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Ecological momentary assessment of purging disorder

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ECOLOGICAL MOMENTARY ASSESSMENT OF PURGING DISORDER

by

Alissa Anne Haedt Matt

An Abstract

Of a thesis submitted in partial fulfillment
of the requirements for the Doctor of Philosophy
degree in Psychology (Clinical Psychology)
in the Graduate College of
The University of Iowa

July 2012

Thesis Supervisor: Professor Pamela Keel

ABSTRACT

Purging Disorder (PD) is characterized by purging after normal or small amounts of food among individuals who are not underweight. Several studies indicate that PD is associated with distress and impairment, underscoring the need for intervention. However, little is known about factors that trigger and maintain purging in PD. This study examined antecedents and consequences of purging using Ecological Momentary Assessment (EMA), a design that involved repeated assessments of current psychological states in participants' natural environments. Women with PD (N = 24) were recruited from the community to make multiple daily ratings of affect, shape/weight concerns, violation of dietary rules, and stomach discomfort using random-, interval-, and event-contingent recordings over a two-week period. Multilevel model analyses were used to examine between-day differences (purge versus non-purge day) and within-day changes in psychological variables relative to purging behavior. Results supported study hypotheses that negative affect and shape/weight concerns would be higher and positive affect would be lower on days when participants purged compared to days they did not purge. In addition, antecedent analyses supported within-day increases in negative affect, shape/weight concerns, and stomach discomfort prior to purging; however, only changes in positive affect and shape/weight concerns on purge days differed from naturally-occurring changes observed on non-purge days. For consequence analyses, negative affect, shape/weight concerns, and stomach discomfort decreased following purging on purge days, and trajectories of change were significantly different from non-purge days. Finally, exploratory analyses suggested that lower levels of impulsivity enhanced associations between antecedent affect and purging. These data are crucial to understand why women with PD purge after consuming normal or small amounts of food and may point to specific targets for the development of effective interventions.

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Iowa City, Iowa

CERTIFICATE OF APPROVAL

PH.D. THESIS

This is to certify that the Ph.D. thesis of

Alissa Anne Haedt Matt

has been approved by the Examining Committee
for the thesis requirement for the Doctor of Philosophy
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To my parents for giving me roots to keep me grounded,
to Pam for giving me wings to fly, and
to Brian for inspiring me to be the best version of myself
whether I am on the ground or in the air.

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ABSTRACT

Purging Disorder (PD) is characterized by purging after normal or small amounts of food among individuals who are not underweight. Several studies indicate that PD is associated with distress and impairment, underscoring the need for intervention. However, little is known about factors that trigger and maintain purging in PD. This study examined antecedents and consequences of purging using Ecological Momentary Assessment (EMA), a design that involved repeated assessments of current psychological states in participants' natural environments. Women with PD (N = 24) were recruited from the community to make multiple daily ratings of affect, shape/weight concerns, violation of dietary rules, and stomach discomfort using random-, interval-, and event-contingent recordings over a two-week period. Multilevel model analyses were used to examine between-day differences (purge versus non-purge day) and within-day changes in psychological variables relative to purging behavior. Results supported study hypotheses that negative affect and shape/weight concerns would be higher and positive affect would be lower on days when participants purged compared to days they did not purge. In addition, antecedent analyses supported within-day increases in negative affect, shape/weight concerns, and stomach discomfort prior to purging; however, only changes in positive affect and shape/weight concerns on purge days differed from naturally-occurring changes observed on non-purge days. For consequence analyses, negative affect, shape/weight concerns, and stomach discomfort decreased following purging on purge days, and trajectories of change were significantly different from non-purge days. Finally, exploratory analyses suggested that lower levels of impulsivity enhanced associations between antecedent affect and purging. These data are crucial to understand why women with PD purge after consuming normal or small amounts of food and may point to specific targets for the development of effective interventions.

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CHAPTER I

INTRODUCTION

Eating disorders are serious mental disorders (Klump, Bulik, Kaye, Treasure, & Tyson, 2009) that affect over five million people in the United States (NIMH, 1994). They have the highest mortality rate of any psychiatric disorder (Harris & Barraclough, 1998), are associated with severe psychiatric and medical morbidity (Keel & Herzog, 2004), and incur an economic burden that equals or exceeds that observed for other severe mental illnesses (Striegel-Moore, Leslie, Petrill, Garvin, & Rosenheck, 2000). For example, the annual cost of eating disorder treatment is between $3,000 and $6,000 per individual, which is similar to the cost of treatment for schizophrenia and greater than the cost of treatment for obsessive-compulsive disorder (Striegel-Moore et al., 2000). Thus, eating disorders represent a significant public health concern, and research is needed to enhance understanding of these particularly pernicious mental illnesses.

The fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000) recognizes two eating disorder syndromes: Anorexia Nervosa (AN) and Bulimia Nervosa (BN). AN is characterized by refusal to maintain minimally normal body weight, intense fear of gaining weight, body image disturbance, and disturbance in menstrual function. BN is characterized by recurrent objectively large binge episodes coupled with inappropriate compensatory behaviors (i.e., purging, fasting, or excessive exercise) and body image disturbance. All clinically significant eating disorders that do not meet criteria for AN or BN are classified as an Eating Disorder Not Otherwise Specified (EDNOS) in the DSM-IV-TR. Notably, EDNOS is the most prevalent eating disorder diagnosis, affecting approximately two-thirds of individuals seen in treatment clinics (Fairburn & Bohn, 2005) and community-based samples (Wade, Bergin, Tiggemann, Bulik, & Fairburn, 2006). However, little empirical research has been conducted on this heterogeneous category.

The DSM-IV-TR provides examples of EDNOS that range from subthreshold AN or BN to binge eating in the absence of purging and purging in the absence of binge eating (American Psychiatric Association, 2000). Thus, an EDNOS diagnosis includes a variety of behavioral configurations and does not inform clinical presentation, course, or treatment (Wilfley, Bishop, Wilson, & Agras, 2007). Given that the EDNOS category is widely used by clinicians yet largely ignored by researchers, experts in the field have called for studies that increase understanding of the epidemiology, etiology, and efficacious treatment of these conditions (Fairburn & Bohn, 2005; Grilo, Devlin, Cachelin, & Yanovski, 1997). The purpose of this study was to investigate an EDNOS recently identified as "Purging Disorder" (PD; Keel, Haedt, & Edler, 2005).

Purging Disorder

PD is characterized by recurrent purging (i.e., self-induced vomiting, laxative abuse, diuretic abuse) and body image disturbance in the absence of objectively large binge episodes among women of minimally normal weight (Keel et al., 2005). Similar to AN and BN, PD involves extreme efforts to control weight coupled with the undue influence of weight or shape on self-evaluation. However, in contrast to AN, purging occurs among individuals who are not underweight, and, in contrast to BN, purging occurs in the absence of objectively large binge episodes. Research supports the inclusion of PD as a provisional diagnostic category within future nosological schemes (Keel & Striegel-Moore, 2009; Keel, 2007). Specifically, previous research supports the clinical significance (Keel, Wolfe, Gravener, & Jimerson, 2008; Keel et al., 2005; Mond et al., 2006; Wade et al., 2006) and distinctiveness of PD (Binford & le Grange, 2005; Keel, Mayer, & Harnden-Fischer, 2001; Keel et al., 2005; Keel, Wolfe, Liddle, Young, & Jimerson, 2007; Pinheiro, Bulik, Sullivan, & Machado, 2008; Sullivan, Bulik, & Kendler, 1998; Wade et al., 2006; Wade, 2007), and suggests that the lifetime prevalence of PD is comparable to that of AN and BN (Favaro, Ferrara, & Santonastaso, 2003; Wade et al., 2006).

Support for the empirical validity of PD comes from latent class analyses which support a purging class with no to minimal binge eating that is distinct from normality (Pinheiro et al., 2008; Striegel-Moore et al., 2005) and from a class characterized by binge-purge behaviors (Pinheiro et al., 2008; Striegel-Moore et al., 2005; Sullivan et al., 1998). Cross-sectional comparisons have found that women with PD differ from women without eating disorders on psychological and biological factors. Women with PD report greater levels of anxiety, depression, and suicidality and higher rates of Axis I and Axis II psychopathology compared to non-eating disorder controls (Keel et al., 2008; Keel et al., 2005; Wade et al., 2006). In addition, women with PD have lower levels of circulating leptin compared to controls (Jimerson, Wolfe, Carroll, & Keel, 2010). Further, PD is associated with psychosocial impairment and distress compared to controls (Keel et al., 2008), and these differences are independent of comorbid psychopathology. Thus, results consistently support the distinctiveness of PD from normality and suggest that individuals with PD experience considerable suffering.

PD appears to be psychologically and biologically distinct from BN (Keel, 2007) and related EDNOS (Keel, Holm-Denoma, & Crosby, 2010). Women with PD report lower feelings of hunger, lower eating concerns, and lower disinhibition around food compared to women with BN (Binford & le Grange, 2005; Keel et al., 2005; Keel et al., 2007), and these differences remain stable at 6-month follow-up (Keel et al., 2005). In addition, PD is associated with greater dietary restraint and body dissatisfaction compared to other EDNOS (e.g., Binge Eating Disorder; Keel et al., 2010). Further, BN and PD show distinct physiological responses to a standardized test meal; BN have blunted postprandial gut peptide responses compared to PD (Keel et al., 2007). However, studies of PD have found equivalent levels of eating disorder severity (Binford & le Grange, 2005; Keel et al., 2001; Keel et al., 2005; Rockert, Kaplan, & Olmsted, 2007) and chronicity (Keel et al., 2005; Wade et al., 2006) compared to BN and AN (Tasca, Maxwell, Bone, Trinneer, Balfour, & Bissada, 2012). Overall, differences between PD and other eating disorders reflect differences in their behavioral presentation rather than differences in clinical severity.

In summary, previous research suggests that PD is a clinically significant, distinct, and prevalent syndrome. Reflecting this literature, the DSM-5 Eating Disorders Workgroup has proposed that PD be included as a named syndrome among Feeding and Eating Disorders Not Elsewhere Classified (http://www.dsm5.org). The primary rationale for not including PD among formal diagnoses was the absence of data regarding treatment or course of PD to ensure predictive validity and clinical utility of the diagnosis. Prior to the development of efficacious treatments, much more research is needed to understand the propensity to purge following normal or small amounts of food in PD. Thus, this study sought to examine psychological factors that may contribute to purging in PD.

Psychological Antecedents of Purging

Very little is known about factors which serve to trigger purging in PD. The vast majority of work on purging has been conducted in the context of BN where predominant theoretical models focus on binge eating as an antecedent to purging. According to cognitive-behavioral theory as proposed by Fairburn, compensatory purging develops as a way to minimize weight gain associated with large binge-eating episodes (Fairburn, 2008). Thus, cognitive-behavioral therapy focuses on eliminating binge-eating episodes, educating patients about the effects of purging on caloric absorption of their binge episodes, and maintains that compensatory purging “does not need to be addressed in treatment because it will decline as the patient gains control over eating” (Fairburn, 2008, p. 82). Interventions specific to purging, such as addressing mood intolerance and feelings of fullness, are based on clinical impressions rather than empirical evidence.

Binge eating as an antecedent to purging is inadequate as a comprehensive account of purging. First, a significant minority of women who are treated for BN continue purging after achieving remission from binge episodes (Keel, Mitchell, Miller, Davis, & Crow, 1999). In addition, some individuals engage in non-compensatory purging that is used as a more “routine” method of weight control than in response to binge eating (Fairburn, 2008). This suggests that purging is related to mechanisms other than binge eating even in women who display both behaviors. Further, the binge eating hypothesis cannot explain purging in the absence of binge-eating episodes. Thus, it does not explain purging in PD. Although available research on PD is limited to cross-sectional or laboratory designs, findings from these and ecological momentary assessment (EMA; described in more detail below) studies of the antecedents and consequences of purging in BN provide important clues regarding the contribution of psychological factors to purging in PD.

Affective Factors

Negative affect is an aversive mood state characterized by sadness, hostility, guilt, and fear (Watson, Clark, & Tellegen, 1988). Negative affect is a risk factor for general eating pathology (Stice, 2002), which has led several researchers to investigate its association with specific disordered eating behaviors. Supporting the relevance of negative affect to PD, PD is associated with elevated anxiety and depression relative to non-eating disordered controls in cross-sectional research (Keel et al., 2008; Keel et al., 2005; Wade et al., 2006), and these elevations are maintained or heightened at 6-month follow-up (Keel et al., 2005). In addition, a laboratory study found that women with PD reported greater levels of tension after consuming a test meal compared to control women (Keel et al., 2007). EMA research suggests that increased negative affect predicts purging in BN (Alpers & Tuschen-Caffier, 2001; Rebert, Stanton, & Schwarz, 1991; Schlundt, Johnson, & Jarrell, 1986; Smyth et al., 2007). Smyth and colleagues (2007) presented exploratory analyses of changes in negative affect prior to self-induced vomiting that did and did not follow binge episodes in BN participants. There was no significant interaction between negative affect trajectory and the presence vs. absence of binge eating. This suggests that negative affect increased prior to self-induced vomiting whether or not vomiting was preceded by binge eating. Thus, previous research points to a potential role of negative affect in triggering purging among women with PD.

In contrast to negative affect, positive affect is a mood state characterized by excitement, enthusiasm, and engagement (Watson et al., 1988). Although related, negative and positive affect represent relatively independent constructs that have demonstrated differential patterns of associations with psychopathology. For example, low positive affect distinguishes depression from anxiety (Watson, Clark, & Carey, 1988). Ingestion of highly palatable food is associated with subjective pleasure and experience of reward (Small, Jones-Gotman, & Dagher, 2003). Therefore, efforts to control food intake in eating disorders may be related to lower positive affect if individuals do not allow themselves to be exposed to a potential source of pleasure. However, little research has been conducted examining the influence of positive affect on specific disordered eating behaviors. One EMA study found that positive affect decreased prior to self-induced vomiting in BN (Smyth et al., 2007). Similarly, decreases in positive affect may represent an antecedent to purging in PD.

