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EATING DISORDER ONSET IN YOUNG GIRLS: A LONGITUDINAL
TRAJECTORY ANALYSIS

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy
in the College of Arts and Sciences at the University of Kentucky

By
Carolyn Mary Pearson

Lexington, Kentucky

Director: Gregory T. Smith, Ph.D., Professor of Psychology

Lexington, Kentucky

2014

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ABSTRACT OF DISSERTATION

EATING DISORDER ONSET IN YOUNG GIRLS: A LONGITUDINAL TRAJECTORY ANALYSIS

To investigate whether there are different patterns of development for binge eating and purging behavior among pre-adolescent and early adolescent girls, I conducted trajectory analyses of those behaviors in 938 girls across eight waves of data from the spring of 5th grade (the last year of elementary school) through the spring of 9th grade (the first year of high school). Analyses revealed four separate developmental trajectories for binge eating behavior (labeled none, increasing, decreasing, and high steady) and three separate developmental trajectories for purging behavior (labeled none, dabble, and increasing). Fifth grade scores on risk factors that were both personality-based (negative affect and negative urgency) and learning-based (expectancies for reinforcement from eating and from thinness) differentiated among the trajectory groups, in some cases before the groups differed in the target behaviors. These findings are the first, to my knowledge, to examine developmental trajectories for eating disorder onset in youth as young as elementary school. Clinical implications are discussed.

KEYWORDS: Eating disorder, Development, Trajectories, Binge eating, Purging

Carolyn Mary Pearson

May 19, 2014

EATING DISORDER ONSET IN YOUNG GIRLS: A LONGITUDINAL
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Chapter One: Introduction

Bulimia Nervosa

Binge eating (consuming unambiguously large amounts of food in a discrete period of time while feeling a sense of loss of control) and purging (self-induced vomiting in an effort to control weight and shape: American Psychiatric Association, 2013) often first occur in very early adolescence (e.g., Combs, Pearson, Zapolski, & Smith, 2013; Stice, 2001; Tanofsky-Kraff, Shoemaker, Olsen, Rozan, Wolkoff, et al., 2011) and tend to be more prevalent in girls than boys (Hoek & van Hoeken, 2003). Early engagement in these behaviors is important because the prevalence of bulimic behaviors tends to increase with age (Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011) and these early-emerging symptoms are highly predictive of later, diagnosable disorders (Kotler, Cohen, Davies, Pine, & Walsh, 2001). In fact, anorexia nervosa (AN) and bulimia nervosa (BN) symptoms at the beginning of adolescence correlate greater than $r = .40$ with symptoms during adulthood, and diagnosable BN at the beginning of adolescence is associated with a nine-fold increase in BN and a 20-fold increase in AN during late adolescence (Kotler et al., 2001). Given the profound negative consequences on overall adolescent health (e.g., esophageal tears, cardiac arrhythmias, type 2 diabetes, panic disorder: American Psychiatric Association, 2013), and the chronicity of BN in youth, even for youth who have undergone treatment (le Grange, Crosby, Rathouz, & Leventhal, 2007), it is crucial for researchers to address three questions. First, when do different girls begin engaging in eating disorder behaviors like binge eating or purging? Second, does the temporal pattern of the emergence of these behaviors vary across individuals? Third, what risk factors lead to the onset of such behaviors for young girls?

The aim of this research was to address these three questions, by identifying different developmental risk pathways for initial engagement in binge eating and purging behaviors in different young girls, and then assessing the relationships between risk pathways and eating disorder risk factors. To introduce this empirical test, I first review relevant findings on eating disorder onset in youth and key factors of risk. I then present my model and specific study aims.

Eating Disorder Onset in Young Girls

The majority of eating disorder risk research has been conducted with adolescent girls around the peak age of onset. For binge eating, the peak age of onset tends to be about 16 years old (Day, Schmidt, Collier, Perkins, Van Den Eynde et al., 2001; le Grange & Loeb, 2007; Stice, Marti, & Rohde, 2013), while for purging, the onset tends to occur a little later at about 18 years of age (Stice, Killen, Hayward, & Taylor, 1998). Using *Diagnostic Statistic Manual 5* (DSM-5: American Psychiatric Association, 2013) criteria, Stice and colleagues (2013) found that the peak age of onset for BN is between 16 and 20 years of age. Several studies suggest, however, that the age of onset for BN is decreasing (e.g., Smink, van Hoeken, & Hoek, 2012). For example, one study found that the peak age of onset has dropped over the last two decades from 18.5 to 17.1 years old (Favaro, Caregato, Tenconi, Bosello, & Santonastaso, 2009).

Because bulimic behaviors among early adolescent girls predict the subsequent emergence of diagnosable BN, it is important to understand disordered eating behaviors in young girls before the emergence of the full-blown disorder, i.e., before the peak age of onset for BN. A handful of studies have begun to address this need. In fact, there is evidence that binge eating occurs in girls as young as 6 years old (Morgan, Yanovski,

Nguyen, McDuffie, Sebring et al., 2002; Nicholls, Lynn, & Viner, 2011). Similarly, the average age of a girl's first loss of control over eating episode is 8.4 years old (Tanofsky-Kraff, Faden, Yanovski, Wilfley, & Yanovski, 2005). Though the rates of binge eating tend to be smaller in pre-adolescent girls at approximately 10% (Combs et al., 2013; Neumark-Sztainer et al., 2011), these rates tend to increase with age and puberty, such that 14% to 25% of mid-late adolescent girls binge eat (Croll, Neumark-Sztainer, Story, & Ireland, 2002; Neumark-Sztainer et al., 2011). This same trend is seen in purging behavior as well: Self-induced vomiting was observed in 4.8% of children as young as 10 years (Combs et al., 2013) and these rates tend to increase with age and puberty (Neumark-Sztainer et al., 2011). The development of binge eating and the development of purging are related: approximately half of those who binge eat by age 14 go on to develop compensatory behaviors, including purging, by the age of 17 (Allen, Byrne, & McLean, 2013), thereby increasing their risk for BN. Thus, in order to understand the development of diagnosable BN in later adolescence, researchers must better understand the initial development of both binge eating and purging behaviors in early adolescence.

Trajectories of Eating Disorder Behavior

Although risk increases across the adolescent years, the emergence of bulimic behaviors occurs at different ages for different girls, and not all girls who binge eat at a young age go on to develop binge eating disorder (BED) or BN later in life (Chamay-Weber, Narring, & Michaud, 2005). Researchers have identified different developmental trajectories for bulimic behavior in mid-late adolescent girls (i.e., approximately 15-16 years old at the initiation of study: Abebe, Lien, & Soest, 2012; Aime, Craig, Pepler, Jiang, & Conolly, 2008; Fay & Lerner, 2013) and in adult women (e.g., Keel, Baxter,

Heatherton, & Joiner, 2007; Lavender, De Young, Franko, Eddy, Kass, Sears, & Herzog, 2011). These findings suggest (a) an overall trend in which disordered eating peaks during adolescence and then gradually declines as girls progress into adulthood, and (b) several trajectories that describe the development for bulimic behaviors in different groups of late-adolescent girls and women (Abebe et al., 2012; Keel et al., 2007; Steinhausen, Gavez & Metzke, 2005; Striegel-Moore & Bulik, 2007; Striegel-Moore, Silbertsein, & Rodin, 1986). For example, a late adolescent girl's eating behavior through the four-year high school period could best be described by one of five developmental trajectories (Aime et al., 2008). The majority of adolescent girls tended to fall into the "normal" (asymptomatic) group (58.5%), followed by the stable but low group (21.9%), high and slightly declining group (10.1%), and the high and chronic group (5.5%: Aime et al., 2008). Interestingly, the group with the smallest membership was the increasing eating problems group, capturing only 3.9% of high school girls (Aime et al., 2008). Similar group trajectories have been found in treatment seeking adult women with AN or BN (Lavender et al., 2011).

To my knowledge, no study has examined specific eating disorder behavior trajectories in young girls beginning in the pre-adolescent years. One study described trajectories for binge eating and purging behaviors across middle school girls (grades 7th through 9th, average age of 12.84 at study onset) and identified the following groups for each behavior: (a) no behavior, (b) moderate levels, (c) high levels, and (d) increasing levels (Smith, Simmons, Flory, Annus, & Hill, 2007). This study, along with those with high school students, are important and informative in helping researchers and clinicians to better understand various progressions of disordered eating for different groups of girls.

They have focused primarily on binge eating and purging behavior during the peak age of diagnosable onset or later; little is known about the developmental course beginning at the youngest ages at which these behaviors appear. Given that binge eating and purging behavior often occur in girls before adolescence, there is a need to identify developmental trajectories for each behavior before the “peak age” of onset. The current study is the first to do so. Thus, the first goal of this study was to develop different developmental trajectories for both binge eating and purging behaviors in pre-adolescent girls as they transition into adolescence.

Risk for Eating Disorder Behavior

Not only is it important to identify the different developmental trajectories for girls’ binge eating and purging behaviors, it is also crucial to determine how binge eating and/or purging behavior develops over time. That is, what risk factors predict what eating disorder trajectory group to which a girl belongs? Are there risk factors unique to the development of binge eating behavior, or of purging behavior? For example, perhaps there are personal characteristics of girls or characteristics of what they have learned from their environments that make them more prone to binge eating as opposed to purging, or vice versa. Or, perhaps there are certain characteristics and risk factors that make some girls vulnerable to engage in both binge eating and purging behavior at a young age. Though numerous risk factors have been identified in the literature, I have focused on two personal characteristics (negative affect and negative urgency) and two environmental/learning factors (eating expectancies and thinness expectancies) that are likely to be particularly important for understanding differences in these developmental trajectories (Pearson, Riley, Davis, & Smith, 2014a). The second goal of the current study

was to study the relationships of these risk factors to binge eating and purging trajectory group memberships.

