</td>
</tr>
<tr>
<td>Sex</td>
<td>-101.696</td>
<td>81.454</td>
<td>-0.228</td>
<td>-1.249</td>
<td>0.222</td>
</tr>
</tbody>
</table>

Girls versus Boys

A stepwise multivariate regression was calculated to predict intake based upon child BMI z-score and child-reported LOC in boys and girls separately (see Table 16 for regression results). Child BMI z-score was not a significant predictor of intake, so it was removed from the models. Child-reported LOC was not a significant predictor of intake in either girls (β = 0.039, p = 0.879) or boys (β = 0.264, p = 0.362).
**Table 16.** Regression analysis of BMI $z$-score (kg/m$^2$) and LOC (1 = LOC, 2 = no LOC) on EAH intake (kcals) in girls (n=14) and boys (n=13).

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODEL 1 (Girls Only):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>266.794</td>
<td>181.866</td>
<td></td>
<td>1.467</td>
<td>0.163</td>
</tr>
<tr>
<td>BMI $z$-score</td>
<td>78.476</td>
<td>44.644</td>
<td>0.413</td>
<td>1.758</td>
<td>0.099</td>
</tr>
<tr>
<td>LOC</td>
<td>15.931</td>
<td>98.276</td>
<td>0.038</td>
<td>0.162</td>
<td>0.873</td>
</tr>
<tr>
<td>MODEL 1 (Boys Only):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>393.372</td>
<td>417.495</td>
<td></td>
<td>0.942</td>
<td>0.366</td>
</tr>
<tr>
<td>BMI $z$-score</td>
<td>-104.460</td>
<td>111.749</td>
<td>-0.311</td>
<td>-0.935</td>
<td>0.370</td>
</tr>
<tr>
<td>LOC</td>
<td>60.245</td>
<td>211.303</td>
<td>0.095</td>
<td>0.285</td>
<td>0.781</td>
</tr>
<tr>
<td>MODEL 2 (Girls Only):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>318.981</td>
<td>190.785</td>
<td></td>
<td>1.672</td>
<td>0.114</td>
</tr>
<tr>
<td>LOC</td>
<td>16.127</td>
<td>104.497</td>
<td>0.039</td>
<td>0.154</td>
<td>0.879</td>
</tr>
<tr>
<td>MODEL 2 (Boys Only):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>148.682</td>
<td>323.527</td>
<td></td>
<td>0.460</td>
<td>0.654</td>
</tr>
<tr>
<td>LOC</td>
<td>167.366</td>
<td>176.573</td>
<td>0.264</td>
<td>0.948</td>
<td>0.362</td>
</tr>
</tbody>
</table>

**Aim 2.2** Influence of child sex on the relationship between child BMI, food-consuming behaviors observed during EAH, and child-reported LOC.

A stepwise multivariate analysis was calculated to predict intake (dependent variable) with child BMI $z$-score, all food-consuming behavior contrasts ($S_{it} > S_{stand}$; $G_{food} > G_{else}$; $E_{at} > P_{lay}$), child-reported LOC, and child sex as independent predictors. Child sex did not influence EAH when child BMI $z$-score, intake, the food-consuming behavior contrasts, and child-reported LOC were included [$\beta = 0.916$, $p = 0.940$; (see Table 17 for regression results)].
Table 17. Regression analysis of BMI z-score (kg/m²), food-consuming behaviors, LOC (1 = LOC, 2 = no LOC), and child sex (0 = boy, 1 = girl) on EAH intake (kcals) (n=27).