Cognitive Factors

Theoretically, overconcern with body shape and weight are the feature of eating pathology that leads to extreme weight-control behaviors when patients fear a discrepancy between their own bodies and that of the thin-ideal. Shape and weight concerns are seen as being of “primary importance in maintaining the [eating] disorder” (Fairburn, Cooper, & Shafran, 2003). Consistent with Fairburn and colleagues’ model, concerns with body shape and weight were predictive of purging onset in a prospective study of adolescent girls (Field, Camargo, Taylor, Berkey, & Colditz, 1999). Of note, this study did not assess purging independent of other disordered eating behaviors and the proportion of adolescent girls who also began binge eating is unknown. In addition, cross-sectional research indicates that women with PD report significantly greater weight and shape concerns compared to non-eating disorder controls (Keel et al., 2005; Keel et al., 2007; Wade, 2007), even when body image disturbance is not explicitly included in the definition of the disorder (Binford & le Grange, 2005; Wade, 2007). Finally, EMA research in BN has found that participants report greater feelings of fatness after binge eating and prior to purging compared to baseline ratings (Powell & Thelen, 1996). Thus, specific cognitions about the impact of eating on shape or weight are likely to increase prior to purging. This research suggests that increased shape/weight concerns may be a proximal antecedent to purging in PD.

Restraint theory (Herman & Polivy, 1980) proposes that cognitive control plays a more influential role than physiological hunger and satiation in regulating food intake among those who chronically diet (Ruderman, 1986). Efforts at dietary restraint increase risk for a sense of loss of control over eating by establishing strict rules regarding what and how much one should eat. The experience of violating dietary rules may disrupt cognitive control, reducing restrained eaters' ability or desire to maintain dietary control (Ruderman, 1986). Thus, violations of dietary rules may act as a cognitive disinhibitor, resulting in counter-regulation in the form of loss of control eating and/or purging. While women with PD do not report objectively large binge episodes, defined as the consumption of an objectively large amount of food coupled with a sense of loss of control during the episode (American Psychiatric Association, 2000), many report a loss of control over eating normal or small amounts of food (i.e., subjective binge eating) (Binford & le Grange, 2005; Keel et al., 2007; le Grange et al., 2006; Mond et al., 2006). Loss of control in PD must be attributed to something other than the objective amount of food consumed. Previous cross-sectional research indicates that individuals with PD report greater dietary restraint, including the presence of dietary rules, compared to controls and equivalent levels of dietary restraint compared to BN (Binford & le Grange, 2005; Keel et al., 2005; Keel et al., 2007). Thus, women with PD appear to exert a significant amount of cognitive control over eating. Reflecting this, PD participants report greater eating concerns, including fear of losing control over eating, compared to controls (Keel, 2007). In interviews with PD participants in our lab, women retrospectively report that many purging episodes follow consumption of “forbidden foods” (i.e., junk foods, high fat foods) even though the amount of food is not objectively large. Consumption of “forbidden foods” predicted purging in two EMA studies of BN (Gleaves, Williamson, & Barker, 1993; Schlundt et al., 1986), and subjective ratings of food intake was a better predictor of purging than actual food intake in BN (Gleaves et al., 1993). In addition, BN participants who purge report more negative food/eating related cognitions compared to binge eating participants who do not purge, suggesting a specific link between thoughts about breaking one’s diet and purging behavior (Hilbert & Tuschen-Caffier, 2007). Taken together, it is likely that loss of control in PD is associated with violation of a dietary rule, such as eating a “forbidden food” in normal or small amounts, and that these violations predict purging among women with PD.

Somatic Factors

Elevated negative affect and shape/weight concerns may explain differences in purging behavior between PD and non-eating disorder controls; however, these features are also present in BN. Thus, they may explain purging behavior across eating disorders but do not account for increased propensity to purge after consuming normal or small amounts of food that is the defining feature of PD. Subjective experience of gastrointestinal distress following food intake has been posited as a possible unique risk factor for developing purging in PD (Keel et al., 2007). Women with PD reported greater increases in fullness and stomach discomfort, and lower levels of hunger following ingestion of a standardized test meal compared to both non-eating disorder controls and women with BN (Keel et al., 2007). Of note, these differences were not attributable to increases in feelings of tension in response to food intake, suggesting that somatic symptoms may contribute to purging independently of negative affect. This research suggests that women who purge may have abnormally enhanced satiety responses. Thus, increases in stomach discomfort and gastrointestinal distress may contribute to purging following normal of small amounts of food in PD.

Summary of Antecedents

Previous research provides initial clues as to why women with PD feel compelled to purge after consuming normal or small amounts of food. Cross-sectional, laboratory, and studies of purging in BN implicate affective, cognitive, and somatic factors as potential triggers of purging behavior. Specifically, increases in negative affect, decreases in positive affect, increases in shape/weight concerns, increases in violations of dietary rules, and increases in stomach discomfort represent prime candidates for an investigation of the psychological antecedents of purging in PD. However, cognitive-behavioral models of disordered eating focus on the function of behaviors in reducing antecedent triggers (Fairburn, 2008). Thus, it is important also to consider the impact of potential psychological consequences of purging on the maintenance of this behavior.

Psychological Consequences of Purging

Affective Factors

Affect regulation models of binge eating propose that binge eating functions to reduce negative affect by using food for comfort or distraction (Hawkins & Clement, 1984; Heatherton & Baumeister, 1991). Notably, previous EMA research does not support actual decreases in negative affect following binge eating; instead, several studies have found increases in negative affect from pre- to post-binge eating in BN (Alpers & Tuschen-Caffier, 2001; Davis, Freeman, & Solyom, 1985; Hilbert & Tuschen-Caffier, 2007; Powell & Thelen, 1996; Sherwood, Crowther, Wills, & Ben-Porath, 2000; Steiger, Gauvin, Jabalpurwala, Seguin, & Stotland, 1999; Steiger et al., 2005). Some researchers have proposed that purging rather than binge eating regulates affect in BN (Rosen & Leitenberg, 1982). These researchers acknowledge that binge episodes trigger distress and anxiety about the effects of excessive food consumption on weight that is alleviated by purging behaviors. Partially supporting this modification of the affect regulation model, negative affect following binge episodes decreases from pre- to post-purge in EMA and retrospective research (Alpers & Tuschen-Caffier, 2001; Cooper, Morrison, Bigman, & Abramowitz, 1988; Corstorphine, Waller, Ohanian, & Baker, 2006; Davis et al., 1985; Elmore & de Castro, 1990; Kaye, Gwirtsman, George, & Weiss, 1986; Powell & Thelen, 1996). Importantly, negative affect levels following purging do not differ significantly from elevated pre-binge affect levels (Alpers & Tuschen-Caffier, 2001; Corstorphine et al., 2006; Powell & Thelen, 1996). These studies suggest that purging may reduce negative affect induced by binge eating. However, negative affect returns to pre-binge levels and thus the binge-purge cycle does not appear to effectively regulate negative affect in BN. Purging may function to regulate negative affect in PD by increasing a perceived sense of control over distress. If supported, this would suggest a similar role of purging in BN and PD; however, the net effect of disordered eating behaviors would differ between syndromes because, at best, women with BN return to pre-binge levels of elevated negative affect whereas women with PD may achieve a net decrease in negative affect. Such results may explain why several studies have supported overall lower levels of depression in PD compared to BN (Keel et al., 2008; Keel et al., 2005; Wade, 2007).

Although regulation models of psychopathology typically propose that maladaptive behaviors function to decrease negative emotions, affect regulation can include the increase of positive emotions (Gross, 2007). Some researchers have proposed that compensatory behaviors like purging may be emotionally cathartic (Hawkins & Clement, 1984) and rewarding. Consistent with a positive affect regulation model, EMA and retrospective research suggest that positive mood increases following purging in BN (Cooper et al., 1988; Smyth et al., 2007). Thus, purging may function to both reduce negative affect and increase positive affect.

Cognitive Factors

In addition to regulating affect, purging may be negatively reinforced through reductions in shape/weight concerns. One EMA study found that cognitions regarding fatness decreased from post-binge to post-purge among women with BN (Powell & Thelen, 1996). This is consistent with clinical impressions and case reports (Mintz, 1982) that individuals report feeling “lighter” after purging. It is likely that purging reduces concerns about the effects of eating on body shape and weight even after eating normal or small amounts of food because women with PD feel as if they have gotten rid of the food.

Somatic Factors

Finally, although general somatic symptoms (such as headache or feeling dizzy) have not been found to decrease following purging, one EMA study reported a decrease in abdominal pain following purging in women with BN (Lingswiler, Crowther, & Stephens, 1989). Purging in PD also may function to reduce the feelings of excessive fullness and gastrointestinal distress that have been documented in laboratory research (Keel et al., 2007). Thus, relief from these aversive physical sensations may further maintain purging behavior through negative reinforcement.

Summary of Consequences

Based on this preliminary work, the roles of affect, shape/weight concerns, and stomach discomfort in the maintenance of purging in PD deserve further attention. Decreases in negative affect and increases in positive affect following purging would provide strong support for an affect regulation model of PD. In addition, reductions in shape/weight concerns and stomach discomfort associated with purging may form powerful negative reinforcers for this behavior. Identification of the psychological consequences of purging is critical to our understanding of the underlying mechanisms maintaining this pernicious symptom.

Moderators of Proximal Antecedents

In addition to identifying antecedents and consequences of purging in PD, the current study sought to provide preliminary information on how the association between antecedents and purging may be moderated by trait variables. Specifically, this study examined the influence of personality on the strength of associations between proximal antecedents and purging.

Impulsivity

Personality traits are frequently used in the assessment of eating disorders (Cassin & von Ranson, 2005). In particular, impulsivity has been implicated as an important trait, distinguishing between PD and controls (Keel et al., 2008; Keel et al., 2005) and between BN patients and controls (Claes, Vandereycken, & Vertommen, 2002) in cross-sectional research. In addition, higher levels of impulsivity have been associated with stronger associations between anger variability and binge eating as well as a trend for impulsivity to moderate the association between anger variability and self-induced vomiting (p = .056) in an EMA study of BN (Engel et al., 2007). Trend-level results for vomiting may be due to the measurement of impulsivity. Engel and colleagues (2007) used the Impulse Action Patterns subscale of the Diagnostic Interview for Borderlines – Revised (Zanarini, Frankenburg, & Vujanovic, 2002), which assessed the presence and frequency of various impulsive behaviors (i.e., substance use, self-mutilation, sexual deviance) thought to represent the underlying construct of impulsivity. Recent conceptualizations of impulsivity have posited four distinct facets that each contribute to the presence of impulsive behaviors: urgency, lack of premeditation, lack of perseverance, and sensation-seeking (Whiteside & Lynam, 2001). Notably, urgency represents the tendency to engage in impulsive behaviors to reduce negative affect despite harmful long-term consequences of the behavior. Thus, associations between negative affect and purging may be moderated by urgency such that women high in urgency are more likely to purge in response to negative emotions compared to women low in urgency. If this is true, individuals with PD who endorse higher levels of impulsivity may experience a stronger association between antecedent negative affect and subsequent purging.

Anxiety

PD was associated with greater rates of current anxiety disorders relative to non-eating disorder controls (Keel et al., 2008; Keel et al., 2005) and BN participants (Keel et al., 2008). These studies suggest that 39% (Keel et al., 2005) – 43% (Keel et al., 2008) of individuals with PD suffer from a current comorbid anxiety disorder. In addition, individuals with PD report greater proneness to anxiety compared to controls (Keel et al., 2008; Keel et al., 2005). Anxiety is characterized by hypervigilance biased towards threatening stimuli (Matthews & MacLeod, 1994). Thus, PD participants higher in trait anxiety may be more responsive to threatening signals, such as somatic symptoms of stomach discomfort, cognitive concerns about weight and shape, or violation of dietary rules, that indicate potential weight gain. Notably, purging frequency is associated with trait anxiety in PD but not in BN, indicating that greater proneness to anxiety may be specifically linked to purging after consuming normal or small amounts of food (Brown, Haedt-Matt, & Keel, 2010). Increased responsiveness indicates that smaller increases in these antecedents would be required before triggering a purge episode. Thus, PD participants with higher levels of trait anxiety may report a weaker association between posited antecedents and subsequent purging.

Limitations of Previous Research

This literature review of purging antecedents and consequences has been restricted to 1) cross-sectional comparisons of individuals with PD and BN or non-eating disorder controls, 2) laboratory-based research on PD, and 3) EMA studies in participants with BN. Each of these study designs has methodological limitations which constrain conclusions about maintenance factors of purging in PD. First, cross-sectional studies cannot assess temporal sequences of changes in affect and changes in purging necessary to establish psychological factors as antecedents to or consequences of purging behavior.

Although laboratory research mitigates this concern when participants are assessed repeatedly throughout an experiment, there are concerns about the ecological validity of research conducted in an experimental setting. Laboratory environments are often very different from participants' natural environments. Thus, research findings, such as increases in stomach discomfort following ingestion of a test meal in PD (Keel et al., 2007), may not generalize to or be representative of what happens outside the laboratory setting. This is particularly problematic for research on eating disorders when setting variables (e.g., alone or with other people, time of day) may influence when individuals engage in purging.

Finally, examinations of purging in BN are confounded by the presence of binge eating. Therefore, EMA studies of BN are inadequate to assess antecedents and consequences of purging in the absence of binge eating. Supporting problems of generalizing antecedents of a behavior between two syndromes, recent meta-analyses of EMA studies of binge eating found that individuals with BN and Binge Eating Disorder (BED; binge eating in the absence of compensatory behaviors) differed significantly on both negative affect and hunger prior to binge eating compared to regular eating episodes (Haedt-Matt & Keel, 2011a,b). Given previous research supports important psychological and biological differences between BN and PD (Keel, 2007), there may be important differences between factors contributing to purging in BN vs. purging in PD.

In summary, although background literature supports the influence of affective, cognitive, and somatic factors on purging in PD, no previous study has adequately tested these psychological factors as antecedents or consequences of purging. This study addressed each of these limitations by using EMA to assess dynamic changes in psychological variables related to purging in PD. EMA has been successfully utilized in previous research on cigarette smoking, alcohol use, pain, mood, anxiety, stress, and gastrointestinal disorders (see Thiele, Laireiter, & Baumann, 2002 for a review). In addition, there are a growing number of EMA studies on antecedents and consequences of disordered eating behaviors that attest to its feasibility and utility for the proposed research.