Negative affect. Negative affect is associated with a multitude of psychological disorders, including eating disorder onset and maintenance. In a young community sample of girls, negative emotionality/affect predicted disordered eating (Leon, Fulkerson, Perry, Keel, & Klump, 1999; Pearson, Zapolski, & Smith, 2014b), frequent use of unhealthy compensatory behaviors (Vander Wal, 2012), and was associated with eating disorder attitudes and cognitions (Klump, McGue, & Iacono, 2002). Using ecological momentary assessment, or EMA, studies have consistently shown that women with BN tend to participate in more binge eating and purging behavior on days during which they experienced negative emotions (Haedt-Matt & Keel, 2011; Smyth, Wonderlich, Heron, Sliwinski, Crosby, et al., 2007). More specifically, negative affect tends to steadily increase in the moments leading up to a binge eating and/or purging episode (Haedt-Matt & Keel, 2011). Thus, binge eating and purging is tied very close in time to the experience of negative affect, suggesting the possibility that the behaviors function in response to distress. In addition, depression is associated with more complex and severe eating disorder presentations and symptoms among children and adolescent girls (Hughes, Goldschmidt, Labuschagne, Loeb, Sawyer, et al., 2013). Based on these findings and the hypothesis that negative affect increases risk, I anticipated that negative affect measured in elementary school would be associated with membership in any trajectory group characterized by disordered eating behavior. It would differentiate membership in those trajectories from membership in trajectory groups defined by absence of the behavior.

Negative urgency. Negative urgency, the tendency to act rashly when distressed, appears to be a particularly important personality risk factor for BN behavior (Fischer, Smith, & Cyders, 2008). In one model of the personality underpinnings to impulsive behavior, negative urgency has been identified as one of five personality traits that disposes individuals to impulsive action (Cyders & Smith, 2008; Cyders, Smith, Spillane, Fischer, Annus, & Peterson, 2007; Whiteside & Lynam, 2001) and the only one with a substantial relationship to BN symptomatology (Cyders et al., 2007; Fischer et al., 2008). Moreover, change in negative urgency levels is associated with change in BN symptoms (Anestis, Selby, & Joiner, 2007), and negative urgency has been found to concurrently and prospectively predict both binge eating and purging behavior in elementary school-aged girls (Combs, Pearson & Smith, 2011; Pearson, Combs, Zapolski, & Smith, 2012; Pearson et al., 2014b). I thus anticipated negative urgency to be an important risk factor for all binge eating and purging trajectories: it would differentiate those trajectories defined by engagement in eating disorder behavior from the trajectory defined by absence of the behavior.

It is important to note that there are many other models addressing the personality underpinnings of impulsive action. I have chosen to rely on this model for two primary reasons: The first is its apparent comprehensiveness (see Cyders & Smith, 2008; Cyders et al., 2007; Whiteside & Lynam, 2001) and the second is the success of negative urgency in predicting onset and maintenance of disordered eating behavior. For consideration of other models that may prove relevant to eating disorder risk, the reader is referred to: Barratt, 1993; Buss and Plomin, 1975, Carver and White, 1994; Dickman, 1990; Gray and McNaughton, 2000; Wills, Pokhrel, Morehouse and Fenster, 2011.

Expectancies for Reinforcement from Eating and from Thinness.

Expectancies represent summaries of individuals' learning histories and are formed based on the multitude of direct and vicarious learning experiences that individuals undergo. They are learned anticipations of the likely consequences of behavioral choices. The expectancies one forms influence one's future behavioral choices. One tends to choose behaviors for which one expects rewards and avoid behaviors for which one expects punishment. Eating disorder symptoms can be understood as extreme eating and dieting behavior, which is thought to stem from extreme or unusual learning histories (Combs & Smith, 2009; Hohlstein, Smith, & Atlas, 1998).

Eating expectancies. Girls differ in their expectancies about eating. Due to their personalities and learning histories, some girls form unusually strong expectancies that eating helps manage one's negative affect (e.g., Hohlstein et al., 1998; MacBrayer, Smith, McCarthy, Demos, & Simmons, 2001; Simmons, Smith, & Hill, 2002; Smith et al., 2007). These eating expectancies have been shown to correlate cross-sectionally with symptom level in child (Combs et al., 2011; Pearson, Combs, & Smith, 2010), adolescent (MacBrayer et al., 2001; Simmons et al., 2002) and adult samples (Fischer, Settles, Collins, Gunn, & Smith, 2012; Hohlstein et al., 1998). Women with BN endorse eating expectancies more strongly than women with AN, normal controls, and psychiatric controls (Bruce, Mansour, & Steiger, 2009; Hohlstein et al., 1998). Longitudinally, these expectancies predict binge eating, including binge eating onset, in longitudinal samples of adolescent girls (Pearson et al., 2012; Smith et al., 2007) and college women (Fischer, Peterson, & McCarthy, 2013). Endorsement of the expectancy that eating helps alleviate negative affect predicts membership in trajectory groups characterized by a large increase

in binge eating during early adolescence (Smith et al., 2007). In contrast, women who do not expect eating to alleviate their distress tend to eat less when distressed (Tice, Bratslavsky, & Baumeister, 2001). I thus anticipated the endorsement of eating expectancies to be an important risk factor for any groups defined by the presence of binge eating.

Thinness expectancies. Girls also differ in their expectancies for thinness. Strong endorsement of the expectancy that thinness leads to overgeneralized life improvement also correlates cross-sectionally with child (Combs et al., 2011), adolescent (MacBrayer et al., 2001; Simmons et al., 2002), and adult symptom levels (Fischer et al., 2012; Hohlstein et al., 1998). Endorsement of expectancies for reinforcement from thinness differentiate women with BN and women with AN from both normal and psychiatric controls (Hohlstein et al., 1998), but not the two eating disorder groups from each other. Longitudinally, thinness expectancy endorsement also predicts membership in trajectory groups characterized by increases in binge eating and purging behavior among middle school girls (Smith et al., 2007). In an experimental study, reduction of thinness expectancies produced a reduction in eating disorder symptoms (Annus, Smith, & Masters, 2008). I thus anticipated the endorsement of thinness expectancies to be an important risk factor for membership in purging groups, but not those groups defined by binge eating only.

Puberty. The experience of puberty is associated with increased risk for eating disorder-related behaviors in girls (Baker, Thornton, Lichtenstein, & Bulik, 2012; Klump, McGue, & Iacono, 2003). It appears to be the case that eating disorder heritability is negligible prior to pubertal onset and then rises dramatically with puberty. For example,

Klump and colleagues (2003) found that the heritability of eating disorder symptoms was 0% in pre-pubertal 11-year-old twins, 54% in pubertal 17-year-old twins, and pubertal 11-year-old twins had similar heritability as the 17-year-old twins. This finding has been replicated (e.g., Culbert, Burt, McGue, Iacono, & Klump, 2009). It is important to appreciate that heritability estimates are based on the degree of symptom covariation in relation to genetic similarity. What changes with puberty is the degree of covariation as a function of zygosity. Once girls go through puberty, twins who share 100% of their genes are much more similar to each other in eating disorder symptomatology than are twins who on average share only 50% of their genes. Prior to pubertal onset, monozygotic twins are no more similar to each other than are dizygotic twins. Of course, if there were no variability in eating disorder symptoms among 11 year olds, restriction of range would preclude covariation as a statistical matter. However, Klump and colleagues (2003) found meaningful variability in eating disorder symptoms among all three groups: Prepubertal 11-year-old girls, postpubertal 11-year-old girls, and 17-year-old girls.

Pubertal onset occurs at different ages for different girls, and I anticipated that the timing of pubertal onset would contribute to variation in time of eating disordered behavior onset among young girls. For example, girls who underwent puberty early would have a greater probability of membership in trajectory groups characterized by the early onset of binge eating and purging than would girls who underwent puberty at a later time. This latter group would have a higher probability of membership in trajectory groups characterized by a later increase in symptom level. Thus, pubertal onset would differentiate potential early-onset and late-onset trajectory groups.

The Current Study

The current study had two primary aims. The first was to identify different developmental trajectories for (a) binge eating and (b) purging behavior in pre-adolescent girls as they transitioned into adolescence. Because prior research has not yet identified such trajectories in girls this young, the development of these trajectories does not involve hypothesis tests.

The second aim was to identify characteristics of girls associated with group trajectory membership. I identified four primary questions with respect to risk factors. One, what distinguishes girls who engage in an eating disorder behavior from those who do not? I anticipated that all four risk factors (negative affect, negative urgency, eating expectancies and thinness expectancies) would differentiate groups characterized by the presence or emergence of binge eating or purging from groups characterized by the absence of those behaviors. Two, what risk factors determine who binge eats versus who purges? I anticipated that the expectancies would differentiate the two behaviors: those who endorsed expectancies about eating would belong to the binge eating groups while those who endorsed only expectancies about thinness would belong to the purging groups. Three, will there be early-onset and later-onset groups that are differentiated by the timing of pubertal onset? Four, what is the nature of the covariation in membership between binge eating trajectory groups and purging trajectory groups? For example, are there girls who develop purging behavior but do not develop binge eating behavior?

In order to test these hypotheses, I identified developmental trajectories and risk processes for girls across four years of adolescent development from 5th grade (the last year of elementary school) through 9th grade (the first year of high school). I used eight waves of data, collected every six months (except for wave 8, which was collected one

year after wave 7), beginning in the spring of 5th grade (wave 1) through the spring of 9th grade (wave 8).

Chapter Two: Method

Participants

The participants were 938 girls who were assessed every six months from the spring of their 5th grade year (first year of elementary school) through the spring of their 8th grade year (last year of middle school), and then one year later in the spring of their 9th grade year (first year of high school) for a total of eight different measurement occasions. The mean age of the participants at the initiation of the study was 10.84 years. Most were European American (60.7%), followed by African American (17.6%); the remainder of the sample identified themselves as Hispanic (6.3%), Asian (4.0%), Middle Eastern (0.5%), or other (10.9%).

Measures

Positive Affect, Negative Affect Scale. (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS measures dimensions of positive and negative affectivity. The scales are internally consistent (alphas range from .84 to .90 in prior research), stable over time, and have impressive evidence for their validity. For this study, I used only the negative affect scale. Concerning reliability, $\alpha = .90$ in wave 1 and was higher in subsequent time points.