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>79.941</td>
<td>113.970</td>
<td>0.701</td>
<td>0.490</td>
<td></td>
</tr>
<tr>
<td>BMI z-score</td>
<td>0.070</td>
<td>0.526</td>
<td>0.604</td>
<td>0.109</td>
<td>0.891</td>
</tr>
<tr>
<td>S_f &gt; S_rand</td>
<td>-0.033</td>
<td>-0.192</td>
<td>0.849</td>
<td>-0.040</td>
<td>0.537</td>
</tr>
<tr>
<td>G_food &gt; G_else</td>
<td>-0.362</td>
<td>-1.413</td>
<td>0.171</td>
<td>-0.283</td>
<td>0.223</td>
</tr>
<tr>
<td>E_at &gt; P_lay</td>
<td>0.365</td>
<td>0.059</td>
<td>0.781</td>
<td>6.157</td>
<td>0.000</td>
</tr>
<tr>
<td>LOC</td>
<td>212.212</td>
<td>64.188</td>
<td>0.419</td>
<td>3.306</td>
<td>0.003</td>
</tr>
<tr>
<td>Sex</td>
<td>0.014</td>
<td>0.107</td>
<td>0.916</td>
<td>0.022</td>
<td>0.940</td>
</tr>
</tbody>
</table>

Discussion

The overall aim of this project was to understand the mechanisms driving increased intake when 7-11 year-old children are not hungry. To do this, we investigated the relationship between child BMI, EAH intake, and food-consuming behaviors observed during EAH. Also, because of previous reports of sex-related differences in the relationship between child weight status and EAH [17,21,45], we measured if child sex influenced the relationship between child weight status, EAH intake and food consuming behaviors. In addition, we analyzed the relationship between EAH intake, child weight status, food-consuming behaviors observed during EAH, and child-reported LOC. Furthermore, we determined if child sex influenced the relationship between child BMI, EAH intake, food-consuming behaviors observed during EAH, and child-reported LOC.

Child BMI and EAH

The results of this thesis project did not support the hypothesis that child BMI z-score would positively predict EAH. These findings counter previous research that found significant relationships between food intake and child weight status [11–13,15]. A possible explanation as to why there was no relationship found between child BMI z-score and food intake may be small
sample size. This project only analyzed 34 participants during the EAH protocol. Previous studies that have found a relationship between child weight status and intake analyzed sample sizes over 100, such as Fisher et al.’s (2002) study of 192 girls [11]. Another possible explanation is that we did not actively recruit and enroll healthy weight children without parents who were obese (i.e. children without high risk for obesity), but instead tested children who were either lean or already overweight/obese. Previous research has found a relationship between children at risk for obesity and EAH intake. Faith et al., (2006) showed that boys at a high-risk for obesity consumed more than two times the amount of energy during EAH than low-risk boys [45]. However, when these children were tested at follow-up, there was no longer a relationship between EAH and weight status. Similarly, a separate study found a positive relationship between FTO, an obesity-related gene, and EAH in 4-5 year old children [25]. These studies suggest that EAH may be a marker or predictor for weight gain, but once obesity is established, the relationship between EAH and weight status may no longer be present.

**Child BMI, EAH, and Food-Consuming Behaviors**

This was the first study to observe and code individual child behaviors during the measurement of EAH. The findings of the current study supported the hypothesis that food-consuming behaviors such as time spent sitting, gazing at food, and eating predicted increased food intake compared to behaviors including standing, gazing elsewhere, and playing with toys. Moreover, $S_{it} > S_{tand}$, $G_{food} > G_{else}$, and $E_{at} > P_{lay}$ positively predicted increased food intake. This means that children who spent more time sitting versus standing, gazing at food versus gazing elsewhere, and eating versus playing with toys consumed more calories during EAH. These novel findings suggest that specific, food-consuming behaviors observed during EAH (including sitting, gazing at food, and eating) may be used to predict increased food intake in the absence of hunger in 7-11 year-old children. This knowledge may aide in our understanding of the mechanisms that drive increased food intake in children. However, while $E_{at} > P_{lay}$ did positively predict increased food intake, this result may be trivial because eat and play were the two main alternatives. Therefore, less time doing one necessarily had a strong effect on time and consumption in the other. Moreover, future research may consider an experimental design in which play is only one of a number of alternatives to eating. This would allow researchers to see if the strength of the relationship between $E_{at} > P_{lay}$ holds when there are other, alternative