Ecological Momentary Assessment

Ecological momentary assessment (EMA; Stone & Shiffman, 1994) examines the daily experiences, behavior, and psychological states of individuals in their natural environment. This method is very similar to experience sampling (Larson & Csikszentmihalyi, 1983) and the daily diary method (Bolger, Davis, & Rafaeli, 2003). EMA can be implemented in a variety of ways, but all EMA studies have some features in common. First, EMA involves repeated assessments over time. In addition, assessment takes place in participants' natural environments as they go about their daily lives. Finally, participants complete ratings regarding their current state (e.g., current mood, current behavior). The first two features allow examination of variability over time and temporal ordering of the variables in question and enhance ecological validity. The third feature addresses limitations of retrospective self-reports. Retrospective reports often inquire about events, thoughts, behaviors, or mood anywhere from the past few days to the past few years. Thus, memory limitations may contribute to inaccurate retrospective reports. In addition, there is evidence of several cognitive biases that emerge in retrospective designs (see Shiffman & Stone, 1998 for a full review). Recall is frequently influenced by participants' current mood such that negative events are more easily recalled during negative moods (Teasdale & Fogarty, 1979). More recent or more salient events are often overly emphasized in retrospective recall of behavior or mood over a longer period of time (Redelmeier & Kahneman, 1996). Finally, individuals may provide explanations for behavior that makes sense given what they know or believe to be true instead of based on their actual experiences (Ross, 1989). These cognitive biases may be especially problematic to the investigation of transient changes in affect important to many models of eating disorders. Thus, EMA methodology is ideally suited to the study of antecedents and consequences of purging behavior.

EMA studies of binge eating highlight the importance of using momentary assessments versus retrospective report. In a meta-analytic review, increases in negative affect were supported as antecedents of binge eating in BN and BED, as evidenced by elevated negative affect prior to binge eating compared to average levels of negative affect and compared to negative affect prior to regular eating episodes (Haedt-Matt & Keel, 2011a). However, results further indicated that negative affect *increases* after binge eating episodes in both BN and BED. This pattern of results contradicted retrospective participant reports that binge eating reduces negative emotions (Abraham & Beumont, 1982; Hawkins & Clement, 1984; Hsu, 1990; Stickney, Miltenberger, & Wolff, 1999), which has formed a key basis for the affect regulation model of binge eating (Hawkins & Clement, 1984). This meta-analytic review indicates that widely accepted explanatory models of binge eating based on retrospective self-report were not supported by EMA findings. Such findings support the potential for an EMA study of PD to significantly enhance our understanding of purging behavior above and beyond retrospective or laboratory designs.

Ecological Momentary Assessment Protocols

Several aspects of EMA protocols influence the ability of this method to detect the temporal sequence of affect, cognition, somatic concerns, and behavior. Wheeler and Reis (1991) describe three categories of EMA protocols: *interval-contingent*, *signal-contingent*, and *event-contingent* recordings. Interval-contingent methods require participants to complete self-report measures after a specified period of time, typically at the end of each day (e.g., daily diary methods). While daily ratings may substantially decrease subject burden (compared to multiple ratings per day) and may allow recording of events that could not be captured otherwise (i.e., a purging episode that occurred while the participant was at a restaurant with friends), lengthy intervals are still subject to the retrospective recall biases that EMA was designed to overcome (e.g., Hedges, Jandorf, & Stone, 1985). More frequent intervals can reduce the level of bias but may become predictable so that participants change their behavior in anticipation of making ratings, which threatens the ecological validity of resulting data (Smyth et al., 2001).

Technological advances have made signal-contingent methods possible, which require participants to complete self-report measures in response to randomly timed signals usually through a watch timer, pager, or palmtop computer. This approach has the advantage of unpredictability as well as gaining a representative sampling of participant's experiences throughout the day (Wheeler & Reis, 1991). Both interval- and signal-contingent methods can be used to address questions regarding daily fluctuations in factors such as mood (Wheeler & Reis, 1991). In addition, these methods are desirable for the assessment of antecedents because ratings made in response to time intervals or random signals are not tied to the behavior itself. Thus, cognitive biases to reconstruct past events are not associated with these ratings because individuals respond before the behavior has occurred (Shiffman et al., 2008). However, these methods are limited in eating disorders research because of their restricted ability to detect infrequent behaviors, such as binge eating or purging. Even participants who meet DSM-IV criteria for BN are only required to purge, on average, twice per week. Thus, EMA that relies solely on interval- or signal-contingent methods may miss important consequences of disordered eating behaviors if those behaviors happen to occur in between rating cycles.

Event-contingent methods require participants to complete self-report measures in response to a particular event or behavior. The advantage of this approach is that it is tied to events, which greatly reduces the likelihood of missing a behavior of interest (Wheeler & Reis, 1991). In addition, this approach is valuable for assessing the immediate consequences of behavior. However, event-contingent methods are not well-suited for identifying antecedents of behaviors that are not planned by the participant. Each of the three methods reviewed above has advantages and disadvantages, leading researchers to recommend a combination of interval-, signal- and event-based approaches in research on eating disorders to capitalize on the strengths of each method (see Smyth et al., 2001).

However, this solution can result in increased participant burden and decreased protocol compliance (Wheeler & Reis, 1991).

Compliance and Acceptability

Previous EMA studies of disordered eating behaviors have ranged in duration from one eating episode (Agras & Telch, 1998; Telch & Agras, 1996) to five weeks (Redlin, Miltenberger, Crosby, Wolff, & Stickney, 2002), with a mean length of EMA of one and a half weeks (M = 10.2, SD = 6.6 days). The average study assessed participants' experiences 7.8 (SD = 7.2) times per day (Haedt-Matt & Keel, 2011a). This frequency has proved adequate for capturing antecedents and consequences of disordered eating behaviors in these studies.

One concern regarding EMA studies is increased participant burden as they can be extremely time-consuming for participants. Risks associated with increasing participant burden include decreased compliance with study protocols (Wheeler & Reis, 1991). Generally, compliance is considered high if participants complete at least 80% of assessments (e.g., Sonnenschein et al., 2007). Overall, compliance with signal-contingent methods in previous EMA studies of eating disorders has ranged from 76% (Wegner et al., 2002) to 92% (Engel et al., 2005), with participants responding to an average of 84.1% of random signals. Interval-contingent methods also are associated with high compliance rates, with participants completing an average of 91.5% of interval ratings. These compliance rates are comparable to EMA studies in other psychiatric samples (Hufford & Shields, 2002).

In addition to high compliance rates, participants find EMA procedures to be acceptable. Across three studies, participants' ratings on an Acceptability Questionnaire (Redlin et al., 2002) indicate that EMA methods are fairly easy (M = 4.25 on a scale of 1 = not at all easy to 7 = extremely easy), but moderately disruptive (M = 3.91 on a scale of 1 = not at all disruptive to 7 = extremely disruptive) and moderately time-consuming (M = 3.84 on a scale of 1 = not at all time-consuming to 7 = extremely time-consuming)

(Deaver, Miltenberger, Smyth, Meidinger, & Crosby, 2003; Redlin et al., 2002; Stickney et al., 1999). However, participants' overall experience completing EMA methods are rated as positive (*M* = 5.01 on a scale of 1 = very negative to 7 = very positive) (Deaver et al., 2003; Redlin et al., 2002; Stickney et al., 1999). In addition, Stein and Corte (2003) report that the majority of participants (92%) indicated they would be willing to participate in another EMA study. Taken together, the use of EMA appears both feasible and acceptable to participants with eating disorders.

Reactivity

Although EMA is ideally suited to assess the antecedents and consequences of behavior within an individual's natural environment, a key concern for any study utilizing EMA is reactivity, or the potential for individuals to alter their behavior as a consequence of measuring the behavior. While reactivity has been long recognized as a challenge in EMA, to my knowledge only one study has been conducted to examine the extent to which disordered eating behaviors are reactive to this methodology. Stein and Corte (2003) asked participants with AN or BN to monitor their disordered eating behaviors over a four week period. To assess reactivity, behavioral frequencies were compared for various timeframes. There were no differences in behavioral frequencies comparing the first and last halves of data collection or comparing the first, second, and last thirds of the assessment period. Given that research has suggested that reactivity is temporary and usually declines as people become accustomed to self-monitoring (Bolger et al., 2003), results provide no evidence of behavioral reactivity to self-monitoring of disordered eating behaviors using EMA. Finally, the majority of participants report that the EMA ratings are an accurate reflection of their daily experiences (Steiger et al., 2005).

Study Hypotheses

This study investigated how affective, cognitive, and somatic factors are related to purging behavior in PD using EMA. The EMA design allowed for the examination of several different aspects of the association between these factors and purging. First, comparisons were made between days when participants purged versus days when participants did not purge. Based on the literature reviewed above, I hypothesized that individuals would report greater negative affect, shape/weight concerns, violation of dietary rules, and stomach discomfort and lower positive affect on days characterized by purging (**Hypothesis 1**). Next, I examined temporal associations between changes in affective, cognitive, and somatic factors prior to and following purging within purge days. I hypothesized that negative affect, shape/weight concerns, violation of dietary rules, and stomach discomfort would increase and positive affect would decrease prior to purging, representing antecedent triggers of this behavior (**Hypothesis 2a**, see Figure B1). Given that significant changes in these antecedents on purge days may be due to extraneous third variables, such as the time of day or work/school schedules, rather than purging behavior, I also compared trajectories of change on purge versus non-purge days as a within-subject control. I expected that posited changes in antecedents described in Hypothesis 2a would be significantly greater on purge days compared to non-purge days (**Hypothesis 2b**). As proposed consequences of purging, I hypothesized that negative affect, shape/weight concerns, and stomach discomfort would decrease and positive affect would increase following purging (**Hypothesis 3a**; see Figure B1) and that these changes would be significantly greater on purge days versus days in which participants did not purge (**Hypothesis 3b**). Finally, moderators of the association between posited antecedents and purging were investigated in a more exploratory fashion. I hypothesized that higher levels of impulsivity would be associated with increased likelihood to purge in response to increasing negative affect, and women with higher levels of trait anxiety would demonstrate less robust associations between all proximal antecedents and purging (**Exploratory Hypothesis 4**).

CHAPTER II

METHODS

Participants and Recruitment

Women with PD (*N* = 24) were recruited from the campus and surrounding community populations of the University of Iowa (*n* = 16) and Florida State University (*n* = 8) to participate in this study. Both sites used identical protocols for recruitment, screening, and data collection. These protocols (described below) were initially developed and implemented by the principal investigator at the University of Iowa, and in-person training was conducted at the Florida State University research lab to set up a second data collection site. The principal investigator oversaw coordination of all study procedures between sites.

Recruitment methods included posters and advertisements that invited normal weight women who purge to participate in a study of their daily experiences. In addition, women were invited to complete an online eligibility screen through mass e-mails to all female students at the University of Iowa and Florida State University. All recruitment methods were followed by a confidential telephone screen to assess initial eligibility. Research assistants trained in the confidential screening of research participants determined whether potential participants appeared to meet study criteria using a brief telephone screen that included questions from Module H (eating disorders module) of the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I). If the individual appeared to be eligible, the research assistant described the study, answered any questions about the study, and invited the caller to participate in an in-person intake assessment that included semi-structured clinical interviews to confirm inclusion/exclusion criteria. Inclusion criteria were: 1) female, 2) age 18-45 years, 3) purging (i.e., self-induced vomiting, laxative abuse, and/or diuretic abuse) at least twice per week for the previous three months, and 4) undue influence of body shape or weight on self-evaluation.

Exclusion criteria were: 1) objectively large binge episodes within the previous 12 months, 2) underweight (i.e., body mass index < 18.5 kg/m^2), 3) psychotic disorder, and 4) inability to read English.

Of the 32 women invited to complete the intake assessment based on their initial telephone screen, 7 were ineligible due to the endorsement of objectively large binge eating episodes during clinical interview, leaving 25 women who began the daily assessments. Once identified, participants were highly likely to complete study procedures. Only one participant withdrew after her first two days of daily assessments and was excluded from subsequent analyses. The remaining 24 participants completed at least one week of EMA and are included in data analyses (96% retention rate). This retention rate is similar to a recent EMA study in BN in which 92% of participants who were eligible and began data collection subsequently completed at least one week of the study (Smyth et al., 2007).

Participants were predominantly young adult women (mean age = 23.08 years, SD = 5.44, range = 18 – 42), who were normal weight (mean body mass index = 21.99 kg/m^2, *SD* = 2.82, range = 18.52 – 30.52), Caucasian (*n* = 21, 87.5%), unmarried (*n* = 20, 83.3% never married or divorced), and had at least some college education (*n* = 20, 83.3%). Although this was a community sample, 41.7% (*n* = 10) of participants reported that they were in current psychological treatment and 66.7% (*n* = 16) reported a lifetime history of psychological treatment. Participants endorsed a range of comorbid psychopathology, including current (*n* = 4, 16.7%) and lifetime (*n* = 16, 66.7%) mood disorders, current (*n* = 5, 20.8%) and lifetime (*n* = 10, 41.7%) anxiety disorders, lifetime substance use disorders (*n* = 10, 41.7%), and lifetime impulse control disorders (*n* = 2, 8.3%). There were no participants who met criteria for a current substance use or impulse control disorder.

Procedure and Measures

This research study was reviewed and approved by institutional review boards at the University of Iowa and Florida State University. Participants provided written informed consent prior to study participation and were asked to complete the following assessments, including four visits to our research lab (see Figure B2):

1) Intake assessment including interviews, questionnaires, and training on EMA procedures (study visit 1),
2) Daily assessments of purging, affect, body shape/weight concerns, physical symptoms, and violation of dietary rules, and
3) Intermediate phone and two in-person assessment check-ins (study visits 2 and 3), and
4) Final assessment including evaluation of changes in eating disorder symptoms (study visit 4).

Intake Assessment

Semi-structured clinical interviews of eating and related Axis I disorders were conducted by at least Bachelor's-level clinical interviewers to confirm inclusion/exclusion criteria. All interviewers completed training under the supervision of Dr. Keel, which included training tapes, didactic role-playing, and observed interviews. This training has led to high interrater reliability in previous studies (Keel et al., 2008; Keel et al., 2005; Keel et al., 2007). In addition, height and weight were objectively measured using a digital scale and wall-mounted ruler and participants completed questionnaires. Finally, participants received detailed instructions for completing the daily assessments on palmtop computers and how to deal with problems or questions that might arise. For example, participants were instructed not to complete ratings at any time they were unable to reply or if safety was a concern (e.g., while driving). This assessment took 2-3 hours to complete.