UPPS-P Negative Urgency Scale (Lynam, Smith, Cyders, Fischer, & Whiteside, 2007). I used the child version of the negative urgency scale, which has recently proved to be internally consistent ($\alpha = .87$), have good convergent validity across assessment method, good discriminant validity from other impulsivity-related measures, and predictive of criteria in theoretically consistent ways (Zapolski, Stairs, Settles, Combs, &

Smith, 2010). In this sample, $\alpha = .85$ at wave 1 and was higher in subsequent time points. An example item is “When I am upset, I often act without thinking.”

The Pubertal Development Scale (PDS; Peterson, Crockett, Richards, & Boxer, 1988). The PDS consists of five questions for girls, using a likert-type rating format. An example item is “Has your skin started to change yet?” This measure correlates highly with physician ratings and other forms of self-report (Brooks-Gunn, Warren, Rosso, & Gargiulo, 1987; Coleman & Coleman, 2002). The PDS permits dichotomous classifications: following prior research, I rated scores of 2.5 or greater as reflective of pubertal onset.

Eating Expectancy Inventory (EEI; Hohlstein et al., 1998). This five-factor measure reflects expectancies for reinforcement from eating. For this study, I used the measure of the expectancy that eating helps one manage negative mood states. This scale has been shown to predict subsequent onset of binge eating (Smith et al., 2007). As with past samples, the scale was internally consistent ($\alpha = .93$ at wave 1 and was higher in subsequent time points). An example item is “Eating helps me forget bad feelings, like being sad, lonely, or scared.”

Thinness and Restricting Expectancy Inventory (TREI; Hohlstein et al., 1998). The TREI measures overgeneralized expectancies for life improvement from thinness and restricting food intake. The scale has been shown to predict the onset of eating disorder symptomatology (Smith et al., 2007); interventions that reduce thinness expectancies also reduce eating disorder symptoms (Annus et al., 2008). Scores on the scale were internally consistent in this sample, as they have been in the past (Wave 1 $\alpha = .91$ and higher in subsequent waves). An example item is, “If I were thin, I would feel more worthwhile.”

Eating Disorder Examination- Questionnaire (*EDE-Q*; Fairburn & Beglin, 1994). The EDE-Q is a self-report version of the Eating Disorders Examination semi-structured interview (Cooper & Fairburn, 1993) designed to assess the full range of behavioral and cognitive or attitudinal features of the specific psychopathology of eating disorders during the preceding four weeks. The EDE-Q has been shown to have good reliability and validity, particularly in clinical samples (Cooper & Fairburn, 1993; Luce & Crowther, 1999; Mond, Hay, Rodgers, Owen, & Beumont, 2004). In this study, the EDE-Q was adapted for use with a younger population by using age-appropriate wording, defining concepts that could possibly be difficult to understand, and shortening the length of time referred to in the questions to the past two weeks, per past recommendations (Carter, Stewart, & Fairburn, 2001). For instance, the word “restrict” was changed to “cut back on” and the word “influence” was changed to “control” throughout the measure. Terms such as “purging”, “laxatives”, “diuretics”, and “binge eating” were defined.

The measure of binge eating used emphasized binge eating with loss of control: girls had to endorse two items, one that assessed episodes of objective binge eating and one that assessed loss of control during these episodes. Since loss of control seems to be a central feature for youth, I excluded girls who endorsed overeating (binge eating but no loss of control), in order to make sure I had a clear contrast between no binge eating and binge eating; however, my findings did not change when I included overeating. I used a 6-point scale (0=absence of loss of control binge eating; 1=one to two loss of control episodes; 2=three to four loss of control episodes; 3=five to seven loss of control episodes; 4=eight to 10 loss of control episodes; 5=11 to 13 loss of control episodes; 6=13 or more loss of control episodes). For purging, girls also had to endorse two items, one

that assessed episodes of self-induced vomiting, and another that assessed the goal of controlling or changing weight or shape during these episodes. Thus, I sought to measure purging for weight or shape reasons. I used the same 6-point scale described above but for purging to control or change body weight or shape.

Procedures

Data collection. The following procedure was approved by the University's IRB and by the participating school systems and was utilized at all eight waves of the study. The questionnaires were administered in school cafeterias or classrooms during school hours in 23 public elementary schools for the first wave, 19 public middle schools for waves two through seven, and seven public high schools for wave eight. A passive consent procedure was used. Each family was sent a letter, through the U.S. Mail, introducing the study. Families were asked to return an enclosed, stamped letter or call a phone number if they did not want their child to participate. Out of 994 5th grade girls in the participating schools, 938 (94.4%) participated in the study. A total of 56 girls did not participate due to one of the following reasons: Families declined to participate, students declined assent, or a variety of other factors, such as language disabilities that precluded completing the questionnaires.

It was made clear to the students that their responses on the questionnaires were to be kept confidential and no one outside of the research team would see them. The research team introduced a federal certificate of confidentiality for the project and emphasized that they were legally bound to keep all responses confidential. After each participant signed the assent form, the researchers then passed out packets of questionnaires. The questionnaire administration took 60 minutes or less. There was no

compensation for participations (except for those who moved out of district). Those who did move out of the study's school districts were contacted and asked to complete the forms by mail and were paid \$30 for doing so in 6th, 7th, and 8th grades and \$40 for doing so in 9th grade.

Data analytic method. I conducted two primary trajectory analyses, one for binge eating behavior and one for purging behavior. I identified groups reporting different trajectories of binge eating behavior and of purging behavior across the eight waves of the study. I used SAS Version 9.1 PROC TRAJ (zero inflated poisson: ZIP) and applied finite mixture modeling (Nagin, 2005) to model trajectories as a function of measurement wave. I specified a ZIP model due to the excess of zeros, or number of girls not engaging in the behaviors of interest. When using this method, one assumes that the target population can accurately be described as a mixture of distinct groups defined by their developmental trajectories. In brief, longitudinal data are used to identify the number of groups that best fit the data and to describe the shape of the trajectory for each group. The probability of each individual belonging to each trajectory group in the model is calculated and individuals are then assigned to the group to which they have the highest probability of belonging.

Several fit indices are used to determine the optimal number of groups and the validity of the grouping result. The Bayesian Information Criterion (BIC) and the Akaike Information Criterion (AIC) become increasingly less negative with improvements in the fit of the group structure. Those statistics can be supplemented by additional statistics and guidelines for selecting the best trajectory solution. When the average probability of group membership is greater than .70 for each group (Nagin, 2005), the identified group

structure is thought to fit well. One also avoids group structures with extremely small group sizes, out of concern for the stability of the structure (Nagin, 2005). To test whether identified trajectory groups differed in negative urgency, negative affect, eating expectancies, and thinness expectancies, I used analysis of variance and planned contrasts.

Chapter Three: Results

Attrition and Treatment of Missing Data

Of the full sample of 938 girls, percentage of participants ranged from 905 (96.5%) at wave 1 to 704 (75.1%) at wave 8. Girls who participated at all eight waves of the study did not differ from those who participated in fewer waves on any study variables. I therefore assumed data were missing at random and used the expectation maximization (EM) procedure to impute values for the missing data points. This procedure has been shown to produce relatively unbiased population parameter estimates and to be superior to traditional methods (Little & Rubin, 1989). As a result, I was able to make full use of the entire sample of $n = 938$.

Possible Effects due to School Membership

In order to determine whether there was significant covariance among the study variables due to participants attending the same school, I calculated intraclass coefficients for each variable (using elementary school membership, $n = 23$, as the nesting variable). Intraclass coefficients ranged from .03 to .00; therefore, I concluded that school membership was essentially unrelated to study variables.

Descriptive Statistics

The sample was made up of 938 girls. By the end of 5th grade (wave 1), 222 girls (23.7%) had experienced pubertal onset. Table 1 presents the frequencies of binge eating and purging behavior over the two weeks preceding each assessment. As the table shows, at each wave, over 8% of girls reported at least one objective binge eating episode and over 3% of girls reported at least one purging episode in the preceding two weeks. There was a change in self-reported binge eating: the rate of binge eating began to increase

around wave 5, the spring of 7th grade. Thus, comparing wave 5 to wave 8 (the spring of 9th grade), there was a significant increase ($\chi^2 = 149.12, p < .001$). The increase consisted primarily of more girls reporting 1-2 binge episodes in the preceding two weeks: from waves 1 to 4, the average percentage of girls reporting that rate of binge eating was 3.1%; from waves 5 to 8, the percentage increased steadily from 4.7% to 10.1%. For purging, rates appeared to be low from spring of 5th grade (wave 1) through spring of 7th grade (wave 5) and then increase through spring of 9th grade (wave 8). This increase in purging behavior is significant ($\chi^2 = 199.71, p < .001$). The increase in purging behavior consisted primarily of more girls reporting 1-2 purge episodes in the preceding two weeks: from waves 1 to 4, the average percentage of girls making such reports was 2.1%. Across waves 5 to 8, the average percentage increased to 5.8%. Table 2 presents the means and standard deviations for negative affect, negative urgency, depression, eating expectancies, and thinness expectancies at each wave. For each variable, the mean scores are very similar to means reported elsewhere for youth (Fischer et al., 2012; Fischer & Smith, 2008; Hohlstein et al., 1998; Laurent, Catanzaro, Joiner, Rudolph, Potter, Lambert, Osborne, et al., 1999). Table 3 presents correlations among study variables at the first and last waves (waves 1 and 8). All correlations reported are Pearson coefficients except for (a) those correlations with puberty, which are point biserial correlations and (b) those with binge eating and purging which are Spearman coefficients.

Table 1.