**Child BMI, EAH, and Child Sex**

Previous research has suggested that child sex may moderate the relationship between EAH intake and child weight status, specifically in boys [17,21,45]. However, only one of these previous analyses analyzed BMI z-score and EAH intake directly, as we did in this thesis [21]. Remy et al., (2015) analyzed adiposity and evaluated EAH intake using a calculated score instead of actual food intake [17] and Faith et al., (2016) evaluated children based upon their risk for obesity (determined via BMI z-score) [45]. The results of this project showed that the relationship between child weight status and EAH did not significantly differ by sex. In addition, when the relationship between EAH and child BMI z-score was separately analyzed in boys and girls, BMI z-score was not a significant predictor of intake in either boys or girls. Although, there was a trend toward significance in girls only. It is worth noting that the direction of the relationship between child weight status and EAH intake was positive in girls (suggesting a positive relationship), but negative in boys (suggesting a negative relationship). This may explain the lack of relationship between child weight status and EAH observed in the current study.

These results suggest that the relationship between EAH and BMI z-score may be moderated by child sex, however, future large cohorts should be tested to fully analyze this hypothesis using a moderation model. Understanding how child sex moderates the relationship between child BMI and EAH may help to uncover some of the mechanisms driving increased food intake in children.

**Child BMI, EAH, Food-Consuming Behaviors, and Child Sex**

When analyzed as an independent predictor of intake, child sex did not influence the relationship between BMI, EAH, and the food-consuming behaviors. However, when analyzed in boys and girls separately, only \( E > P \) positively predicted increased food intake in girls. Yet, in boys, \( S_{it} > S_{tand}, G_{food} > G_{else}, \) and \( E > P \) positively predicted increased food intake. Furthermore, while \( E > P \) positively predicted only 28.4% of the variability in intake in girls, \( E > P \) positively predicted 55.7% of the variability in intake in boys. Moreover, the food-consuming behaviors were more predictive of intake in boys than they were girls. Child sex did not affect the relationship between intake and child BMI; but these findings suggest child sex
may influence the relationship between EAH and and the food-consuming behaviors observed during the EAH protocol, as we predicted.

**Child BMI, EAH, and LOC**

LOC was not a significant predictor of EAH intake when only including BMI z-score in the regression model. Only one study has previously evaluated the relationship between LOC and intake from a protocol similar to EAH [39]. This study showed a positive relationship between LOC and intake in 120, 8-13 year-old children. However, this research study did not use Tanofsky-Kraff et al.,’s (2008) LOC screener [24], as was used in this study. In addition, the authors of this previous study [39] note that their study design was similar to designs assessing EAH but that their test meal procedure was not aimed to ensure satiety or absence of hunger. Therefore, snack food intake following this test meal cannot truly be considered EAH. Ultimately, differences in methodology may account for the contradicting results between that study [39] and this thesis project.

Previous research has also suggested that children who report LOC eating may consume more foods during LOC episodes due to a lack of awareness and an under-estimation of the amount of foods consumed [61]. One hundred fifty-six, 8-17 year-old children were assessed for LOC eating [53] and were interviewed following consumption of a multi-item, laboratory buffet test meal [61]. Children with LOC did not significantly differ from children without LOC in their accuracy of reporting total food intake, but children with LOC were less accurate in reporting the percentage of energy intake from carbohydrates and desserts. In addition, research shows that children with LOC [53] consumed more calories from carbohydrates, snacks, and dessert-type foods in both a normal and a binge laboratory meal compared to children without LOC [35]. In this thesis, LOC may not have significantly predicted intake because we only chose to analyze overall intake during EAH as opposed to looking at intake from individual foods. Future research should analyze whether LOC predicts intake of certain types of foods during EAH. In this project, breaking EAH intake down into savory fats, sweet fats, and sweets may have yielded different results.