Eating Disorder Examination (EDE; Fairburn & Cooper, 1993). This semi-structured clinical interview assesses frequency of disordered eating behaviors (binge eating, purging, fasting, and excessive exercise) and specific features of eating disorders on four subscales: Restraint, Eating Concern, Shape Concern, and Weight Concern. The main advantage of the EDE for the current study was the inclusion of questions to distinguish between objectively large versus subjective binge episodes. Thus, in addition to providing an estimate of eating disorder severity, the EDE was used to confirm study eligibility. The EDE subscales have demonstrated good discriminant (Cooper, Cooper, & Fairburn, 1989; Fairburn & Cooper, 1993) and concurrent validity (Rosen, Vara, Wendt, & Leitenberg, 1990), adequate internal consistency (Beumont, Kopec-Schrader, Talbot, & Touyz, 1993; Cooper et al., 1989), and the EDE is considered the “gold standard” in eating disorder assessment (Grilo, 2005). Further, studies using the EDE have documented high interrater reliability (Cooper & Fairburn, 1987; Grilo, Masheb, LozanoBlanco, & Barry, 2004; Keel et al., 2005; Keel et al., 2007; Rizvi, Peterson, Crow, & Stewart Agras, 2000; Rosen et al., 1990) and high test-retest reliability (Peterson et al., 2007). Internal reliability (Cronbach’s alpha) of the EDE in the current study was 0.81 for the total score, and 0.59 for Restraint, 0.45 for Eating Concern, 0.68 for Shape Concern, and 0.51 for Weight Concern subscales.

Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I; First, Spitzer, Gibbon, & Williams, 1996). This structured interview was used to screen for exclusion criteria (i.e., psychotic disorders module). In addition, the SCID-I overview and eating disorders module was used to characterize the sample for comparisons with previous research. The SCID-I has demonstrated good to excellent test-retest and interrater reliabilities in a large, multi-site study (Zanarini et al., 2000).

International Personality Item Pool (IPIP-NEO-N1; Goldberg et al., 2006). Participants completed a measure of trait-based anxiety that included 10 items from the International Personality Item Pool (IPIP). The IPIP was developed as a publicallyavailable alternative to commercial personality assessments. The anxiety scale has demonstrated convergent validity with the corresponding facet subscale of the NEO Personality Inventory (correlation between IPIP and NEO-PI-R = .75) and good internal consistency (Goldberg et al., 2006). Cronbach's alpha in the current study was .68.

State-Trait Anxiety Inventory (STAI; Spielberger, Gorusch, Lushene, Vagg, & Jacobs, 1983). This 40-item questionnaire assesses levels of current (state) anxiety as well as proneness to anxiety (trait). This two-factor structure has been supported in clinical (Oei, Evans, & Crook, 1990) and non-clinical samples (Spielberger, Vagg, Barker, Donham, & Westberry, 1980; Vagg, Spielberger, & O'Hearn, 1980). The STAI was used in the current study to examine the potential moderating effect of trait anxiety on associations between posited antecedents and purging. The trait subscale was associated with a lack of reactivity to changes in situational stress and is highly correlated with other measures of trait anxiety, such as the Manifest Anxiety Scale, supporting concurrent validity (Spielberger & Vagg, 1984). Further, the trait subscale has shown high internal consistency (Ramanaiah, Franzen, & Schill, 1983) and test-retest reliability (Spielberger & Vagg, 1984). Internal reliability (Cronbach's alpha) of the trait subscale in the current study was 0.87.

UPPS Impulsive Behavior Scale (UPPS; Whiteside & Lynam, 2001). This 45-item self-report questionnaire assesses impulsive behavior on four scales: Urgency, (lack of) Premeditation, (lack of) Perseverance, and Sensation Seeking. Notably, the Urgency scale taps the tendency to engage in impulsive behaviors to reduce negative affect despite harmful long-term consequences of the behavior. The UPPS was included in the present study to examine the potential moderating effect of impulsivity on associations between state mood and purging. Factor analysis supports the four-subscale structure of the UPPS (Whiteside & Lynam, 2001), and the UPPS has demonstrated internal consistency and good convergent and divergent validity (Whiteside & Lynam, 2001; Whiteside, Lynam, Miller, & Reynolds, 2005). Cronbach's alpha of the UPPS in the current study was 0.92

for the global score, and 0.90 for Premeditation, 0.86 for Urgency, 0.93 for Sensation Seeking, and 0.78 for Perseverance subscales.

Daily Assessments

Participants completed EMA on palmtop computers. Palmtop computers were chosen over paper diaries because of their ability to provide date and time stamps for all participant ratings. Previous research has found that paper diary ratings are subject to falsification, which may undermine inferences drawn from such data (Stone, Shiffman, Schwartz, Broderick, & Hufford, 2002). Thus, the use of palmtop computers provided a direct assessment of participant compliance. Participants carried the palmtop computer and completed assessments of purging, affect, shape/weight concerns, violation of dietary rules and stomach discomfort for a total of 16 days, including two practice days and 14 days of data collection. Data collected during the initial two-day practice period were examined for evidence of reactivity to reduce concerns about the effect of immediate reactivity to self-monitoring. Each rating took less than 5 minutes to complete.

This study included three types of EMA methods as described by Wheeler and Reis (1991). First, participants were signaled at six semi-random times throughout the day (signal-contingent) to complete momentary ratings of affect, shape/weight concerns, violation of dietary rules, and stomach discomfort and to report any purging that has not been previously recorded. The time of signals was determined by randomly selecting times within six equally spaced intervals between 8:00am and 11:00pm to ensure a representative sampling throughout the day. In addition, participants were instructed to complete momentary ratings of affect, shape/weight concerns, and stomach discomfort as soon after each purging episode as possible (event-contingent). Purging-related ratings allowed the assessment of immediate consequences of purging that may have been missed by the random signals. Finally, participants completed ratings of affect, shape/weight concerns, and stomach discomfort at the end of each day (interval-contingent) to capture any changes since the last random signal. As noted above, this combination of signal-, interval-, and event-contingent recordings capitalized on the strengths of each approach (Smyth et al., 2001; Wheeler & Reis, 1991) and has been successfully implemented in a previous EMA study of BN (Smyth et al., 2007).

Purging. Participants were asked to make ratings after engaging in any purging behaviors (i.e., self-induced vomiting, laxative abuse, or diuretic abuse). In addition, random signal and end-of-day assessments asked participants if they had engaged in any purging methods that were not previously reported. Self-reports of purging behaviors have demonstrated high test-retest reliability (Peterson, Miller, Johnson-Lind, Crow, & Thuras, 2007) and high agreement with interview-based assessments, likely because these behaviors are salient and questions regarding these behaviors are less susceptible to misinterpretation than questions about binge eating (Fairburn & Beglin, 1990; Stein & Corte, 2003).

Affect. The Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) consists of 20 items that assess positive (e.g., excited, proud, inspired) and negative (e.g., anger, sadness, nervousness) emotions. The PANAS was designed to assess mood over different time periods, including momentary ratings. Thus, this scale has been validated for the assessment of state mood required for momentary assessments in the current study. The PANAS has demonstrated excellent internal consistency and good convergent and discriminant validity (Watson et al., 1988). In the current study, internal consistency (Cronbach's alpha) was .84 for NA and .89 for PA.

Shape/weight concerns. Body shape/weight concerns were assessed with items from the Shape Concerns and Weight Concerns subscales of the Eating Disorder Examination – Questionnaire (EDE-Q; Fairburn & Beglin, 1994). The EDE-Q is a self-report version of the EDE that asks participants about their eating attitudes and behaviors over the past 28 days. Items in the current study were modified to ask participants about their shape and weight concerns at the present moment. The EDE-Q has shown good concurrent validity with the EDE (Fairburn & Beglin, 1994) and excellent internal consistency (Luce & Crowther, 1999). Three additional items were selected from the Body Shape Questionnaire (BSQ; Cooper, Taylor, Cooper, & Fairburn, 1987) to assess feelings and attitudes about body shape and weight not covered by the EDE-Q. The BSQ also has demonstrated good discriminant and concurrent validity (Cooper et al., 1987; Rosen, Jones, Ramirez, & Waxman, 1996) as well as good test-retest reliability (Rosen et al., 1996). This 10-item scale was significantly correlated with the Body Shape Questionnaire (r = .48, p < .05) and EDE Shape Concerns subscale (r = .45, p < .05) in the current study, supporting the concurrent validity of the modified measure. In addition, internal consistency was .95.

Violation of dietary rules. The presence of dietary rules was established using the EDE item during participants' intake assessment. Participants were given a note card to carry with the palmtop computer that included a written definition and illustrative examples of their own dietary rules. Momentary assessments asked participants if they had eaten since completing their last rating. When participants indicated that they had eaten, they were asked if they felt they had broken any dietary rules that they set for themselves while eating (rated as yes or no). In addition, participants were asked if their eating felt out of control on a scale of 1 = no (completely in control) to 5 = yes (completely out of control). Previous studies have demonstrated that single item assessments correspond well to standardized measures of dietary restraint (Steiger, Lehoux, & Gauvin, 1999).

Stomach discomfort. Stomach discomfort was assessed with items from the Gastrointestinal Symptom Survey (GISS; Waldholtz & Anderson, 1990), which rates the severity of feelings of fullness, abdominal/stomach pain, nausea, bloating, intestinal gas, heartburn, indigestion, and belching. These symptoms are prevalent in previous research on AN (Waldholtz & Anderson, 1990) and BN (Chami, Andersen, Crowell, Schuster, & Whitehead, 1995). The GISS is sensitive to changes in gastrointestinal symptomatology following treatment (Chami et al., 1995; Waldholtz & Anderson, 1990), and daily fluctuations in symptom severity has been seen in participants with Irritable Bowel Syndrome (IBS) as well as participants without IBS (Heitkemper et al., 1995). Cronbach's alpha of this eight-item measure was .48, indicating low internal consistency. Thus, a composite score from this measure was excluded from data analyses. Instead, single items of fullness, stomach pain, and nausea were selected for inclusion in analyses of stomach discomfort based on previous research supporting the importance of these variables in Purging Disorder (Keel et al., 2007).

Intermediate Assessment Check-Ins

Participants returned to the research lab after the first two days of EMA, at which point their practice data were collected. Participants were given feedback regarding their compliance rates, and any questions or concerns regarding assessment procedures were discussed with a research assistant. Palmtop computers were returned to participants for data collection over the next 14 days, and an appointment was scheduled for participants to come back one week later to upload palmtop data mid-way through the assessment phase. The in-person assessment check-ins took 10-15 minutes to complete. Throughout the 14-day assessment period, participants were telephoned at least twice per week to check in with them regarding any problems or concerns. This approach has demonstrated success in participant retention and compliance during a previous research study which required daily collection of saliva samples and interval ratings of mood and disordered eating behaviors over 35 days (Edler, Lipson, & Keel, 2007).

Final Assessment

At the completion of the daily assessment phase, participants returned the palmtop computers and completed a final assessment. The final assessment included a modified version of the EDE interview that covered the previous two weeks during which EMA was conducted. This assessment was used to determine changes in symptom frequency (i.e., potential reactivity to study procedures) and correspondence between retrospective reports of disordered eating with EMA recordings. Internal reliability (Cronbach's alpha) of the EDE conducted during the final assessment was 0.73 for the total score, and 0.74 for Restraint, 0.60 for Eating Concern, 0.48 for Shape Concern, and 0.17 for Weight Concern subscales. The final assessment took between 30 minutes and one hour to complete.

Study Reimbursement

Participants were offered up to $250 for completion of study procedures ($50 for the intake assessment, $175 for daily assessments prorated according to degree of response to random signals, and $25 for the final assessment). This compensation was based on a recent EMA study of BN that used similar procedures and demonstrated high compliance rates (Smyth et al., 2007).

Statistical Analyses

Preliminary Data Considerations

Baseline comparisons between sites were made on demographic, eating pathology, and general psychopathology variables using t-tests and chi-square tests, and site was evaluated for use as a covariate in multilevel model analyses described below. Prior to analyses, data were examined for normality. Raw scores for negative affect, positive affect, fullness, stomach pain, and nausea were log-transformed to correct for significant positive skew and multiplied by 10 to avoid boundary constraints (Singer & Willett, 2003).

Hypothesis Testing

Multilevel model (MLM) analyses were used to test study hypotheses that 1) negative affect, shape/weight concerns, violation of dietary rules, and stomach discomfort would be higher and positive affect would be lower on purge days compared to non-purge days, 2) negative affect, shape/weight concerns, stomach discomfort, and violation of dietary rules would increase and positive affect would decrease prior to purging, 3) negative affect, shape/weight concerns, and stomach discomfort would decrease and positive affect would increase following purging, and 4) impulsivity and anxiety would moderate associations between posited antecedents and purging. MLM is superior to alternative analytical methods, such as repeated measures ANOVA, because of its ability to handle correlated within-person data with unequal variances in unbalanced designs. Data collected using EMA are unlikely to result in the same number of measurements per participant because of differences in purging frequency, differences in participant compliance, and because participants will inevitably miss some random signals due to unavoidable circumstances (e.g., driving) (Schwartz & Stone, 1998). MLM analyses use maximum likelihood estimation methods to include information for participants when there are missing data rather than using list-wise deletion.

Applied to EMA data, MLM analyses are ideal to assess momentary ratings (level 1) made by individuals (level 2). The inclusion of random effects for intercept, slope, and their covariation was investigated, and models which specified a random intercept provided the best fit to the data. MLM models further specified a first-order autoregressive covariance structure to model the autocorrelation between within-person random errors because ratings made closer in time were expected to have errors that were more highly correlated compared to ratings made farther apart. Model fit was improved for all analyses using this specification. Full maximum likelihood estimates were used to permit comparisons of model fit. Significance of fixed effects was examined using the t statistic with degrees of freedom equal to $N - 1$ – number of predictors (Raudenbush & Byrk, 2002) and a significance level of $p < .05$.

Hypothesis 1: differences between purge and non-purge days. Between-days analyses compared mean levels of affect, shape/weight concerns, stomach discomfort, and likelihood of violation of dietary rules on purge days versus non-purge days. Each study day was dummy coded to distinguish days when purging occurred (purge day) versus days purging did no (non-purge day). Data were aggregated across within-day assessments so that scores reflect the average values for each participant on each day.

Hypothesis 2a: antecedents of purging on purge days. Within-day analyses compared changes in affect, shape/weight concerns, stomach discomfort, and violation of dietary rules over time in relation to purging behavior. Following recommendations of Singer and Willett (2003), an unconditional means model was first examined to determine if there was significant within-person variance in each dependent variable. Next, unconditional growth models were conducted to examine linear and non-linear (quadratic) effects of time. Fit indices and the log-likelihood ratio test were used to determine if the addition of linear and non-linear effects improved model fit over the unconditional means model.