Frequencies of Binge Eating and Purging Behavior across Waves

Behav- ior	Number of episodes in last 14 days	Frequencies							
		Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 8
Binge Eating	None	806 (85.9)	846 (90.2)	852 (90.8)	861 (91.8)	839 (89.4)	796 (84.9)	780 (83.2)	794 (84.6%)
	1 - 2	24 (2.6%)	32 (3.4%)	27 (2.9%)	34 (3.6%)	44 (4.7%)	80 (8.5%)	86 (9.2%)	95 (10.1%)
	3 - 4	75 (8.0%)	30 (3.2%)	32 (3.4%)	28 (3.0%)	31 (3.3%)	38 (4.1%)	32 (3.4%)	24 (2.6%)
	5 - 7	23 (2.5%)	18 (1.9%)	11 (1.2%)	8 (0.9%)	11 (1.2%)	9 (1.0%)	13 (1.4%)	13 (1.4%)
	8 - 10	7 (0.7%)	4 (0.4%)	4 (0.4%)	5 (0.5%)	1 (0.1%)	6 (0.6%)	8 (0.9%)	2 (0.2%)
	11 - 13	2 (0.2%)	4 (0.4%)	5 (0.5%)	0	3 (0.3%)	6 (0.6%)	6 (0.6%)	2 (0.2%)
	14 or more	1 (0.1%)	4 (0.4%)	7 (0.7%)	2 (0.2%)	9 (1.0%)	3 (0.3%)	13 (1.4%)	8 (0.9%)

Table continued on next page

Purging	None	898 (95.7%)	906 (96.6%)	915 (97.5%)	915 (97.5%)	906 (96.6%)	837 (89.2%)	829 (88.4%)	875 (93.3%)
	1 - 2	29 (3.1%)	21 (2.2%)	13 (1.4%)	16 (1.6%)	24 (2.6%)	81 (8.6%)	68 (7.2%)	45 (4.8%)
	3 - 4	6 (0.6%)	6 (0.6%)	7 (0.7%)	3 (0.3%)	2 (0.2%)	10 (1.1%)	14 (1.5%)	8 (0.9%)
	5 - 7	5 (0.5%)	0	2 (0.2%)	1 (0.1%)	1 (0.1%)	2 (0.2%)	5 (0.5%)	1 (0.1%)
	8 - 10	0	3 (0.3%)	1 (0.1%)	1 (0.1%)	0	4 (0.4%)	8 (0.9%)	0
	11 - 13	0	0	0	0	0	1 (0.1%)	1 (0.1%)	3 (0.3%)
	14 or more	0	2 (0.2%)	0	3 (0.3%)	5 (0.5%)	3 (0.3%)	13 (1.4%)	6 (0.6%)

Table 2.

Descriptive Statistics for Negative Urgency, Negative Affect, Eating Expectancies, and Thinness Expectancies at all Waves

Personality Factor	Mean (SD)	Learning Factor	Mean (SD)
Negative Urgency 1	2.20 (0.68)	Eating Expectancies 1	2.23 (1.32)
Negative Urgency 2	2.12 (0.69)	Eating Expectancies 2	1.91 (1.26)
Negative Urgency 3	2.15 (0.72)	Eating Expectancies 3	1.86 (1.20)
Negative Urgency 4	2.18 (0.71)	Eating Expectancies 4	1.71 (1.10)
Negative Urgency 5	2.19 (0.71)	Eating Expectancies 5	1.74 (1.12)
Negative Urgency 6	2.19 (0.69)	Eating Expectancies 6	1.67 (0.93)
Negative Urgency 7	2.22 (0.69)	Eating Expectancies 7	1.88 (1.20)
Negative Urgency 8	2.25 (0.66)	Eating Expectancies 8	2.00 (1.19)
Negative Affect 1	2.10 (0.74)	Thinness Expectancies 1	3.06 (1.61)
Negative Affect 2	1.82 (0.74)	Thinness Expectancies 2	2.67 (1.67)
Negative Affect 3	1.75 (0.69)	Thinness Expectancies 3	2.62 (1.72)
Negative Affect 4	1.68 (0.72)	Thinness Expectancies 4	2.50 (1.65)
Negative Affect 5	1.71 (0.71)	Thinness Expectancies 5	2.47 (1.66)
Negative Affect 6	1.71 (0.67)	Thinness Expectancies 6	2.33 (1.48)
Negative Affect 7	1.79 (0.76)	Thinness Expectancies 7	2.40 (1.57)
Negative Affect 8	1.84 (0.78)	Thinness Expectancies 8	2.61 (1.51)

Note. The number following the factor represents the wave the data was collected (e.g., negative urgency 4, negative urgency wave 4).

Table 3.

Correlations among study variables in waves 1 and 8

	PU B	NU- 1	NU- 8	NA- 1	NA- 8	EE- 1	EE- 8	TE- 1	TE- 8	BE- 1	BE- 8	Prg- 1	Prg- 8
PU B	-	-	-	-	-	-	-	-	-	-	-	-	-
NU- 1	.06	-	-	-	-	-	-	-	-	-	-	-	-
NU- 8	.06	.24* *	-	-	-	-	-	-	-	-	-	-	-
NA- 1	-.04	.39* *	.12* *	-	-	-	-	-	-	-	-	-	-
NA- 8	.05	.22* *	.42* *	.27* *	-	-	-	-	-	-	-	-	-
EE- 1	-.01	.08* *	.39* *	.20* *	.06	-	-	-	-	-	-	-	-
EE- 8	.01	.20* *	.36* *	.15* *	.44* *	.14* *	-	-	-	-	-	-	-
TE- 1	.04	.14* *	.10* *	.18* *	.09* *	.32* *	.10* *	-	-	-	-	-	-
TE- 8	-.01	.17* *	.33* *	.19* *	.39* *	.08* *	.59* *	.25* *	-	-	-	-	-
BE- 1	.05	.20* *	.11* *	.18* *	.17* *	.25* *	.08* *	.27* *	.12* *	-	-	-	-
BE- 8	.00	.13* *	.23* *	.11* *	.33* *	.02	.32* *	.04	.26* *	.05	-	-	-
Prg- 1	.07* *	.11* *	.03	.15* *	.11* *	.07* *	.04	.07* *	.06	.15* *	.09* *	-	-
Prg- 8	-.02	.08* *	.16* *	.08* *	.29* *	.01	.14* *	.02	.16* *	-.01	.41* *	.05	-

Note: PUB, puberty; NU, negative urgency; NA, negative affect; EE, eating expectancies; TE, thinness expectancies; BE, binge eating; Prg, purging; each number following the variable represents the wave in which the data was collected (i.e., NU-1 = Negative Urgency, wave 1). Correlations with puberty are point-biserial correlations, correlations with binge eating or purging are Spearman's rank order correlations, and others are Pearson correlations. * $p < .01$, ** $p < .001$.

Developmental Trajectories of Eating Disorder Behavior

I used Nagin's (2005) procedure to determine (a) whether individual differences in girls' trajectories of binge eating and purging could be accurately characterized in terms of subgroups and (b) what the number and shapes of the binge eating and purging trajectory groups were. I separately developed trajectory groups for binge eating and purging. For each behavior, I assigned each participant to the group for which she had the highest probability of belonging.

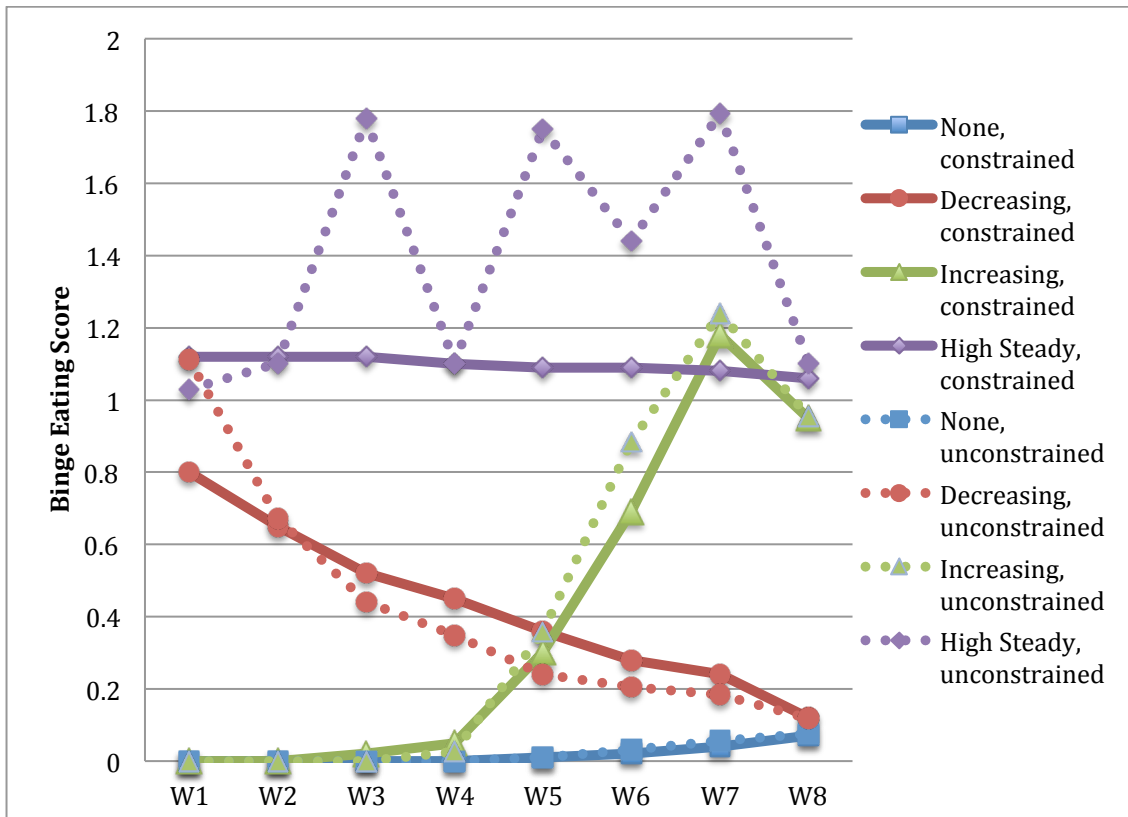
Using SAS Version 9.1 PROC TRAJ (zero inflated poisson (ZIP) modeling; Jones, Nagin, & Roeder, 2001), I conducted two trajectory analyses, each on eight waves (waves from 1 through 7 were each six months apart from each other and wave 8 was one year following wave 7) to model the trajectories as a function of a measurement wave. For the analyses, I first specified two groups and then tested a series of models in which I increased the number of groups and used the BIC, the AIC, the average probability of group membership, and the group sample size to evaluate model fits (Nagin, 2005). In making modifications to the models, I utilized a backward elimination strategy in which I removed whichever model feature had the largest p -value, keeping my model as simple as possible, and selected the model with the most optimized fit indices. For binge eating, the five-group solutions produced less negative BIC and AIC values, but they included groups with very small sample sizes and groups with very similar trajectories as those in the four-group solutions. The same was true for the four-group solutions for purging behavior. I therefore adopted a four-group solution for binge eating and a three-group solution for purging behavior. The four-group solution for binge eating had average group membership probabilities from .73 to .92. The three-group solution for purging had

average group membership probabilities from .76 to .92. These groups produced clear, straightforward assignments of girls to trajectory groups for each behavior.