**Child BMI, EAH, Food-Consuming Behaviors, and LOC**

Together, E at > P lay and child-reported LOC positively predicted increased food intake.
This means that children who spent more time eating versus playing with toys and those who did not report LOC consumed more during EAH. These findings may suggest that LOC cannot be measured or observed accurately in the laboratory, however, this is unlikely given numerous reports from Tanofsky-Kraff et al. [35,61] that report increased laboratory intake in children and adolescents who report LOC. Participant age may explain why not reporting LOC promoted increased food intake in this study. Tanofsky-Kraff et al.’s [35,61] work analyzed children between the ages of 8 and 17. This is such a broad age range compared to the current study, which only analyzed children ages 7-11. It is possible that age may influence the relationship between LOC and intake, but future studies are needed to test this theory.

Previous research also shows that children with LOC have reported consuming more energy [33] and a higher percentage of calories from snack foods [35] during LOC episodes. However, it is possible that the children who reported LOC in this study were not experiencing a LOC eating episode during EAH. Moreover, the EAH foods offered in this study may not have elicited true loss of control in the participants. In addition, the children may have been uncomfortable because they were being observed during the EAH protocol. Therefore, it is impossible to tell whether or not the children were acting naturally. Children who reported LOC may not have experienced a LOC episode because they were more concerned with their surroundings and the unfamiliarity of a new setting in the laboratory. Additional studies are needed to replicate and test this paradigm in a larger sample of 7-11 year-old children to strengthen and expand upon these findings.

**Child BMI, EAH, LOC, and Child Sex**

Contrary to our expectations, this project showed that child sex did not directly influence the relationship between child BMI, LOC and intake during EAH. To date, no research has directly examined this relationship. To expand upon these findings, future analyses may wish to examine the LOC screener as a whole. Perhaps the nature and duration of LOC eating behavior is influenced by child sex instead of LOC in general. Children who report LOC do not all exhibit the signs of this eating disorder in the same way. The LOC-ED questionnaire [24] does not simply ask children to report LOC eating behavior; it analyzes the feelings that a child has prior to, during, and after a LOC eating episode. It is possible that child sex may influence how LOC eating makes children feel and furthermore, food intake. Ultimately, understanding how child
sex may affect the relationship between intake, BMI, and LOC is important in understanding the mechanisms that drive increased food intake in children.

**Limitations**

The current study had several limitations. A major limitation was small sample size. The study population of this project included 34 children in the analysis of EAH intake and child BMI. Only 27 children had completed data sets and therefore were included in the analyses of EAH intake, food-consuming behaviors, and LOC. Furthermore, only 9 children reported LOC and only 7 of these 9 were included in the analysis. These small sample sizes limited the types of analyses we could run. Just as well, the lack of diversity in this sample of participants may have skewed results. Recruitment for participants took place in central Pennsylvania and yielded a sample of mostly white children. A more diverse sample may have produced findings that were more representative of the United States population as a whole. Ultimately, more participants are needed to confirm the results of this project. However, it should be noted that these results are preliminary findings of an on-going research project. The data that is still being collected may help to validate and strengthen the results of this research study.

Additionally, Tanofsky-Kraff et al.’s (2008) LOC screening questionnaire [24] is still being validated. Furthermore, this thesis project did not offer any other eating disorder questionnaires to the children. Therefore, restrictive eating and/or other eating disorders were not assessed. Screening for multiple eating disorders would have allowed children to report a broader range of eating behaviors. Moreover, these behaviors may have been predictive of increased intake or restrained eating during EAH. The current thesis was only able to analyze LOC, which we found to be associated with a decrease in EAH intake.