Level 1 analyses examined within-person changes in affect, shape/weight concerns, and stomach discomfort prior to purging on purge days in separate general linear mixed models. The dependent variable in analyses of dietary rules was the presence vs. absence of violating a dietary rule (coded as a binary outcome). Thus, the MLM for this analysis used a generalized linear model based on a binary logistic function for dichotomous outcome data (Stiratelli, Laird, & Ware, 1984). The main predictor variable in antecedent analyses was the linear effect of time leading up to a purging behavior. Using negative affect as an example, Hypothesis 2a would be supported if there is a significant, positive coefficient for time prior to purging indicating increases in negative affect prior to purging. A quadratic effect of time was included as a predictor variable in a second growth model to examine the influence of non-linear changes in dependent variables over time in relation to purging. When multiple purging behaviors were reported on the same day (51 multiple purge days), only ratings made prior to the first purging episode of the day were included in antecedent analyses.

Hypothesis 2b. comparisons of antecedent change trajectories between purge and non-purge days. Within-day analyses on purge days examined changes in posited antecedents prior to purging behavior. However, individuals with PD may experience similar changes in affect, shape/weight concerns, dietary rules, and stomach discomfort over time on days that they do not purge. Thus, additional MLM analyses were conducted to examine differences in trajectories of change on purge days compared to non-purge days to assess the specificity of these changes in triggering purging behavior. In order to examine whether the trajectory of change differed, an average purge time was calculated for each participant and momentary ratings on non-purge days were centered relative to average purge time. For these analyses, predictors included time prior to purging, purge day, and their interaction. Using negative affect as an example, hypothesis 2b would be supported with a significant positive interaction between time prior to purging and purge day, reflecting greater increases in negative affect prior to purging on purge days relative to the trajectory of negative affect prior to average purge time on non-purge days.

Hypothesis 3a: consequences of purging on purge days. Level 1 analyses were used to examine within-person changes in affect, shape/weight concerns, and stomach discomfort following purging behavior using general linear mixed models. Separate models were conducted for each dependent variable. As in antecedent analyses, the predictor variable was the linear effect of time after purging on days in which participants purged. Hypothesis 3 would be supported for negative affect if there is a significant negative slope coefficient for time following purging behavior, indicating decreases in negative affect over time. The non-linear effect of time was added to a second growth model to investigate whether or not non-linear effects improved model fit. When multiple purging behaviors were reported on the same day, only ratings made following the last purging episode of the day were included in these analyses.

Hypothesis 3b. comparisons of consequence change trajectories between purge and non-purge days. Similar to the approach described for Hypothesis 2b, additional MLM analyses were conducted to examine differences in trajectories of change on purge days compared to non-purge days to assess the specificity of these changes as a consequence of purging behavior. In order to examine whether the trajectory of change differed, an average purge time was calculated for each participants and momentary ratings on non-purge days were centered relative to average purge time. For these analyses, predictors included time after purging, purge day, and their interaction. Using negative affect as an example, hypothesis 3b would be supported with a significant negative interaction between time after purging and purge day, reflecting greater decreases in negative affect following purging behavior on purge days relative to the trajectory of negative affect following average purge time on non-purge days.

Exploratory hypothesis 4: moderators of associations between antecedents and purging. Exploratory analyses were conducted to investigate moderators of associations between within-person changes over time and purging. Given anticipated differences in trajectories of change on purge versus non-purge days, moderator analyses investigated how impulsivity and trait anxiety influenced differences in those change trajectories. Level 1 and 2 analyses were used to examine the moderating effects of trait anxiety and impulsivity (between-person predictors, level 2) on associations between changes in antecedents over time and purging (within-person associations, level 1). As in analyses for hypothesis 2, models were conducted separately for each posited antecedent. Predictors in multilevel models included time prior to purging, purge day (binary coded as purge day or non-purge day), the putative moderator (impulsivity or trait anxiety), all two-way interactions (hours prior to purging x purge day, hours prior to purging x moderator, purge day x moderator), and the three way interaction (hours prior to purging x moderator x purge day). To test hypothesis 4, the hours prior to purging x moderator x purge day interaction term was the predictor of interest. These models assessed whether the level of the moderator influenced the slope of change in the antecedent on purge days versus non-purge days. Hypotheses would be supported if there is a significant three-way interaction. For example, hypotheses regarding anxiety would be supported if individuals high on anxiety have smaller slope coefficients for changes in stomach discomfort prior to purging on purge days compared to changes on non-purge days versus individuals low on anxiety.

Post-Hoc Power Analyses

MLM analyses often have substantial power because of the collection of repeated assessments. Post-hoc power analyses were conducted using "Optimal Design for Multi-Level and Longitudinal Research" (version 1.77) software (Spybrook, Raudenbush, Liu, & Congdon, 2006). Based on two recent meta-analyses of EMA studies examining associations between affect and binge eating (Haedt-Matt & Keel, 2011a) and between hunger and binge eating (Haedt-Matt & Keel, 2011b), I expected changes over time in psychological antecedents and consequences of purging to be associated with large to very large effect sizes. The average number of momentary ratings made prior to or after purging in the current study was 3, and the average number of days completed was 17 (reflecting the fact that many participants continued to carry the palmtop computers and make ratings if unable to complete their final assessment on day 16). Thus, the number of repeated assessments necessary for post-hoc power calculations was set at 51. Based on observed within-person and between-person variance estimates, results of the post-hoc power analysis indicated that the sample size of 24 and a p value of .05 had 80% power to detect large effect sizes (standardized effect size $r > .51$) for changes over time in antecedents and consequences. Results across analyses indicated a mean effect size $r = .52$ for linear growth models and $r = .37$ for quadratic growth models. Thus, linear growth effect sizes were similar to those expected based on prior EMA studies, and this study appeared to have adequate power to detect significant linear effects for primary hypotheses regarding antecedents and consequences of purging. However, this study may have been underpowered to detect non-linear changes. In addition, post-hoc power analyses indicated that the current study had 80% power to detect interaction or moderating effects that were very large ($r < .67$). Given concerns of low statistical power to detect interaction effects and the influence of adding additional parameters in reducing power, quadratic effects of time were not examined in comparisons of antecedent or consequence trajectories of change on purge versus non-purge days. Finally, because moderator effects are unlikely to be very large in magnitude, it is possible that the sample size of $N = 24$ was not sufficient to test the fourth hypothesis. Thus, moderator analyses were appropriately considered exploratory.

CHAPTER III

RESULTS

Preliminary Data Analyses

There were 2,445 momentary ratings completed, including 1,978 signal-contingent ratings, 313 end-of-day ratings, and 154 event-contingent behavior ratings. Compliance with the study protocol was good; 77.9% of all signal and interval ratings were completed (Sonnenschein et al., 2007). In addition, participants were timely in responding to random signals and completed 45.7% of signal-contingent ratings within five minutes and 71.4% within 30 minutes, suggesting that signal response time was comparable to previous EMA research (e.g., Smyth et al., 2007). Participants reported that EMA methods used in the current study were fairly easy (*M* (SD) = 5.53 (1.33) on a scale of 1 = not at all easy and 7 = extremely easy), moderately disruptive (*M* (SD) = 4.24 (1.48 on a scale of 1 = not at all disruptive and 7 = extremely disruptive), and moderately time-consuming (*M* (SD) = 3.29 (1.40) on a scale of 1 = not at all time-consuming and 7 = extremely time-consuming), consistent with previous research (Deaver et al., 2003; Redlin et al., 2002; Stickney et al., 1999). Participants' overall experience completing EMA methods were rated as positive (*M* (SD) = 5.24 (.97) on a scale of 1 = very negative to 7 = very positive). Across participants, there were 194 non-purge days and 209 purge days consisting of 268 purging episodes (two purging episodes were reported on 44 days and three episodes were reported on 7 days). The average purge time for each participant ranged from 2:15pm to 7:49pm with a mean purge time of 4:50pm. Participants recruited at Florida State University reported greater body dissatisfaction, eating disorder-related impairment, and impulsivity, and more frequent purging compared to participants recruited at the University of Iowa (see Table A1). Thus, site was included as a covariate in all analyses.

Hypothesis 1: Differences Between Purge and Non-Purge Days

Between-days analyses compared mean levels of affect, shape/weight concerns, likelihood of violation of dietary rules, and stomach discomfort on purge days versus non-purge days (see Table A2). The estimate for "purge day" reflects the average difference of each factor on purge days compared to non-purge days. As hypothesized, participants reported significantly greater negative affect and lower positive affect on purge days compared to days they did not purge. In addition, shape/weight concerns were higher on purge versus non-purge days. However, in contrast to expectations, violation of dietary rules was significantly less likely to occur on purge days than on non-purge days. Follow-up analyses were conducted to determine if there were any factors that may have contributed to this unexpected finding. For example, more frequent purging, a between-subjects factor, may reduce cognitive control over eating and the perception of violating a dietary rule if participants believe that their eating is being controlled by the purging behavior. However, there remained a decreased likelihood of violating a dietary rule on purge days in follow-up exploratory analyses that controlled for purging frequency (purge day coefficient = -1.66, $SE = .24$, $t = -7.03$, $p < .001$). There were no significant mean-level differences in stomach discomfort on purge versus non-purge days; however, there was a trend for participants to report higher nausea on purge days ($p = .077$).

Hypothesis 2: Antecedents of Purging

Hypothesis 2a: Antecedents of Purging on Purge Days

Within-day analyses of antecedents examined trajectories of change prior to purging behavior. Unconditional means models revealed significant within-person variance in all dependent variables (NA variance estimate (SE) = 1.06 (.05), < .001; PA variance estimate (SE) = 1.55 (.08), $p < .001$; shape/weight concerns variance estimate (SE) = 19.87 (.98), $p < .001$; dietary rules variance estimate (SE) = .92 (.04), $p < .001$; fullness variance estimate (SE) = 4.79 (.19), $p < .001$; stomach pain variance estimate

(*SE*) = 2.49 (.11), $p < .001$; nausea variance estimate (*SE*) = 2.37 (.10), $p < .001$), indicating significant within-day changes in these variables on days that purging occurred.

Results from linear and non-linear growth models are presented in Table A3. The estimate for "hours prior to purging" reflects the linear rate of change, or slope, of each dependent variable leading up to a purging behavior. As hypothesized, results indicated significant linear increases in negative affect, shape/weight concerns, fullness, and nausea prior to purging behavior. There were no significant changes in stomach pain prior to purging. The addition of a non-linear, quadratic predictor in analyses of negative affect, shape/weight concerns, and stomach discomfort failed to improve model fit compared to the linear predictor only model. However, the addition of a non-linear trend significantly improved model fit for analyses of positive affect. The linear estimate indicated significant decreases in positive affect prior to purging. The negative non-linear estimate indicated affective recovery as positive affect began to increase close to purge time.

Finally, the likelihood of violating a dietary rule decreased prior to purging. Similar to between-days analyses, the direction of this effect was opposite of *a priori* hypotheses. Follow-up analyses were conducted to examine loss of control in a separate general linear mixed model as an alternative measure of cognitive control over eating. Results indicated that loss of control increased over time prior to purging (linear coefficient (*SE*) = .05 (.01), $t = 3.44$, $p < .001$). Thus, loss of control appeared to be more relevant to triggering purging behavior and must be attributable to something besides violating a dietary rule in this sample.

Hypothesis 2b. Comparisons of Antecedent Change

Trajectories Between Purge and Non-Purge Days

Analyses presented in Table A3 provide evidence of associations between changes in several posited antecedents and purging behavior. However, these analyses do not provide information regarding the difference between trajectories of posited antecedents on purge versus non-purge days. Thus, additional MLM analyses were used to examine interactions between rates of change prior to purging and purge day. Results from within-day multilevel models examining comparisons of antecedent growth trajectories on purge versus non-purge days are presented in Table A4 (and depicted in Figures B3a – B8a). Only the trajectories of change in positive affect and shape/weight concerns were significantly different on purge versus non-purge days. Positive affect increased over time on non-purge days and failed to change relative to purging on purge days (see Figure B4a). In addition, the rate of change in shape/weight concerns was higher on non-purge days (see Figure B5a). There were no significant interaction effects for negative affect, stomach discomfort, or violation of dietary rules, suggesting that changes in these variables prior to purging did not differ from changes in theses variables on days when participants did not purge.

Hypothesis 3: Consequences of Purging

Hypothesis 3a: Consequences of Purging on Purge Days

Results from linear and non-linear growth models for analyses of the consequences of purging are presented in Table A5. Similar to antecedent analyses, the estimate for “hours after purging” reflects the rate of change, or slope, of each dependent variable following purging behavior. As hypothesized, results indicated significant linear decreases in negative affect, shape/weight concerns, fullness, and nausea and a trend-level decrease in stomach pain (p = .067) following purging behavior. The addition of a non-linear, quadratic predictor improved model fit in analyses of negative affect, fullness, and nausea indicating significant non-linear changes in these variables over time following purging. For each variable, the positive non-linear estimate indicated that decreases in negative affect, fullness, and nausea are time-limited and begin to reverse as time moves further away from the purge behavior. There were no linear changes in positive affect over time after purging, and the addition of a non-linear predictor did not improve model fit.

Hypothesis 3b: Comparisons of Consequence Change

Trajectories Between Purge and Non-Purge Days

Within-day multilevel models examining comparisons of growth trajectories after purging on purge days versus after average purge time on non-purge days are presented in Table A6 (and depicted in Figures B3b – B8b). For these interaction models, results indicated that purge days influenced the trajectory of linear change in all variables. Negative interaction coefficients for analyses of negative affect, shape/weight concerns, and stomach discomfort indicate larger decreases in these variables over time following purging behavior on purge days relative to average purge time on non-purge days. As can be seen in Figures B3b, B5b, B6b, B7b, and B8b these variables tended to remain stable or increase slightly on non-purge days versus decreasing over time on purge days. The positive interaction coefficient for positive affect indicated smaller decreases in positive affect following purging on purge days (see Figure B4b).