Binge eating behavior. As shown in the Figure 1, 517 of the 938 girls reported essentially no binge eating behavior at each of the eight data collections from 5th grade through 9th grade (non-binge eating group). A group of 218 girls reported decreasing binge eating behavior throughout the four-year period of eight data collections (decreasing binge eating group). That is, they reported binge eating behavior at the beginning of the study, in 5th grade, and reported fewer instances over time throughout middle school and into high school. The rate of linear decrease was statistically significant, $t(1) = -6.56, p < .001$. A group of 110 girls reported increasing levels of binge eating behavior during the eight measurement waves (increasing binge eating group). These girls reported virtually no binge eating behavior in the first three waves, but increasing levels of the behavior beginning in the fall of 7th grade (averaging at about 1-2 objective binge eating episodes a week). The pattern of increase followed a combination of a significant linear trend ($t(1) = 6.92, p < .001$) and a significant quadratic trend ($t(1) = -6.51, p < .001$). The final group was the smallest group, consisting of 93 girls who consistently endorsed relatively high levels of binge eating behavior throughout the study time, from 5th through 9th grade (high steady binge eating group). On average, these girls reported objective binge eating episodes between 1-3 times per week, and the slope of the linear trend did not differ from zero.

Figure 1.

Binge Eating Trajectory Groups

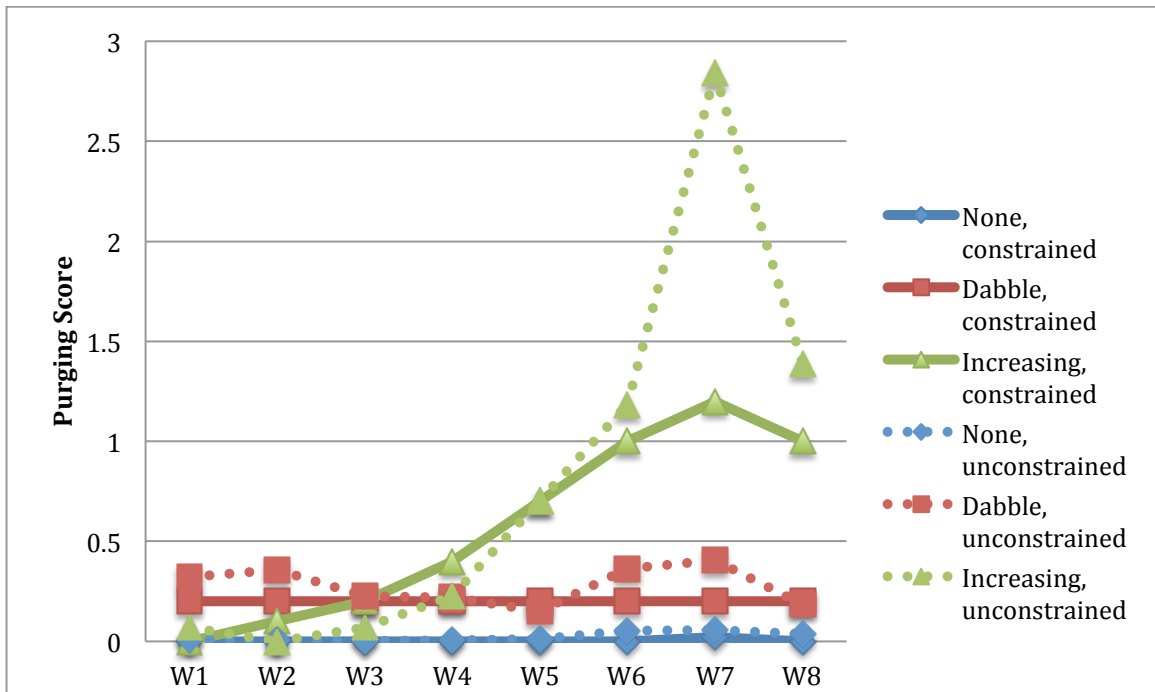


Note. The solid lines represent group development with constraints placed on the values by statistical analyses. The dotted lines represent group development with unconstrained, or raw data. On the x-axis, each wave represents 6 months of development, except between W7 and W8, which represents 12 months of development. Waves 1-7 refer to biannual data collections, which occurred in every 6 months beginning in the spring of 5th grade (W1) through the spring of 8th grade (W7). W8 refers to the fall of 9th grade, the last data collection, which took place one year after W7. Scores of 1 represent 1-2 binge eating episodes in the past 2 weeks from assessment and scores of 2 represent 3-4 binge eating episodes in the past 2 weeks from assessment. None-binge eating, $n = 517$; Decreasing binge eating, $n = 218$; Increasing binge eating, $n = 110$; High Steady binge eating, $n = 93$.

Purging behavior. As shown in Figure 2, of the 938 girls in the study, 698 reported essentially no purging behavior across the four-year, eight-wave time period (non-purging group). A group of 177 girls reported at least one episode of purging during the eight measurement waves, with an overall pattern in which at some waves they had reported purging in the preceding two weeks but at other ways they had not. I identified this group as “the dabble” purging group because it described the girls who tried the behavior at one time point or another, but tended not to engage in it regularly or increasingly over time. The smallest group consisted of 63 girls and was characterized by a trajectory of purging that increased across the eight waves (increasing purging group). Although this group does seem to report some decline in purging behavior from wave 7 to wave 8, more data points are necessary in order to determine if this is indeed a trend; thus I refer to this group as the “increasing” purging group because of the overall steady increase in the behavior. By the end of 9th grade, these girls purged 1-3 times a week. The pattern of increase followed a combination of a significant linear trend ($t(1) = 4.28, p < .001$) and a significant quadratic trend ($t(1) = -4.01, p < .001$).

Figure 2.

Purging Trajectory Groups



Note. The solid lines represent group development with constrains placed on the values by statistical analyses. The dotted lines represent group development with unconstrained, or raw data. On the *x*-axis, each wave represents 6 months of development, except between W7 and W8, which represents 12 months of development. Waves 1-7 refer to biannual data collections, which occurred in every 6 months beginning in the spring of 5th grade (W1) through the spring of 8th grade (W7). W8 refers to the fall of 9th grade, the last data collection, which took place one year after W7. Scores of 1 represent 1-2 purge episodes in the past 2 weeks from assessment and scores of 2 represent 3-5 purge episodes in the past 2 weeks from assessment. None-Purging, $n = 698$; Dabble Purging, $n = 177$; Increasing Purging, $n = 63$.

Prediction of Trajectory Groups Membership from Personal Characteristics

I next conducted a series of analyses to test whether trajectory groups differed from each other on the risk factors I described above. First, I tested whether the risk factors differentiated those who engaged in the target behavior (binge eating or purging) from those who did not engage in the behavior. I did this by conducting one-way analysis of variance (ANOVA) with a contrast designed to compare the groups who engaged in the behavior to the group that consistently did not engage in the behavior. Second, I tested how the different groups of individuals who engaged in the target behavior differed from each other. For this type of test, I conducted a series of ANOVAs with various contrasts to compare how the different trajectory groups who engaged in the behavior compared with each other on the risk factors of interest (e.g., how the high steady binge eating group differed from the increasing and the decreasing binge eating groups on negative urgency).

Binge eating. I next describe the analyses conducted for binge eating behavior. I conducted the following contrasts to examine how the four trajectories differed from each other.

Non-binge eating group vs. binge eating groups. First, I examined the differences between those groups who binge eat (the increasing group, the decreasing group, and the high steady group) and the non-binge eating group. Contrasts revealed that girls in the binge eating groups were significantly more likely ($p < .001$) to be high on all risk factors at wave 1 (see table 4). Those girls who were high on negative urgency, negative affect, eating expectancies, and thinness expectancies at the end of 5th grade were significantly more likely to belong to a group that engaged in binge eating at that

time or over the following four years; those who were not high on these risk factors at the beginning of 5th grade were not likely to binge eat during the following four year time period.

Increasing group vs. non-binge eating group. The increasing group and the non-binge eating group both reported no binge eating behavior at wave 1, so I conducted a follow-up ANOVA (see Table 4) to examine whether risk factors differentiated those two groups specifically. Contrasts revealed that girls in the increasing group reported significantly greater ($p < .001$) negative affect and negative urgency in wave 1 than did girls who were in the non-binge eating group. The two groups did not differ in eating or thinness expectancies. Of the girls who reported no binge eating at the end of 5th grade, it was those girls who were higher on negative affect and negative urgency who were likely to go on to binge eat later (and be in the increasing binge eating trajectory group). Those who were low on negative urgency and negative affect in 5th grade and who also did not binge eat in 5th grade were likely to continue to not binge eat throughout the four-year time period.

Increasing group vs. other binge eating groups. Between the three binge eating groups, only two groups reported high levels of binge eating at the end of 5th grade (wave 1): the high steady group and the decreasing group. I conducted analyses to determine what differentiates those who binge eat at the end of 5th grade from those who do not binge eat at that time, but do go on to later binge eat (increasing group). Contrasts (Table 4) revealed that wave 1 eating expectancies and thinness expectancies differentiated among the binge eating groups at the end of 5th grade: those groups who were high on binge eating at the end of 5th grade (the high steady group and the decreasing group) had

significantly higher ($p < .001$) scores on both expectancies at wave 1 than did the increasing binge eating group, who were not yet engaging in binge eating at the time. Thus, of those who engaged in binge eating between 5th and 9th grade, the girls who endorsed both expectancies in 5th grade are more likely to engage in binge eating behavior at the beginning of 5th grade.

Table 4.