Additionally, the program used to code and analyze human behaviors in this project (Noldus) only allowed for the manual coding of these behaviors. To date, there is no program that allows for the automatic coding of human behaviors. Therefore, human error was almost unavoidable as the coding of each behavior was a very objective process. In addition, coding was only done by one researcher and this data was not double checked which along with manual coding issues, may make the data more variable. Moreover, future research should aim to find a more effective method of coding human behavior in order to eliminate possible sources of human error.
**Strengths**

While this study did have limitations, it also had strengths. This thesis required the rigorous measurement of food intake data under controlled laboratory conditions. Measuring actual food intake in the laboratory is a more reliable and accurate method to measure consumption than child self-report. In addition, EAH was tested according to a well-validated paradigm [16] for this thesis. This not only lends legitimacy to the EAH intake data collected, but it makes it much easier to compare the results of this study to previous research also assessing EAH intake.

Furthermore, this study included a cohort that was balanced for both sex and weight status. This helped to prevent any bias in results. We also collected data from a pre-adolescent sample, making the results of this project a unique contribution to the field. Moreover, this was also the first study to observe and code individual child behaviors during the measurement of EAH. Therefore, some of the findings of this study are novel and may influence the direction of future research.

**Future Directions**

Some of the findings of this study are contradictory with those of previous research. Child BMI z-score did not predict EAH intake, nor did child sex significantly influence any of the proposed relationships in this thesis. In addition, not reporting LOC positively influenced EAH intake. However, the findings of the current study do demonstrate an effect of food-consuming behaviors upon EAH intake. Moreover, there is an inherent need for further investigation. Future research studies may wish to re-examine the aims of this thesis project in a larger, more diverse study population. Furthermore, as this study gains more participants, the findings from this thesis project should be further explored and appropriate measures should be taken to eliminate previous sources of error. Ultimately, understanding the interactions between EAH food intake, child weight status, food-consuming behaviors observed during EAH, and LOC may help to isolate key elements influencing the overconsumption of highly palatable foods in children. This, in turn, has the potential to aid in the prevention of childhood obesity.
Appendix

Figure A-1. Meal preload and EAH liking scales

Explanation of Five-point Scale
I am going to give you some fun foods to taste and I want you to taste each one and use these smiley faces to tell me how they taste, okay?

Hate It  Dislike It  It’s Okay  Like It  Love it

1. How much do you like this macaroni and cheese?

Hate It  Dislike It  It’s Okay  Like It  Love it

2. How much do you like this garlic bread?

Hate It  Dislike It  It’s Okay  Like It  Love it

3. How much do you like this broccoli?

Hate It  Dislike It  It’s Okay  Like It  Love it

4. How much do you like these cherry tomatoes?

Hate It  Dislike It  It’s Okay  Like It  Love it
**Explanation of Five-point Scale**
I am going to give you some fun foods to taste and I want you to taste each one and use these smiley faces to tell me how they taste, okay?

- Hate It
- Dislike It
- It's Okay
- Like It
- Love it

1. How much do you like this popcorn?
- Hate It
- Dislike It
- It's Okay
- Like It
- Love it

2. How much do you like this potato chip?
- Hate It
- Dislike It
- It's Okay
- Like It
- Love it

3. How much do you like this pretzel?
- Hate It
- Dislike It
- It's Okay
- Like It
- Love it

4. How much do you like this *cizz buzz*?
- Hate It
- Dislike It
- It's Okay
- Like It
- Love it
5. How much do you like this brownie?