Exploratory Hypothesis 4: Moderators of Associations

Between Antecedents and Purging

Hypotheses regarding personality moderators of purging antecedents were examined with three-way interaction models. A summary of the fixed effects coefficients and associated effect sizes for each three-way interaction are presented in Table A7. There was a significant interaction between the trajectory of negative affect prior to purging, purge day, and impulsivity measured by the UPPS global score, reflecting a large effect size (Cohen, 1992). This interaction is depicted in Figure B9 for ease of interpretation. Level of impulsivity did not appear to influence the trajectory of negative affect prior to average purge time on non-purge days; however, lower levels of impulsivity were associated with greater increases in negative affect prior to purging on purge days compared to changes in negative affect on non-purge days. Follow-up analyses examined whether this moderator was driven by any specific facet of impulsivity. There was a significant time x purge day x facet interaction for lack of perseverance (coefficient (*SE*) = -.15 (.06), $t = -2.40$, $p < .05$). Interaction effects for urgency, lack of premeditation, and sensation seeking were not significant (*p*s > .14).

There was a significant interaction between the trajectory of shape/weight concerns prior to purging, purge day, and impulsivity, reflecting a large effect size. This interaction is depicted in Figure B10. Level of impulsivity did not appear to influence changes in shape/weight concerns prior to purging on purge days. Participants with higher levels of impulsivity demonstrated larger increases in shape/weight concerns prior to average purge time on non-purge days compared to participants with lower levels of impulsivity. Follow-up analyses of specific facets of impulsivity indicated that this interaction was driven by lack of premeditation (coefficient (*SE*) = -.51 (.25), $t = -2.00$, $p < .05$). Follow-up interaction effects for urgency, lack of perseverance, and sensation seeking were not significant (*p*s > .26). The influence of impulsivity on changes in nausea as an antecedent of purging was associated with a negative effect that was medium in magnitude. Effect sizes for positive affect, fullness, stomach pain, and violation of dietary rules were small.

There were no statistically significant interactions between trait anxiety measured by the STAI Trait subscale and changes in antecedents of purging on purge versus non-purge days (see Table A7). This was mirrored in analyses using the IPIP-NEO-N1 as a measure of trait anxiety. However, the influence of trait anxiety on trajectories of negative affect, fullness, nausea, and likelihood of violating a dietary rule were associated with negative interactions and moderate effect sizes. Interactions between trait anxiety and changes in positive affect, shape/weight concerns, and stomach pain on purge versus non-purge days were associated with small effect sizes.

Supplemental Analyses

Reactivity to Ecological Momentary Assessment

Exploratory analyses were conducted to investigate the presence of reactivity to study procedures. EDE scores during the intake assessment (retrospectively reported for the 28 days prior to study participation) were compared to EDE scores during the final assessment (retrospectively reported for the previous 14 days during EMA data collection and multiplied by two to be on a comparable scale as initial EDE scores). Paired *t*-tests and correlations were used to determine whether self-monitoring during EMA influenced participants' eating disorder attitudes or behavioral frequencies (see Table A8). There were significant, positive correlations between initial and final EDE assessment scores for total, restraint, weight concerns, shape concerns, all purging frequencies, and frequency of excessive exercise. In addition, there were no significant differences between initial and final EDE assessment scores for these scales. Eating concerns at the initial assessment was not significantly correlated with eating concerns at the final assessment, but the difference between mean levels was not significant. Subjective binge eating frequency was the only aspect of disordered eating that decreased significantly from initial to final assessments, suggesting the potential presence of reactivity. Taken together, results do not provide clear support for eating disorder behavioral or attitudinal reactivity to self-monitoring other than for subjective binge eating.

Concurrent Validity of Ecological Momentary
Assessment and Eating Disorder Examination

Exploratory analyses also were conducted to examine the concurrent validity of EMA (14 days momentary assessment) and EDE data from the final assessment (retrospectively reported for the same 14 day period). Correlations and paired t-tests between EDE and EMA data are presented in Table A9. There were significant, positive correlations between EDE and EMA for vomiting, laxative, and overall purging frequency, and there were no differences between type of assessment. Frequency of subjective binge episodes assessed by EDE was compared to frequency of EMA ratings of self-identified binge eating (coded as yes/no for each eating episode). EDE subjective binge eating episodes were rated as significantly more frequent than EMA binge eating frequency (*M* (SD) = 1.80 (2.38) for EDE subjective binge eating frequency and .70

(1.66) for EMA binge eating frequency). A follow-up analysis compared EDE subjective binge eating frequency to frequency of EMA ratings of loss of control (loss of control coded as > 1 on a scale of 1 = completely in control to 5 = completely out of control) and found that EMA endorsement of loss of control episodes were significantly more frequent (*M* (SD) = 21.65 (10.97)) than EDE subjective binge episodes. EMA momentary ratings of shape/weight concerns were aggregated within participants and was not significantly correlated with the EDE weight or shape concerns subscales, although the correlation between EMA shape/weight concerns and EDE shape concerns approached traditional levels of significance ($p = .063$). Overall, comparisons of momentary EMA and retrospective EDE data provide strong support for the concurrent validity of purging assessments.

CHAPTER IV

CONCLUSION

This study sought to further understand psychological factors that contribute to purging in PD, a form of Eating Disorder Not Otherwise Specified (American Psychiatric Association, 2000). PD is associated with clinically significant distress and psychosocial impairment (Keel et al., 2008) and has been recommended for inclusion as a provisional syndrome within Eating Disorders Not Elsewhere Classified in the DSM-5 (http://www.dsm5.org). Previous research on PD has provided important clues regarding potential antecedents and consequences of purging but has been restricted to cross-sectional designs that cannot establish temporal sequences and laboratory-based studies that may lack ecological validity. The current study addressed these limitations by using EMA to examine associations between affective, cognitive, and somatic factors and purging behavior at different levels of analysis.

Affective Factors

Negative affect increased prior to purging on purge days, consistent with previous EMA research that increased negative affect predicts purging in BN (Alpers & Tuschen-Caffier, 2001; Rebert et al., 1991; Schlundt et al., 1986; Smyth et al., 2007). However, this increase was not significantly different from the trajectory of negative affect on non-purge days, suggesting that increases in negative affect do not specifically trigger purging behavior. Instead, individuals with PD appear to experience a significant amount of daily affective lability regardless of the presence of purging. Although purging does not appear to be triggered by unique increases in negative affect, decreased negative affect following purging was significantly different from the trajectory of negative affect on non-purge days. This is consistent with previous retrospective (Cooper et al., 1988; Rosen & Leitenberg, 1982) and EMA (Alpers & Tuschen-Caffier, 2001; Corstorphine et al., 2006; Powell & Thelen, 1996) studies finding decreases in negative affect following purging in

BN participants. Thus, purging in PD may be maintained through negative reinforcement by reducing negative affect.

Although negative affect or emotional distress has been the focus of a great deal of research, few studies have examined the role of positive affect in disordered eating. This study suggests that positive affect plays an important role in the propensity to purge among women with PD. Compared to non-purge days, positive affect failed to increase prior to purging behavior on purge days. Thus, an absence of positive affect may trigger purging behavior compared to the protective effects of increases in positive affect. There were no significant changes in positive affect following purging on purge days, which does not support changes in positive affect in the maintenance of purging.

Taken together, findings support unique roles of negative and positive affect in triggering and maintaining purging in PD and indicate that purging may function to regulate affect. Although previous EMA research suggests that negative affect and positive affect have inverse relations with self-induced vomiting in BN (Smyth et al., 2007), results of this study suggest that negative and positive affect have different functional associations with purging in PD. The absence of positive affect increased vulnerability to purging whereas decreases in negative affect negatively reinforced the behavior.

Cognitive Factors

Concerns about body shape and weight increased prior to purging on purge days, consistent with EMA research in BN (Powell & Thelen, 1996). However, there were even greater increases in shape/weight concerns relative to average purge time on non-purge days. Given that mean levels of shape/weight concerns were significantly greater on purge days, one possibility is that a smaller increase in shape/weight concerns was necessary to trigger purging, or there may be a ceiling effect for examining changes in shape/weight concerns over time. Results suggest that purging in PD may be more related to high overall level of shape/weight concerns rather than the magnitude of change in shape/weight concerns prior to purging. Notably, there were significant decreases in shape/weight concerns following purging on purge days whereas the trajectory of shape/weight concerns remained stable or increased slightly following average purge time on non-purge days. Results regarding reductions in shape/weight concerns as a consequence of purging are consistent with clinical impressions (Mintz, 1982) and EMA research examining cognitions pre- and post-purging in BN (Powell & Thelen, 1996). Thus, purging is likely partially maintained through reductions in cognitive concerns about the effects of eating on shape or weight.

I hypothesized that violation of dietary rules would be more likely to occur on days when participants purged and that the likelihood of violating a dietary rule would increase prior to purging on purge days. Contrary to expectations, the opposite pattern was observed; violation of dietary rules was significantly *less* likely to occur on purge days and the likelihood of violating a dietary rule *decreased* leading up to a purge. In addition, current results contradicted previous EMA studies in BN that consumption of "forbidden foods" predicts purging (Gleaves et al., 1993; Schlundt et al., 1986). One possibility is that purging is associated with decreased cognitive control over eating such that individuals relax rigidly held dietary rules in anticipation of subsequent purging. Individuals cannot violate a dietary rule that they are not actively trying to follow, which would then lead to decreases in violations of dietary rules prior to purging. Supporting this assertion, participants reported increases in loss of control over eating prior to purging while reporting decreases in the likelihood of violating a dietary rule. Thus, decreased cognitive control over eating was supported as an antecedent trigger of purging behavior in PD.

Somatic Factors

Finally, symptoms of stomach discomfort were examined as potential antecedents to and consequences of purging in PD. Although there were no mean level differences in stomach discomfort on purge days compared to non-purge days, feelings of fullness and nausea increased prior to purging. This is consistent with previous research findings that PD is associated with excessive postprandial fullness and gastrointestinal distress following ingestion of a standardized test meal (Keel et al., 2007). This study extended previous research by supporting the ecological validity of laboratory-based models of stomach discomfort and purging. Further, fullness and nausea decreased following purging on purge days, consistent with an EMA study in BN (Lingswiler et al., 1989). Only decreases in stomach discomfort after purging were significantly different from the trajectories on non-purge days. Thus, results suggest that reductions in stomach discomfort following purging are negatively reinforcing and likely contribute to the maintenance of this behavior among women with PD.

Moderators

Exploratory analyses were conducted to gain a deeper understanding of the interaction between trait and state psychological factors and purging in PD. Impulsivity was a significant moderator of changes in negative affect as an antecedent of purging. Individuals with lower levels of impulsivity endorsed greater increases in negative affect prior to purging on purge days compared to non-purge days whereas the trajectory of negative affect did not differ between purge and non-purge days among individuals with higher levels of impulsivity. Thus, negative affect increased prior to purging, but this increase was only uniquely associated with the presence of purging behavior among individuals with lower levels of impulsivity. This interaction was attributable to the lack of perseverance facet of impulsivity. Lack of perseverance represents the tendency to experience difficulty focusing on and completing boring tasks without distraction from external stimuli (Whiteside & Lynum, 2001). Thus, individuals who score low on this facet, or high on perseverance, may require larger increases in negative affect to trigger purging behavior in PD.

Results also supported impulsivity as a moderator of antecedent associations between changes in shape/weight concerns and purging. Level of impulsivity did not appear to influence changes in shape/weight concerns prior to purging on purge days. However, participants with higher levels of impulsivity demonstrated larger increases in shape/weight concerns prior to average purge time on non-purge days. This interaction was driven by the lack of premeditation facet. Lack of premeditation represents impulsive behavior without thinking about potential negative consequences of the behavior (Whiteside & Lynum, 2001). Given that increases in shape/weight concerns over time were not specifically linked to purging behavior, individuals who do not think about the potential consequences of their behavior may be less likely to engage in purging in order to regulate high levels of weight/shape concerns.

Trait-based anxiety did not influence trajectories of change in posited antecedents in exploratory analyses. Importantly, moderator analyses were only adequately powered to detect very large effect sizes. The influence of trait anxiety on trajectories of negative affect, fullness, nausea, and likelihood of violating a dietary rule were associated with negative interactions and medium effect sizes. As medium effects may still be clinically significant, anxiety as a potential moderator should be investigated in a larger sample.

Reactivity and Concurrent Validity

While researchers have long recognized the potential for reactivity as a challenge in self-monitoring (Stone & Shiffman, 1994), few studies have systematically explored reactivity to EMA procedures. As described in Chapter I, the only study of reactivity to EMA of disordered eating found no differences in behavioral frequencies comparing the first and last halves of EMA data collection or comparing the first, second, and last thirds of the assessment period (Stein & Corte, 2003). This research may indicate that there is no evidence of behavioral reactivity to self-monitoring of disordered eating behaviors, similar to other areas of EMA research (Shiffman et al., 2008). However, because the length of time during which reactivity might be observed is unknown, results may indicate that reactivity was present throughout the entire assessment period. The current study significantly extended previous research on reactivity in two important ways. First, participants completed pre- and post-monitoring clinical interviews in order to compare eating pathology reported for the four weeks prior to self-monitoring to eating pathology reported during the two week self-monitoring period. Second, reactivity may be both behavioral, influencing the frequency of purging, and psychological, affecting scores on measures of related pathology (e.g., shape/weight concerns, dietary restraint). The current study empirically investigated the influence of self-monitoring during EMA on *both* eating disorder attitudes and eating disorder behaviors.

Results indicated that EMA procedures did not produce significant changes in global eating pathology, including purging frequency, dietary restraint, shape and weight concerns, and eating concerns. Although sample size was small and lack of significant changes may be due to low statistical power, examination of the direction of differences between pre- and post-EMA interviews indicated no clear pattern. Some scales were higher during EMA (restraint, weight concerns, laxative frequency) compared to before data collection, while other scales were lower during EMA (total, eating concerns, shape concerns, vomiting frequency, and excessive exercise frequency). Notably, correlations between pre- and post-monitoring EDE assessments were comparable to previous studies of the test-retest reliability of EDE over a similar time frame (Berg, Peterson, Frazier, & Crow, 2012). In addition, strong correlations between purging reported during EMA and reported during the final assessment EDE suggest that retrospective reports of purging frequency were not only consistent with purging frequency prior to self-monitoring but also accurate. Overall, results are consistent with other maladaptive behaviors (e.g., problem drinking; Hufford, Shields, Shiffman, Paty, & Balabanis, 2002), failing to provide strong support for the presence of eating disorder behavioral or attitudinal reactivity to self-monitoring.