Binge Eating: Wave 1 Contrasts

Risk Factor	Binge Eating Trajectory Group Means (SD)				t-tests		
	None	Decreasing	Increasing	High, Steady	Contrast 1 (None vs. others)	Contrast 2 (None vs. Increasing)	Contrast 3 (Increasing vs. Decreasing and High)
NU-1	2.08 (0.66)	2.40 (0.64)	2.31 (0.71)	2.43 (0.68)	6.44**	3.31**	1.41
NA-1	1.96 (0.66)	2.35 (0.82)	2.27 (0.77)	2.21 (0.85)	6.26**	4.17**	0.13
EE-1	1.98 (1.13)	2.84 (1.56)	2.09 (1.19)	2.74 (1.55)	6.39**	0.78	4.70**
TE-1	2.86 (1.55)	3.55 (1.67)	2.83 (1.51)	3.76 (1.67)	4.62**	0.218	4.44**

Note. NU, negative urgency; NA, negative affect; EE, eating expectancies; TE, thinness expectancies; each number following the variable represents the wave in which the data was collected (i.e., NU-1 = Negative Urgency, wave 1); all contrasts had $df = 934$; ** $p < .001$.

Increasing group vs. decreasing group. As Figure 1 shows, the trajectories for the increasing group and the decreasing group crossed over at wave 5: the increasing group began to increase their binge eating behavior and surpass the decreasing group at waves 6 and 7 in the frequency of their binge eating. I conducted a series of ANOVAs (see Table 5) to test whether risk factors differentiated the two groups at this important time point. Interestingly, contrasts revealed that there were no significant differences in any risk factors in waves earlier than 6. Further contrasts, however, showed that the increasing group scored significantly higher on negative affect than the decreasing group at waves 6 ($t(934) = 2.81, p < .05$) and 7 ($t(934) = 3.89, p < .001$). By wave 7, the increasing group also endorsed the expectancy that eating helps to alleviate negative mood at a significantly higher level than the decreasing group ($t(934) = 2.33, p < .05$). Therefore, it seems that changes in the risk factors appeared to co-occur with changes in binge eating behavior. Moreover, in the following section, when I present covariations between purging and binge eating trajectory groups, analyses show that purging behavior helps to explain differences between these two binge eating trajectory groups.

Table 5.

Binge Eating: Waves 6 and 7 Contrasts

Risk Factor	Binge Eating Trajectory Group Means (SD)		T-Test
	Increasing	Decreasing	<i>t</i>
NU-6	2.28 (0.65)	2.37 (0.68)	1.21
NU-7	2.42 (0.71)	2.29 (0.66)	1.54
NA-6	2.03 (0.89)	1.81 (0.67)	2.81*
NA-7	2.19 (0.95)	1.87 (0.68)	3.89**
EE-6	1.87 (0.96)	1.84 (0.94)	0.21
EE-7	2.36 (1.54)	2.06 (1.18)	2.33*
TE-6	2.61 (1.58)	2.65 (1.53)	0.29
TE-7	2.81 (1.75)	2.70 (1.60)	0.63

Note. NU, negative urgency; NA, negative affect; EE, eating expectancies; TE, thinness expectancies; each number following the variable represents the wave in which the data was collected (i.e., NU-6 = Negative Urgency, wave 6); all contrasts had *df* = 934; * *p* < .05; ** *p* < .001.

Pubertal onset. I considered whether pubertal onset differentiated the increasing group from the decreasing group around waves 4 or 5, when the increasing group began binge eating. Analyses revealed that pubertal onset did not differentiate the two groups, nor did it explain the increase in binge eating behavior for the increasing group.

High steady group vs. other binge eating groups. I next conducted a series of ANOVAs to examine how the high steady binge eating group differed from the other binge eating trajectory groups (the decreasing and increasing groups). Contrasts revealed that the high steady group was significantly higher ($p < .001$) on all four risk factors (negative urgency, negative affect, eating expectancies, and thinness expectancies) than the other two groups throughout the four-year, eight-wave developmental period. Thus, it seems that girls who consistently binge eat from 5th through 9th grade also tend to consistently endorse the risk factors at a high rate.

High steady group vs. increasing group. Because the increasing group and the high steady group reported similar levels of binge eating at waves 7 and 8, I conducted a separate ANOVA to compare those two groups only. That contrast revealed that the high steady group scored significantly higher ($p < .001$) than the increasing group on all risk factors during all waves (with the exception of negative affect in wave 6; that was not significantly different). Therefore, it appears that the high steady binge eating group tends to be worse off, overall, in that these girls continually endorse high levels of the risk factors negative urgency, negative affect, eating expectancies, and thinness expectancies throughout this period of adolescent development.

Purging. I next describe the results for purging behavior. I conducted the following analyses to examine what differentiates the purging trajectory groups.

Non-purging group vs. purging groups. I examined what differentiates the girls who purged (belonging to the dabble group or the increasing group) from those who did not purge (the non-purging group) by running an ANOVA and comparing mean levels on risk factors (see Table 6). Just like for binge eating, contrasts revealed that those who purged were significantly higher ($p < .05$) on all four risk factors (negative urgency, negative affect, eating expectancies, thinness expectancies) at the end of 5th grade than those who never purged throughout this four-year adolescent time period. If a girl belonged to a purging group, whether it be the dabble group or the increasing group, she was significantly more likely to endorse high levels of negative urgency, negative affect, eating expectancies, and thinness expectancies at the end of her 5th grade year than a girl who belonged to the group that did not purge from 5th through 9th grade. Those who did not endorse these risk factors were not likely to report purging behavior during this time period.

Table 6.

Purging: Wave 1 None vs. Others Contrast

Risk Variable	Purging Trajectory Groups Means (SD)			T-test
	None	Dabble	Increasing	<i>t</i>
NU-1	2.15 (0.66)	2.42 (0.67)	2.37 (0.79)	-3.53*
NA-1	2.04 (0.71)	2.41 (0.84)	2.11 (0.76)	-3.23*
EE-1	2.18 (1.28)	2.43 (1.48)	2.43 (1.42)	-2.06*
TE-1	3.00 (1.59)	3.27 (1.70)	3.44 (1.63)	-2.31*

Note. NU, negative urgency; NA, negative affect; EE, eating expectancies; TE, thinness expectancies; each number following the variable represents the wave in which the data was collected (i.e., NU-1 = Negative Urgency, wave 1); all contrasts had $df = 934$; * $p < .05$

Increasing group vs. dabbler group. I next examined how the two purging groups differed from each other: how do those who just purged occasionally (the dabble group) differ from those who tried purging and went on to engage in the behavior at an increasing level? I conducted a series of ANOVAs to examine whether the four risk factors differentiated between the increasing purging trajectory group and the dabble purging trajectory group. None of the risk factors (negative urgency, negative affect, eating expectancies, thinness expectancies) differentiated between the two purging groups at any waves: those who tried purging at least once and those who increased their purging behavior did not differ on any of those variables. The next section, however, which describes covariations between purging and binge eating trajectory groups, suggests that binge eating behavior helps to differentiate among purging trajectory groups.

Pubertal onset. I considered whether pubertal onset differentiated the increasing purging group from the dabble purging group around waves 4 or 5, when the increasing group began purging and surpassed the dabble group. It did not: pubertal onset did not differentiate the two purging groups, nor did it explain the increase in purging behavior for the increasing group.

Covariation between Membership in Binge Eating and Purging Trajectories

As shown in Table 7, the cross-classification of the models showed that there was a high degree of overlap in groups across the binge eating and purging models. Of the 12 possible cross-classifications, over half (54.6%) of the girls did not engage in any binge eating and purging behavior throughout the study time frame. About one fifth (20.3%) of participants engaged in only one disordered eating behavior throughout the four-year

time period and the other 25.1% of girls engaged in both binge eating and purging behavior at some point throughout the eight-wave longitudinal time period.

Due to the high degree of overlap between binge eating and purging trajectory groups, I conducted analyses to examine how trajectory groups for one behavior overlapped with trajectory groups for the other behavior (e.g., if different binge eating trajectory groups consisted of different purging trajectory groups). Based on the results described above, I ran two chi-square tests of independence: one to examine the differences in purging behavior among the increasing and decreasing binge eating groups and another to examine the differences in binge eating behavior among the dabble and increasing purging groups.

Table 7.

Cross-Classification between Binge Eating Trajectory Groups and Purging Trajectory

Groups: Frequencies of Membership

	No Purging	Dabble Purging	Increasing Purging	Total
No Binge Eating	512 (54.6%)	5 (0.5%)	0 (0%)	517
Decreasing Binge Eating	153 (16.3%)	66 (7.0%)	0 (0%)	219
Increasing Binge Eating	7 (0.8%)	74 (7.9%)	28 (3.0%)	109
High, Steady Binge Eating	25 (2.7%)	33 (3.5%)	35 (3.7%)	93
Total	697	178	63	938

Note. The percentages reported are derived from PROJ TRAC output as population estimates; the frequencies provided for each group are therefore estimates in the current sample based on those percentages.

Increasing vs. decreasing binge eating groups. In order to test how to differentiate girls who belonged to the increasing binge eating group from girls who belonged the decreasing binge eating group, I conducted a chi-square test of independence to see if the two groups differed in purging behavior. There was a significant difference in group membership by purging ($\chi^2 = 187.69, p < .001$) such that those who increased their binge eating behavior were more likely to be in a purging group while those who decreased their binge eating behavior were more likely to be in the non-purging group. Of the 112 girls who made up the increasing binge eating group, almost all of them (105 girls, 94%) also purged: 82 (73%) were in the dabble purge group and 23 (21%) were in the increasing purge group. In contrast, of the 195 girls in the decreasing binge eating group, none of them increased their purging behavior and only 38 (19%) dabbled with purging. In fact, most of the girls in the decreasing binge eating group never purged from 5th through 9th grade (157 girls, 81%).

Dabble vs. increasing purging groups. Since the two purging groups did not differ on any personality or learning risk factors, I conducted a chi-square test of independence to see whether they differed by binge eating behavior. There was a significant difference in purging group membership by binge eating behavior ($\chi^2 = 27.38, p < .001$). All of the girls who increased their purging behavior were also binge eating: 52% increased their binge eating behavior and 48% engaged in binge eating at a high steady level. There was no group of girls engaging in extensive purging behavior who were also not binge eating. Those girls who dabbled with purging, however, engaged in various kinds of binge eating behavior, including decreasing binge eating behavior (26%),

no binge eating behavior at all (2%), increasing binge eating (53%), or was binge eating steadily throughout the study (19%).