- Hate It
- Dislike It
- It’s Okay
- Like It
- Love it

6. How much do you like these chocolate chip cookies?

- Hate It
- Dislike It
- It’s Okay
- Like It
- Love it

7. How much do you like this starburst?

- Hate It
- Dislike It
- It’s Okay
- Like It
- Love it

8. How much do you like this m & m?

- Hate It
- Dislike It
- It’s Okay
- Like It
- Love it

9. How much do you like this chocolate?

- Hate It
- Dislike It
- It’s Okay
- Like It
- Love it

10. How much do you like these chocolate kisses?

- Hate It
- Dislike It
- It’s Okay
- Like It
- Love it
Figure A-2. Fullness doll [42]
References

[18] Birch LL, Fisher JO, Davison KK. Learning to overeat: Maternal use of restrictive feeding


ACADEMIC VITA

Academic Vita of Arimani Caprio
amc6291@psu.edu
614 Snydertown Road
Howard, PA 16841

Education

The Pennsylvania State University
Bachelor of Science in Biology with a Vertebrate Physiology Option
Schreyer Honors College
Expected Graduation: August 2016, University Park, PA

Awards and Honors

- Clarence Ritchie and Esther Welsh Wiedhahn Academic Excellence Scholarship
- R. Metz, Jr., Betty and Dennis Lynn Headings Scholarship
- George E. Sperling and Elizabeth Smollett Sperling Trustee Scholarship
- Robert V. and Merriam K. Edwards Honors Scholarship

Research Experience

The Metabolic Kitchen and Children’s Eating Behavior Laboratory
Position: Research Assistant
Supervisor: Dr. Kathleen Keller, Ph.D.
January 2015–Present

- Run clinical visits that require direct interaction with parents and children
- Provide leadership and supply supervision to other undergraduate students working in the lab
- Call participants and conduct various organizational tasks
- Enter, collect, and analyze data using SPSS and Noldus Observer XT Software
- Handle and prepare food according to standard safety regulations

Clinical Experience

Hershey Medical Groups’ Shadow
Supervisor: Dr. Scott Kenneth Andrews, M.D.
Mentor: Dr. Jennifer Kymer Seidenberg, M.D.
February 2014 – May 2014

- Shadow various doctors and specialties within the Hershey Medical Group System (4 hours per week)
• Report progress during the program to an assigned mentor
• Maintain the confidentiality of all patients
• Meet and interact with current students attending Penn State Hershey’s College of Medicine

**Published work**

*Abstracts*


**Leadership & Service**

**Penn State Marching Blue Band**

*Majorette Captain (2015-Present)*

*Majorette Co-captain (2014-2015)*

*Spring 2012 – Present*

• Leadership position in which I am responsible for leading a team of 15 in a professional manner, while practicing appropriate communication skills
• Work effectively in a team setting as both a leader and a teammate
• Represent The Pennsylvania State University at home and away football games, as well as community events
• Meet and interact with various members of the community

**Bellefonte Area High School Majorette Coach**

*Spring 2012 – Present*

• Responsible for leading and coaching a team of high school baton twirlers
• Organize events
• Responsible for communication with both children and parents
• Train team members in proper baton twirling technique
• Foster the growth of each team members’ communication, leadership, and teamwork skills
• Choreograph and teach baton twirling routines
FFA (Future Farmers of America)  
*Fall 2011 – Fall 2015*

- Practice appropriate leadership skills through the study and promotion of agriculture
- Care for livestock animals including Holstein cows, chickens, ducks and rabbits
- Show animals at the county fair
- Participate in state-wide, agricultural competitions and events
- Educate the community about agricultural matters

Operation Christmas Child Volunteer  
*Fall 2009 – Present*

- Pack and send shoeboxes full of toys and necessities to young, needy children all over the world
- Interact with the community to promote the organization and spread the Christian message

**Technical Skills**

- Microsoft Office – Word, Excel, Powerpoint
- Database Management
- Data Analysis (SPSS, Noldus Observer XT)
- Coding (Noldus Observer XT)

**Software**

- Statistical Package for the Social Sciences (SPSS)
- Noldus Media Recorder/Observer XT
- Minitab Statistical Software

**Certifications and Training**

- Serving it Safe Food Safety Certification
- Children Sexual Abuse Prevention Training, Penn State
- CITI Human Protection Training
- Clery Act Training, Penn State
- MRI Safety Training Certification