Subjective binge eating frequency was the only behavior that decreased significantly from initial to final assessments, suggesting potential reactivity to self-monitoring during EMA. Researchers have suggested that self-monitoring in cognitive-behavioral treatment (CBT) of BN is fundamental to producing early symptom changes (Wilson & Vitousek, 1999). In addition, Fairburn's model of cognitive-behavioral theory proposes that compensatory purging declines when individuals regain control over eating (Fairburn, 2008). However, current findings indicate that this may not be true for individuals with PD given that declines in subjective binge eating during self-monitoring were not associated with concurrent declines in purging frequency. Thus, CBT that focuses solely on reducing loss of control eating (objective or subjective binge eating) may be inadequate in the treatment of PD. Additional therapeutic interventions incorporating research on other psychological antecedents and consequences of purging are necessary to eliminate purging in PD.

Clinical Implications

These data are crucial to understand why women with PD purge after consuming normal or small amounts of food. Findings could have important implications for the development of effective interventions for PD, a syndrome for which no evidence-based treatments currently exist. Current results suggest that increases in positive affect may be protective against the use of purging behavior. Thus, individuals who purge may benefit from treatments incorporating behavioral activation techniques in order to gain greater access to experiences that are likely to augment positive affect (Dimidjian, Barrera, Martell, Muñoz, & Lewinsohn, 2011). In addition, given that purging may function to regulate affect through decreases in negative affect following purging, psychological treatment of PD should focus on developing more adaptive affect regulation strategies to cope with intense emotions. Despite decreases in negative affect immediately following purging, there was a significant non-linear trend suggesting that reductions of negative affect are time-limited as affect begins to worsen again over time. This information could be incorporated into psychoeducational components of treatment about the short- versus long-term effects of purging as an affect regulatory mechanism. Finally, women with PD also may benefit from treatments aimed at improving distress tolerance and impulse-control skills, such as techniques used in Dialectical Behavior Therapy (Linehan, Cochran, & Kehrer, 2001).

Support for the role of shape/weight concerns in maintaining purging suggests that treatment should focus on minimizing the importance of shape and weight and enhancing the importance of other factors in determining self-worth in order to decrease cognitive concerns that reinforce purging. Finally, purging is likely maintained through negatively reinforcing reductions in stomach discomfort. Thus, potential pharmacological treatments that alleviate excessive feelings of fullness and nausea associated with eating in PD may be helpful given current results supporting the relevance of stomach discomfort in maintaining purging in PD.

Strengths and Limitations

The current study had several notable strengths. First, this study represented the first application of EMA to PD and provided much needed information regarding psychological factors that trigger and maintain purging in this syndrome. In addition, this study assessed both negative and positive affect. The influence of positive affect on purging or other disordered eating behaviors has not been a focus of much previous research. Findings from the current study expanded our understanding of the affective mechanisms underlying purging in PD by pointing to a potential role for positive affect in triggering purging behavior. Finally, this study applied a unique analytical approach that distinguished within-day from between-day predictors of purging behavior. Previous EMA studies of binge eating have examined temporal associations only within purge days. However, these analyses do not control for changes in posited antecedents and consequences that may be unrelated to the purging behavior, such as work/school schedule or time of day effects. Thus, comparisons of trajectories of change on purge versus non-purge days provided a more rigorous test of study hypotheses.

Several limitations also must be noted. While EMA is ideally suited to assess events that precede and follow a behavior within an individual’s natural environment, a key concern for any study utilizing EMA is inability to draw causal inferences from a longitudinal design. For example, findings that negative affect, shape/weight concerns, and stomach discomfort increased prior to purging do not indicate that changes in these variables *caused* an individual to purge as this is essentially a correlational design over time. Another important limitation was the small sample size, which limited the ability to adequately examine potential moderators. However, this research established an estimate of effect size for moderators which will be important to designing larger studies. Further, previous EMA studies of disordered eating published in peer-reviewed journals had an average sample size of N = 29 participants (Haedt-Matt & Keel, 2011a), making the current study comparable in size to other published studies in the field. Moreover, the current sample size of N = 24 was sufficient for detecting significant associations between psychological factors and purging behavior.

Future Research

This study highlights the utility of EMA in examining complex temporal relationships among antecedents and consequences of purging in PD. Future research is needed to further examine these and other mechanisms underlying purging behavior after consuming normal or small amounts of food. It will be important for future studies to include larger samples in order to adequately test moderating effects of personality and gain a deeper understanding of the interaction between trait and state psychological factors in the maintenance of purging in PD. In addition, specific targets for intervention discussed above should be tested in future randomized controlled trials in order to determine their efficacy in treating PD. Studies are needed to continue empirically investigating reactivity to self-monitoring in EMA. Although there was a high degree of correspondence between initial and final assessments of disordered eating attitudes and behaviors, reactivity may still be a concern for other psychological factors such as affect. Finally, additional research is needed to elucidate associations between cognitive control over eating and purging behavior.

Summary

There were mean level differences in affective and cognitive factors on purge versus non-purge days. In addition, this study provided robust evidence that dynamic changes in affect, cognition, and somatic distress at the momentary level are related to purging behavior in PD. Results supported the absence of increases in positive affect as an antecedent trigger of purging behavior in PD. Decreases in negative affect, shape/weight concerns, and stomach discomfort may negatively reinforce and maintain the use of purging as a regulatory behavior. Future EMA research has the unique potential to further improve our understanding of the complex mechanisms maintaining purging in PD and to contribute to the development of effective treatments for this syndrome. The integration of EMA methodology into treatment designs represents a particularly innovative path forward (Wonderlich, Mitchell, Peterson, & Crow, 2001).

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APPENDIX A

TABLES

Table A1. Site Differences: Demographic Characteristics, Eating Pathology, and Related Psychopathology

	Iowa (*n* = 16)		**Florida (*n* = 8)**				
Variable (Measure)	**M**	**SD**	**M**	**SD**	**t**	**df**	***p***
Age	23.56	6.39	22.13	2.85	.602	22	.553
Body mass index	22.09	3.14	21.79	2.23	.237	22	.815
Eating pathology (EDE total)	3.63	0.73	3.52	.89	.317	22	.754
Body dissatisfaction (BSQ)	125.69	22.83	149.25	25.73	-2.287	22	.032
Purging frequency (weekly)	4.13	2.20	6.43	3.01	-2.134	22	.044
Subjective binge frequency (weekly)	1.82	2.23	3.61	5.27	-1.181	22	.250
Clinical impairment (CIA)	16.44	6.24	22.88	6.06	-2.404	22	.025
Anxiety (IPIP)[a]	32.09	5.02	34.50	5.42	-.998	17	.332
Anxiety (STAI trait subscale)[a]	46.09	6.93	51.00	10.72	-1.215	17	.241
Impulsivity (UPPS global)	2.04	0.37	2.39	0.39	-2.124	22	.045
	n	**%**	***n***	**%**	**χ^2**	**df**	***p***
Race					1.71	1	.190
Caucasian	13	81.2	8	100			
Non-Caucasian	3	18.8	0	0			
Marital status					2.40	1	.121
Married	4	25	0	0			
Never married or divorced	12	75	8	100			
Education level					0.15	1	.699
HS degree or some college	13	81.2	7	87.5			
College degree or some graduate	3	8.8	1	12.5			
Current psych treatment					0.12	1	.729
Yes	5	45.5	3	37.5			
No	6	54.5	5	62.5			
Lifetime psych treatment					0.38	1	.540
Yes	10	62.5	6	75			
No	6	37.5	2	25			
Current mood disorder					0.15	1	.699
Yes	3	18.8	1	12.5			
No	13	81.2	7	87.5			
Lifetime mood disorder					0.38	1	.540
Yes	10	62.5	6	75			
No	6	37.5	2	25			
Current anxiety disorder					0.28	1	.599
Yes	3	18.8	2	28.6			
No	13	81.2	5	71.4			
Lifetime anxiety disorder					2.14	1	.143
Yes	5	31.2	5	62.5			
No	11	68.8	3	37.5			
Current substance use disorder					---	---	---
Yes	0	0	0	0			
No	16	100	8	100			
Lifetime substance use disorder					2.14	1	.143
Yes	5	31.2	5	62.5			
No	11	68.8	3	37.5			
Current impulse control disorder					2.09	1	.149
Yes	0	0	1	12.5			
No	16	100	7	87.5			

Table A1. Continued

Variable (Measure)	***n***	**%**	***n***	**%**	**χ^2**	**df**	***p***
Lifetime impulse control disorder					0.27	1	.602
Yes	1	6.2	1	12.5			
No	15	93.8	7	87.5			

[a]df = 17 because 5 pilot participants did not complete these measures.

Table A2. Between-Days Multilevel Model Analyses

	Affect				Shape/Weight		Violation of		Stomach Discomfort					
	Negative Affect[a]		Positive Affect[a]		Concerns		Dietary Rules		Fullness[a]		Stomach Pain[a]		Nausea[a]	
Fixed Effects	**Estimate (SE)**	**t**	**Estimate (SE)**	**t**	**Estimate (SE)**	**t**	**Estimate (SE)**	**t**	**Estimate (SE)**	**t**	**Estimate (SE)**	**t**	**Estimate (SE)**	**t**
Intercept	11.78 (.30)	39.68***	12.7 (.36)	35.76***	39.11 (2.76)	14.19***	0.64 (.47)	1.37	4.37 (.45)	9.69***	1.67 (.37)	4.42***	1.53 (.44)	3.46**
Site	-0.70 (.36)	-1.93	.19 (.47)	.40	-4.01 (3.37)	-1.19	.45 (.56)	.80	-1.71 (.55)	-3.12**	-.30 (.45)	-.67	-.54 (.54)	-1.01
Purge Day	.25 (.06)	4.15***	-.19 (.08)	-2.48*	1.44 (.28)	5.17***	-1.67 (.23)	-7.12***	.09 (.12)	.71	-.04 (.10)	-.45	.17 (.10)	1.77
Covariance Parameters	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**
Within-person variance	.61 (.07)	8.57***	.56 (.06)	10.06***	12.16 (1.38)	8.82***	.92 (.07)	12.91***	1.45 (.12)	12.14***	1.31 (.13)	9.75***	.94 (.08)	12.19***
Autocorrelation	.56 (.05)	10.83***	.34 (.06)	5.30***	.52 (.06)	9.45***	.16 (.06)	2.87**	.25 (.06)	4.11***	.48 (.05)	9.08***	.27 (.06)	4.73***
Between-person intercept	.59 (.21)	2.87**	.94 (.33)	2.85**	58.67 (17.59)	3.34**	1.28 (.58)	2.22*	1.46 (.46)	3.16**	.89 (.31)	2.85**	1.45 (.45)	3.26**

[a]The dependent variables in analyses of affect and stomach discomfort are the log-transformed values (to correct for positive skew) x 10 (to avoid boundary constraints).

**p* < .05, ***p* < .01, ****p* < .001

Table A3. Within-Days Multilevel Model Analyses: Antecedents of Purging on Purge Days

	Linear Growth Model			Non-linear Growth Model		
NEGATIVE AFFECT[a]						
Fixed Effects	**Estimate**	**SE**	**t (21)**	**Estimate**	**SE**	**t (20)**
Intercept	11.98	.30	40.03***	12.08	.31	39.39***
Site	-.80	.35	-2.24*	-.79	.36	-2.22*
Hours prior to purging	.03	.01	2.68*	.08	.03	2.69*
(Hours prior to purging)^2				<.01	<.01	1.88
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	.94	.07	12.80***	.94	.08	12.79***
Autocorrelation	.59	.04	15.73***	.59	.04	15.75***
Between-person intercept	.53	.19	2.79**	.54	.09	2.79**
Model Fit Indices						
AIC	1666.76			1665.25		
BIC	1693.66			1696.64		
-2 Log Likelihood	1654.76			1651.25		
Likelihood Ratio[b]	$\chi 2(2)=2195.98$***			$\chi 2(1)=3.51$		
POSITIVE AFFECT[a]						
Fixed Effects	**Estimate**	**SE**	**t (16)**	**Estimate**	**SE**	**t (15)**
Intercept	12.44	.32	38.69***	12.01	.33	36.14***
Site	.56	.40	1.40	.56	.40	1.40
Hours prior to purging	.01	.01	1.01	-.20	.04	-4.50***
(Hours prior to purging)^2				-.02	<.01	-5.09***
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	1.39	.10	13.67***	1.32	.10	13.68***
Autocorrelation	.41	.05	8.28***	.41	.05	8.27***
Between-person intercept	.58	.22	2.66**	.59	.22	2.67**
Model Fit Indices						
AIC	1696.53			1673.25		
BIC	1722.32			1703.35		
-2 Log Likelihood	1684.53			1659.25		
Likelihood Ratio[b]	$\chi 2(2)=2047.05$***			$\chi 2(1)=25.28$***		

Table A3. Continued

	Linear Growth Model			Non-linear Growth Model		
SHAPE/WEIGHT CONCERNS						
Fixed Effects	**Estimate**	**SE**	**t (21)**	**Estimate**	**SE**	**t (20)**
Intercept	41.64	2.92	14.26***	42.06	2.92	14.38***
Site	-4.53	3.54	-1.28	-4.51	3.54	-1.28
Hours prior to purging	.26	.05	5.77***	.48	.14	3.49**
(Hours prior to purging)^2				.02	.01	1.67
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	16.85	1.17	14.40***	16.71	1.16	14.46***
Autocorrelation	.46	.04	10.57***	.46	.04	10.44***
Between-person intercept	64.23	19.15	3.35**	64.01	19.08	3.36**
Model Fit Indices						
AIC	3694.66			3693.88		
BIC	3721.56			3725.26		
-2 Log Likelihood	3682.66			3679.88		
Likelihood Ratio[b]	$\chi 2(2)$=4325.68***			$\chi 2(1)$=2.78		
VIOLATION OF DIETARY RULES						
Fixed Effects	**Estimate**	**SE**	**t (21)**	**Estimate**	**SE**	**t (20)**
Intercept	1.44	.44	3.27**	1.56	.49	3.21**
Site	-.10	.48	-.21	-.10	.48	-.21
Hours prior to purging	-.20	.04	-5.16***	-.13	.13	-1.04
(Hours prior to purging)^2				.01	.01	.57
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	.82	.05	17.78***	.81	.05	17.76***
Autocorrelation	<-.01	.04	-.04	<-.01	.04	-.02
Between-person intercept	.59	.31	1.90	.59	.31	1.90
Model Fit Indices						
AIC	3530.30			3546.04		
BIC	3543.70			3559.43		
-2 Log Likelihood	3524.26			3540.00		
Likelihood Ratio[b]	$\chi 2(2)$=3575.81***			$\chi 2(1)$=.00		