Chapter Four: Discussion

Studying the development of disordered eating in girls before the peak age of onset is important for the goal of understanding different trajectories of risk; it may also facilitate the development of appropriate prevention and intervention strategies. This study was the first to identify developmental trajectories for binge eating and purging behaviors in girls spanning late elementary school through early high school. I found that different trajectories of risk exist in girls as they transition into early and mid-adolescence. I also found that certain risk factors related to personal characteristics and learned experiences influence to which trajectory group girls belong.

I did find good evidence that girls' development for disordered eating from pre-adolescence through mid-adolescence can best be described by different trajectories. The development of binge eating behavior followed four different trajectories in this sample: none, decreasing, increasing, and high steady. By 5th grade, the last year of elementary school, girls already differed in their engagement in binge eating behavior. Though the majority of girls never engaged in binge eating (55%), a surprising proportion (45%) engaged in at least some binge eating episodes throughout the four-year time frame. Some of these girls began binge eating in elementary school and others did not, and some of them went on to continue to binge eat through high school and others did not. Of particular importance, there were subgroups of girls who reported (a) high steady levels of binge eating throughout the four-year period and (b) significant increases in binge eating during middle school and through early high school.

Girls' purging behavior followed three different trajectories: none, dabble, and increasing. There was a small portion of girls (about 4%) who tried purging in elementary

school and early middle school. Interesting, some girls dabbled with purging throughout this adolescent time frame, yet never increased the behavior. The group of greatest concern (6.7%) began engaging in the behavior in the fall of 7th grade and increased their frequency of purging into high school. These findings make it clear that risk assessment in girls this young is both important and informative.

The trajectories identified in this study differ slightly from those identified in prior research with community samples (e.g., Aime et al., 2008; Smith et al., 2007). Smith and colleagues (2007) had the most similar sample in that they studied girls from 7th through 9th grade. They identified four trajectories for both binge eating and purging: none, moderate, increasing, and high. This difference could be due to the fact that the current study began two years before and included 5th and 6th grade. Thus, the current study expands on research conducted by Smith and colleagues (2007) by identifying a decreasing group that began binge eating in 5th grade and then decreased in behavior through 7th grade; perhaps this group approximated their moderate group.

When examining the development of both binge eating and purging behaviors together, there are three important findings to note. First, a little over half (54.6%) of the girls never engaged in any disordered eating behavior from pre-adolescence through mid-adolescence. This percentage is much lower than the 72% reported by Smith and colleagues (2007), which studied a sample of adolescent girls from 7th through 9th grade. Perhaps this difference occurred because of the reasons mentioned above: those who reported binge eating in 5th grade and decreased the behavior by 7th grade would not have been identified by Smith and colleagues (2007). Second, there was a small group of girls (2.7%) who engaged in only binge eating (no purging) at a high steady level throughout

the four-year study. Future research should examine how this group differs from other high steady binge eating groups who also purge. Third, I did not find a group of girls who only purged: those girls who increased their purging behavior also engaged in binge eating. Thus, the increasing purge group (6.7%) can perhaps be described as a bulimia nervosa group since they also either simultaneously increased their binge eating behavior or engaged in binge eating at a high steady level.

For the second aim of this study, I examined whether risk factors differentiated different trajectory groups of disordered eating. I found support for my risk model. That is, I found that all four risk factors differentiated those who engaged in disordered eating from those who did not. Girls who endorsed high levels of (a) negative affect, (b) negative urgency (the tendency to act rashly when experiencing distress), (c) expectancies that eating alleviates negative mood, and (d) expectancies that thinness leads to overgeneralized life improvements during 5th grade were significantly more likely to belong to a binge eating and/or purging group than those who did not endorse those risk factors in 5th grade. This was true even for girls who were not engaging in binge eating or purging behavior during 5th grade. In other words, girls who did not endorse negative affect, negative urgency, or the expectancies about eating and thinness in late elementary school were not likely to engage in binge eating and purging behavior in the next four years. This finding is consistent with prior cross-sectional and longitudinal research with pre-adolescent and adolescent girls (Combs et al., 2011; Pearson et al., 2012; Pearson et al., 2014b).

Late-elementary school seems to be an important time to assess eating disorder risk. Not only do risk factors at that time predict subsequent engagement in disordered

eating, but they also differentiate between trajectories of behavior development. First, 5th grade levels of negative affect and negative urgency differentiated girls who never engaged in disordered eating from girls who did not binge eat in 5th grade but later went on to engage in disordered eating behaviors at increasingly high levels. In other words, if a girl did not engage in disordered eating in 5th grade, but she endorsed high levels of negative affect and negative urgency at that time, she was significantly more likely to engage in bulimic behaviors at increasing frequency from the end of 7th grade through high school. Second, those girls who were in the high stable binge eating group (the majority of whom also engaged in some purging) reported significantly higher levels of all four risk factors (negative urgency, negative affect, eating expectancies and thinness expectancies) from 5th grade through 9th grade. It therefore seems that these girls are much worse off in that they were not only high on disordered eating behavior, but also on transdiagnostic risk factors (like negative urgency and negative affect) that put them at risk for several other problem behaviors (like depression, smoking, and drinking: Pearson et al., 2014b; Settles, Fischer, Cyders, Combs, Gunn, & Smith, 2012). Thus, these personal characteristics appear to be quite important in identifying girls at risk at a young age.

These findings have important clinical implications. Different trajectories for disordered eating behavior may require different intervention strategies. For instance, girls who are high on negative urgency and negative affect in late elementary school, even if they do not binge or purge, are at risk for disordered eating later. Thus, perhaps learning skills like those in dialectical behavior therapy (DBT: Linehan, 1993) in 5th grade would help to reduce the behavioral consequences of negative affect and negative

urgency, thus reducing risk for future eating disorder behavior. It also seems that all girls belonging to a trajectory characterized by any levels of binge eating or purging, particularly those who binge eat in 5th grade, would benefit from cognitive behavioral interventions to challenge the expectations that eating alleviates negative mood and that thinness improves one's life (success for an intervention challenging expectancies for thinness has been shown: Annus et al., 2008). Those girls who engage in disordered eating at a high steady level from elementary school through high school may require more intensive, thorough, and longer-term therapy.

I did not find that the expectancies differentiated binge eating and purging behaviors, although I had anticipated such an effect. Rather, expectancies about eating were associated with both binge eating and purging behaviors and not binge eating, as anticipated. However, given that the increasing purging group could be identified as a bulimia group since all participants also engaged binge eating, it is not surprising that this group also endorsed beliefs that eating would alleviate negative mood. Since I did not find a true purging group, this hypothesis could not be tested.

Surprisingly, puberty did not play a significant role in the current study. It did not differentiate the late-onset groups (e.g., the increasing groups) from other groups. In fact, pubertal onset was not associated with initiation of behavior in any way. I do not know what to make of this finding, which appears inconsistent with prior work on puberty's role in the heritability of eating disorder symptom expression (e.g., Culbert et al., 2009; Klump et al., 2003; Pearson et al., 2012).

The personality and learning risk factors failed to differentiate between girls who increased their purging behavior over time (and who also binged) and girls who just

dabbled with purging. Levels of negative affect, negative urgency, eating expectancies, or thinness expectancies did not explain the differences between these two groups; nor did pubertal onset. One possibility for this lack of finding could be due to the fact that these were not true purging groups. That is, because these girls also engaged in various kinds of binge eating behavior, I was not able to test how purging groups may differ.

Nonetheless, future research should examine the differences between these two groups with other risk factors, including perfectionism (Vohs, Bardone, Joiner, Abramson, & Heatherton, 1999), a history of weight suppression (Lowe, Thomas, Safer, & Butryn, 2007), ineffectiveness (Combs, Smith, Flory, Simmons, & Hill, 2010), and anxiety (Bulik, Sullivan, Carter, & Joyce, 1996; Godart, Flament, Lecrubier, & Jeammet, 2000).

This study helped expand the current understanding for the development of disordered eating in girls. By combining the results of the current study with those of Aime and colleagues (2008), which studied girls from 9th through 12th grade, researchers and clinicians can better understand the full developmental trajectories for disordered eating from elementary school through high school. They found five groups: none, stable and low, high declining, high chronic, and increasing. If the findings of the current study and Aime et al. (2008) can be combined, it seems that: (a) some girls continue to dabble with disordered eating; (b) some girls engage in binge eating and purging through middle school and the beginning of high school and then decrease their engagement in the behavior; (c) some girls continue to binge eat and purge at a high level from 5th grade through the end of high school; and (d) some girls continue to increase their binge eating and purging behavior throughout adolescence. Of course, further research needs to be

conducted to validate these potential trajectories of behavior from elementary school throughout high school.

This study has important limitations. First, my model that girls' development can be described in terms of a finite number of discrete groups involves an assumption that I imposed on the data, just as linear prediction models impose an assumption that there are not separable groups of participants. As is true for any study, my findings should be understood with that perspective in mind. Second, there is, of course, variability among girls who are members of the same trajectory group, and that variability was not modeled or related to risk factors. Third, though there were relatively low attrition rates, and there is good evidence for the validity of the expectation maximization method for addressing missing data, I cannot know whether the results would have differed with even higher retention. Fourth, all risk and bulimic symptom reporting was done by questionnaire and was not supplemented by interview data. Although there is considerable evidence for the validity of all measures used, face-to-face interviews provide opportunities for further clarification of terms and perhaps more precise and specific assessment. Fifth, I did not assess the context of the eating disorder behavior; as a result, the nature of these early bulimic experiences is unclear.

It is also important to recognize that these findings do not show causal processes. The results of this study are consistent with, but of course not proof of, the causal processes implied by relating 5th grade risk factors to developmental trajectories that span the following four years. Though this study is prospective, there is the possibility that the risk factors are predictive only as artifacts of other causes.

In sum, the present findings provide clear support for different developmental trajectories of bulimic behaviors in girls as they transition from pre-adolescence through mid-adolescence. The current study showed that personal characteristics (negative affect and negative urgency) along with psychosocial learning (expectancies about eating and thinness) predict membership in eating disorder trajectory groups and also help differentiate between specific groups. These findings can help inform researchers and clinicians about the different ways in which binge eating and purging may develop in girls early in life, which may inform theories of etiology as well as intervention efforts.

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- of risk factors for bulimia. *American Psychologist*, 41, 246-263.
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Zapolski, T. C., Stairs, A. M., Settles, R. F., Combs, J. L., & Smith, G. T. (2010). The measurement of dispositions to rash action in children. *Assessment*, 17, 116-125.

CAROLYN (CARI) M. PEARSON
VITA

EDUCATION

- 2011 M.S., Clinical Psychology
University of Kentucky
Lexington, KY
Thesis Title: A Longitudinal Transactional Risk Model for Early Eating Disorder Onset
- 2007 B.S., Neuroscience and Behavioral Biology
Emory University
Atlanta, GA

RESEARCH INTERESTS

Risk factors, prevention, and intervention for eating disorders.

RESEARCH GRANTS RECEIVED

- 2011-2013 Co-Investigator
University of Kentucky Research Support Grant
Using a Novel, fMRI-based Procedure to Test the Reward Theory of Binge Eating
\$8,084 direct costs

RESEARCH GRANTS SUBMITTED and SCORED

- 2013 F31 National Research Service Award (NRSA)
A momentary analysis of the influence of urgency and expectancies on bulimia
Impact Score: 25; Percentile: 19
Co-sponsors: Gregory T. Smith, Ph.D., Stephen A. Wonderlich, Ph.D., Scott Engel, Ph.D., Ross D. Crosby, Ph.D.

PUBLICATIONS

- Smith, G.T., & Pearson, C. M. (in press). Construct Validity. In R. Cautin and S. Lilienfeld (Eds.), *The Encyclopedia of Clinical Psychology*. New York: Wiley-Blackwell.
- Pearson, C. M., Chester, D. L., & Smith, G. T. (2014). Planning a binge is reinforcing for women with bulimia nervosa: A functional magnetic resonance imaging (fMRI) study. Manuscript submitted for publication.
- Pearson, C. M., & Smith, G. T. (2014). Eating disorder onset in young girls: A longitudinal trajectory analysis. Manuscript submitted for publication.

- Pearson, C. M.,** Wonderlich, S., & Smith, G. T. (2014). A risk and maintenance model for Bulimia Nervosa: From impulsive action to compulsive behavior. Manuscript submitted for publication.
- Pearson, C. M.,** Zapolski, T. C. B., & Smith, G. T. (2014). A longitudinal test of impulsivity and depression pathways to early binge eating onset. *International Journal of Eating Disorders*. Published online.
- Pearson, C. M.,** Riley, E. N., Davis, H. A., & Smith, G. T. (2014). Two Pathways toward impulsive action: An integrative risk model for bulimic behavior in youth. *Journal of Child Psychology and Psychiatry*. Published online.
- Pearson, C. M.,** Guller, L., & Smith, G. T. (2014). Dimensions of personality and neuropsychological function in eating disorders, substance use disorders and addictions. In T. Brewerton & A. B. Dennis (Eds). *Eating Disorders, Addictions, and Substance Use Disorders: Research, Clinical and Treatment Perspectives* (pp. 107-126). Springer Publishers.
- Combs, J. L., **Pearson, C. M.,** Zapolski, T. C. B., & Smith, G. T. (2013). Pre-adolescent disordered eating predicts subsequent eating dysfunction. *Journal of Pediatric Psychology*, 38, 41-49.
- Pearson, C. M.,** Guller, L., McPherson, L., Lejuez, C. W., & Smith, G. T. (2013). Validation of an existing measure of eating disorder risk for use with early adolescents. *Eating Behaviours*, 14, 113-118.
- Pearson, C. M.,** Zapolski, T. C. B., Levinson, C. A., Wood, A., & Smith, G. T. (2013). Defining beauty: Cultural variations in the pursuit of attractiveness and associated harms. Empirical paper published in N. Gotsiridze-Columbus (Ed.), *Binge Eating and Binge Drinking: Psychological Social and Medical Implications* (pp. 169-186). New York: Nova Science Publishers.
- Pearson, C. M.,** Combs, J. L., Zapolski, T. C. B., & Smith, G. T. (2012). A longitudinal transactional risk model for early eating disorder onset. *Journal of Abnormal Psychology*, 121, 707-718.
- Pearson, C. M.,** Guller, L., Birkley, E. L., & Smith, G. T. (2012). Multiple personality dispositions to engage in rash, impulsive action. In M. A. Cyders (Ed.), *The Psychology of Impulsivity*. New York: Nova Science Publishers.
- Smith, G. T., Combs, J. L., & **Pearson, C. M.** (2012). Brief instruments and short forms. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA handbook of research methods in psychology, Vol 1: Foundations, planning, measures, and psychometrics* (pp. 395-409), Washington, D.C.: American Psychological Association.

Combs, J. L., **Pearson, C. M.**, & Smith, G. T. (2011). A risk model for pre-adolescent disordered eating. *The International Journal of Eating Disorders*, 44, 596-604.

Pearson, C. M., Guller, L., Spillane, N. S., & Smith, Gregory T. (2011). A developmental model of addictive behavior: From impulsivity to compulsivity. In A. M. Columbus (Ed.), *Advances in Psychology Research* (pp. 49-73). New York: Nova Science Publishers.

Pearson, C. M., Combs, J. L., & Smith, G. T. (2010). A risk model for disordered eating in late elementary school boys. *Psychology of Addictive Behaviors*, 24, 696-704.

AWARDED RESEARCH TALKS

Pearson, C. M. (2013, September). From Impulsivity to Compulsivity. Talk presented during the plenary, "Eating Disorders and Cognitive Neuroscience: Implications for the Developmental Progression of Dysfunction" at the annual Eating Disorder Research Society Conference in Bethesda, MD.

Pearson, C. M., Anderson, A., Powell, D., Chester, D., Terry, D., & Smith, G. T. (2012, September). Planning a Binge is Reinforcing for Women with BN: An fMRI Study. Talk presented at the annual Eating Disorder Research Society Conference in Porto, Portugal.

FORMAL CLINICAL EXPERIENCE

- 08/13-04/14 **Adolescent Dialectical Behavior Therapy (DBT) Group Creator and Group Leader, Jesse G. Harris Psychological Services Center**
Supervisor: Lindsey Jasinski, Ph.D.
- 07/13-06/14 **Groups Coordinator, Jesse G. Harris Psychological Services Center**
Supervisor: David Susman, Ph.D.
- 03/12- 12/13 **Dialectical Behavior Therapy (DBT) Group Leader, Jesse G. Harris Psychological Services Center**
Supervisor: Ruth Baer, Ph.D.
- 08/12-06/13 **Inpatient Therapist Trainee, Good Samaritan Hospital Adolescent Inpatient Unit**
Supervisor: Lindsey Jasinski, Ph.D.
- 08/12-11/12 **Social Skills Group Leader, Jesse G. Harris Psychological Services Center**
Supervisor: Lindsey Jasinski, Ph.D.
- 07/11-07/12 **Psychological Assessment Trainee, Department of Psychiatry at the University of Kentucky**
Supervisor: John Ranseen, Ph.D.
- 08/10-06/14 **Student Therapist, Jesse G. Harris Psychological Services Center**
Supervisors: Mary Beth McGavran, Ph.D., Gregory T. Smith, Ph.D., Lindsey Jasinski, Ph.D., Ruth Baer, Ph.D.
- 08/10-06/14 **Psychological Assessment Trainee, Jesse G. Harris Psychological Services Center**

- Supervisors:* Mary Beth McGavran, Ph.D., Gregory T. Smith, Ph.D., Ruth Baer, Ph.D.
- 05/10-06/11 **Student Therapist, University of Kentucky Counseling Center**
Supervisors: Tina Bryant, Ph.D., Felito Aldarondo, Ph.D., Susan Mathews, Ph.D.
- 09/09-12/12 **Group Leader, Going for Goals**, Multiple settings: training clinic, middle schools
Supervisor: Gregory T. Smith, Ph.D.

AWARDS and HONORS

- 2014 Science-Practitioner Award
University of Kentucky, Department of Psychology
- 2014 Excellence in Clinical Practice
University of Kentucky, Department of Psychology
- 2013 Research Challenge Trust Fund (RCTF) Award
University of Kentucky, Department of Psychology
- 2012 Pre-Doctoral Research Award
University of Kentucky, Department of Psychology
- 2010, 2011, 2012 Coordinator and organizer for graduate student applicant interview weekend
- 2011-2012 Graduate student representative for Department of Psychology
- 2004 Dean's List (top 10%; undergraduate)

PROFESSIONAL ACTIVITIES

- 10/13 Presented talk on Dialectical Behavior Therapy for Adolescents in clinical psychology class and clinic assistant class
- 10/13 Attended the Dialectical Behavior Therapy for Adolescents intensive training workshop lead by Jill Rathus, Ph.D., in Lake Forest, IL
- 07/13 Initiated and implemented a Dialectical Behavior Therapy (DBT) Skills Training Group for Adolescents at our student-run clinic
- 01/11, 01/12 Co-organized clinical psychological applicant interview weekend
- 5/11 Co-created behavioral health group for student clinic
- 08/09-12/09 Teaching assistant for undergraduate Psychology 100 course

POSITIONS HELD

- 2010 – 2014 **Research Assistant**
University of Kentucky; Lexington, Kentucky
Principal Investigator: Gregory T. Smith, Ph.D.
Part-Time Position
- 2009 **Teaching Assistant**, Introduction to Psychology
University of Kentucky; Lexington, KY
- 2008 - 2009 **Research Project Coordinator**
Emory University; Atlanta, Georgia
Principal Investigator: Joseph R. Manns, Ph.D.
Full-Time Position
- 2007 - 2008 **Research Assistant**

Emory University; Atlanta, Georgia
Principal Investigator: Joseph R. Manns, Ph.D.
Full-Time Position