Table A3. Continued

	Linear Growth Model			Non-linear Growth Model		
FULLNESS[a]						
Fixed Effects	**Estimate**	**SE**	**t (21)**	**Estimate**	**SE**	**t (20)**
Intercept	4.26	.56	7.63***	4.22	.58	7.29***
Site	-1.71	.65	-2.62*	-1.71	.65	-2.61*
Hours prior to purging	.11	.02	5.00***	.09	.07	1.27
(Hours prior to purging)^2				<-.01	.01	-.24
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	4.16	.24	17.63***	4.16	.24	17.63***
Autocorrelation	.07	.05	1.41	.07	.05	1.40
Between-person intercept	1.89	.61	3.09**	1.90	.61	3.09**
Model Fit Indices						
AIC	2854.23			2856.18		
BIC	2881.13			2887.56		
-2 Log Likelihood	2842.23			2842.18		
Likelihood Ratio[b]	$\chi 2(2)$=3402.34***			$\chi 2(1)$=.05		
STOMACH PAIN[a]						
Fixed Effects	**Estimate**	**SE**	**t (21)**	**Estimate**	**SE**	**t (20)**
Intercept	1.18	.40	2.94**	1.18	.41	2.86**
Site	-.15	.47	-.33	-.15	.47	-.33
Hours prior to purging	<.01	.02	.17	<.01	.05	.05
(Hours prior to purging)^2				<-.01	<.01	-.01
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	2.23	.15	14.73***	2.23	.15	14.73***
Autocorrelation	.44	.04	9.95***	.44	.04	9.95***
Between-person intercept	.90	.31	2.88**	.90	.31	2.88**
Model Fit Indices						
AIC	2335.24			2337.24		
BIC	2362.14			2368.62		
-2 Log Likelihood	2323.24			2323.24		
Likelihood Ratio[b]	$\chi 2(2)$=2898.23***			$\chi 2(1)$=.00		

Table A3. Continued

	Linear Growth Model			Non-linear Growth Model		
NAUSEA[a]						
Fixed Effects	**Estimate**	**SE**	**t (21)**	**Estimate**	**SE**	**t (20)**
Intercept	1.40	.42	3.33**	1.54	.43	3.57**
Site	-.50	.50	-.99	-.49	.50	-.98
Hours prior to purging	.04	.01	2.37*	.10	.05	2.13*
$(\text{Hours prior to purging})^2$				<.01	<.01	1.46
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	1.83	.11	16.68***	1.82	.11	16.72***
Autocorrelation	.25	.05	5.23***	.24	.05	5.11***
Between-person intercept	1.11	.36	3.09**	1.11	.36	3.10**
Model Fit Indices						
AIC	2291.79			2291.66		
BIC	2318.69			2323.05		
-2 Log Likelihood	2279.79			2277.66		
Likelihood Ratio[b]	$\chi 2(2)$=2955.01***			$\chi 2(1)$=2.13		

[a]The dependent variables in analyses of affect and stomach discomfort are the log-transformed values (to correct for positive skew) x 10 (to avoid boundary constraints).

[b]Likelihood ratio tests for the linear growth model reflect improvement in model fit over the unconditional means model; likelihood ratio rests for the non-linear model reflect improvement in model fit over the linear growth model.

**p* < .05, ***p* < .01, ****p* < .001

Table A4. Within-Day Multilevel Model Analyses: Comparisons of Antecedent Growth Trajectories on Purge versus Non-Purge Days

	Affect				**Shape/Weight Concerns**		**Violation of Dietary Rules**		**Stomach Discomfort**					
	Negative Affect[a]		**Positive Affect**[a]						**Fullness**[a]		**Stomach Pain**[a]		**Nausea**[a]	
Fixed Effects	**Estimate (SE)**	**t (19)**	**Estimate (SE)**	**t (14)**	**Estimate (SE)**	**t (19)**	**Estimate (SE)**	**t (19)**	**Estimate (SE)**	**t (19)**	**Estimate (SE)**	**t (19)**	**Estimate (SE)**	**t (19)**
Intercept	11.72	40.15***	13.26	33.94***	39.87	13.42***	2.53	5.03***	3.89	7.26***	1.37	3.57**	1.33	3.14**
	(.29)		(.39)		(2.97)		(.50)		(.54)		(.38)		(.42)	
Site	-0.63	-1.82	.29	.59	-3.21	-.89	.22	.47	-1.80	-2.87**	-.20	-.45	-.43	-.86
	(.35)		(.49)		(3.61)		(.47)		(.63)		(.44)		(.50)	
Hours prior to purging	.01	1.04	.14	6.32***	.45	6.47***	-.13	-1.85†	.07	2.04	.01	.52	.01	.62
	(.01)		(.02)		(.07)		(.07)		(.03)		(.02)		(.02)	
Purge Day	.12	1.08	-.56	-3.22**	.29	.49	-1.33	-3.21**	.42	1.74	-.15	-.78	.02	.10
	(.12)		(.17)		(.59)		(.41)		(.24)		(.20)		(.17)	
Purge Day * Hours prior to purging	.01	.71	-.13	-4.73***	-.22	-2.50*	-.07	-.83	.03	.87	-.01	-.27	.02	.89
	(.02)		(.03)		(.09)		(.08)		(.04)		(.03)		(.03)	
Covariance Parameters	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**
Within-person variance	.88	18.45***	1.44	19.52***	21.47	20.73***	.79	24.09***	4.26	23.99***	2.45	20.70***	1.84	23.14***
	(.05)		(.07)		(1.04)		(.03)		(.18)		(.12)		(.08)	
Autocorrelation	.55	18.61***	.32	8.01***	.42	12.90***	.02	.54	.07	2.10*	.43	13.33***	.22	6.09***
	(.03)		(.04)		(.03)		(.03)		(.04)		(.03)		(.04)	
Between-person intercept	.59	3.19**	1.06	2.84**	68.48	3.42**	.79	2.14*	1.95	3.25**	.94	3.09**	1.28	3.31**
	(.18)		(.37)		(20.06)		(.37)		(.60)		(.30)		(.39)	

[a]The dependent variables in analyses of affect and stomach discomfort are the log-transformed values (to correct for positive skew) x 10 (to avoid boundary constraints).

*p < .05, **p < .01, ***p < .001

Table A5. Within-Days Multilevel Model Analyses: Consequences of Purging on Purge Days

	Linear Growth Model			Non-linear Growth Model		
NEGATIVE AFFECT[a]						
Fixed Effects	**Estimate**	**SE**	**t (21)**	**Estimate**	**SE**	**t (20)**
Intercept	12.43	.36	34.40***	12.59	.37	34.20***
Site	-.84	.44	-1.93	-.83	.44	-1.86
Hours after purging	-.06	.01	-4.62***	-.23	.03	-7.33***
(Hours after purging)^2				.02	<.01	5.87***
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	1.03	.07	13.76***	.1.02	.08	13.24***
Autocorrelation	.52	.04	13.00***	.56	.04	14.38***
Between-person intercept	.90	.29	3.09**	.93	.30	3.09**
Model Fit Indices						
AIC	1692.47			1662.02		
BIC	1718.97			1692.94		
-2 Log Likelihood	1680.47			1648.02		
Likelihood Ratio[b]	$\chi2(2)$=2170.27***			$\chi2(1)$=32.45***		
POSITIVE AFFECT[a]						
Fixed Effects	**Estimate**	**SE**	**t (16)**	**Estimate**	**SE**	**t (15)**
Intercept	11.90	.30	40.39***	11.83	.30	39.76***
Site	.42	.37	1.11	.40	.37	1.07
Hours after purging	-.03	.02	-1.45	.04	.04	1.00
(Hours after purging)^2				-.01	<.01	-1.82
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	1.46	.11	12.85***	1.46	.11	12.79***
Autocorrelation	.50	.04	11.54***	.51	.04	11.60***
Between-person intercept	.51	.21	2.39*	.51	.21	2.40*
Model Fit Indices						
AIC	1590.99			1589.69		
BIC	1616.42			1619.36		
-2 Log Likelihood	1578.99			1575.69		

Table A5. Continued

	Linear Growth Model			Non-linear Growth Model		
SHAPE/WEIGHT CONCERNS						
Fixed Effects	**Estimate**	**SE**	**t (21)**	**Estimate**	**SE**	**t (20)**
Intercept	42.31	2.52	16.79***	42.51	2.53	16.82***
Site	-4.05	3.07	-1.32	-4.02	3.07	-1.31
Hours after purging	-.28	.06	-4.63***	-.48	.14	-3.47**
(Hours after purging)^2				.02	.01	1.63
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	19.54	1.46	13.37***	19.53	1.47	13.32***
Autocorrelation	.54	.04	12.83***	.54	.04	12.95***
Between-person intercept	47.89	14.45	3.31**	48.00	14.48	3.31**
Model Fit Indices						
AIC	3509.00			3508.36		
BIC	3535.50			3539.28		
-2 Log Likelihood	3497.00			3494.36		
Likelihood Ratio[b]	χ2(2)=2773.54***			χ2(1)=3.3		
FULLNESS[a]						
Fixed Effects	**Estimate**	**SE**	**t (21)**	**Estimate**	**SE**	**t (20)**
Intercept	4.40	.55	8.02***	4.53	.55	8.21***
Site	-1.43	.66	-2.18*	-1.41	.66	-2.16*
Hours after purging	-.09	.03	-3.04**	-.23	.07	-3.08**
(Hours after purging)^2				.01	.01	2.03*
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	4.54	.29	15.80***	4.52	.29	15.75***
Autocorrelation	.32	.05	6.92***	.32	.05	7.05***
Between-person intercept	1.91	.64	2.98**	1.90	.64	2.97**
Model Fit Indices						
AIC	2678.88			2676.77		
BIC	2705.38			2707.69		
-2 Log Likelihood	2666.88			2662.77		
Likelihood Ratio[b]	χ2(2)=3577.69***			χ2(1)=4.11*		

Table A5. Continued

	Linear Growth Model			Non-linear Growth Model		
STOMACH PAIN[a]						
Fixed Effects	**Estimate**	**SE**	**t (21)**	**Estimate**	**SE**	**t (20)**
Intercept	1.77	.39	4.47***	1.84	.40	4.65***
Site	-.43	.47	-.91	-.42	.47	-.89
Hours after purging	-.04	.02	-1.84	-.12	.06	-2.09*
(Hours after purging)^2				.01	<.01	1.47
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	2.84	.19	15.26***	2.83	.19	15.27***
Autocorrelation	.38	.05	8.24***	.37	.05	8.19***
Between-person intercept	.93	.33	2.86**	.92	.32	2.86**
Model Fit Indices						
AIC	2367.20			2367.05		
BIC	2393.70			2397.96		
-2 Log Likelihood	2355.20			2353.05		
Likelihood Ratio[b]	$\chi 2(2)=2866.27$			$\chi 2(1)=2.15$		
NAUSEA[a]						
Fixed Effects						
Intercept	1.97	.47	4.17***	2.12	.48	4.45***
Site	-.62	.57	-1.09	-.60	.57	-1.06
Hours after purging	-.07	.02	-3.06**	-.22	.06	-3.97***
(Hours after purging)^2				.01	<.01	2.99**
Covariance Parameters	**Estimate**	**SE**	**Wald Z**	**Estimate**	**SE**	**Wald Z**
Within-person variance	2.70	.17	15.64***	2.65	.17	15.64***
Autocorrelation	.33	.05	7.14***	.33	.05	7.07***
Between-person intercept	1.48	.48	3.06**	1.49	.49	3.07**
Model Fit Indices						
AIC	2360.44			2353.55		
BIC	2386.94			2384.47		
-2 Log Likelihood	2348.44			2339.55		
Likelihood Ratio[b]	$\chi 2(2)=2886.36$***			$\chi 2(1)=8.89$**		

[a]The dependent variables in analyses of affect and stomach discomfort are the log-transformed values (to correct for positive skew) x 10 (to avoid boundary constraints).

Table A5. Continued

[b]Likelihood ratio tests for the linear growth model reflect improvement in model fit over the unconditional means model; likelihood ratio rests for the non-linear model reflect improvement in model fit over the linear growth model.

*p < .05, **p < .01, ***p < .001

Table A6. Within-Day Multilevel Model Analyses: Comparisons of Consequence Growth Trajectories on Purge versus Non-Purge Days

	Affect				**Shape/Weight**		**Stomach Discomfort**					
	Negative Affect[a]		**Positive Affect[a]**		**Concerns**		**Fullness[a]**		**Stomach Pain[a]**		**Nausea[a]**	
Fixed Effects	**Estimate (SE)**	**t (19)**	**Estimate (SE)**	**t (14)**	**Estimate (SE)**	**t (19)**	**Estimate (SE)**	**t (19)**	**Estimate (SE)**	**t (19)**	**Estimate (SE)**	**t (19)**
Intercept	11.62 (.34)	34.85***	13.24 (.34)	39.12***	39.37 (2.69)	14.66***	4.29 (.53)	8.07***	1.24 (.37)	3.31**	1.29 (.47)	2.75*
Site	-.62 (.39)	-1.57	-.12 (.42)	-.30	-4.01 (3.37)	-1.27	-1.57 (.60)	-2.59*	-.33 (.42)	-.79	-.38 (.55)	-.69
Hours after purging	.02 (.02)	1.39	-.15 (.02)	-6.26***	.10 (.08)	1.28	.05 (.04)	1.20	.04 (.03)	1.32	.01 (.03)	.41
Purge Day	.68 (.12)	5.70***	-.98 (.16)	-6.02***	2.77 (.54)	5.13***	.27 (.25)	1.05	.48 (.20)	2.43*	.52 (.18)	2.84**
Purge Day * Hours after purging	-.09 (.02)	-4.07***	.12 (.03)	4.06***	-.35 (.10)	-3.51***	-.13 (.05)	-2.62**	-.08 (.04)	-2.11*	-.07 (.04)	-2.16*
Covariance Parameters	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**	**Estimate (SE)**	**Wald Z**
Within-person variance	1.01 (.05)	18.86***	1.48 (.08)	17.62***	20.59 (1.06)	19.50***	4.81 (.22)	22.27***	2.84 (.13)	21.14***	2.45 (.11)	21.51***
Autocorrelation	.52 (.03)	18.06***	.47 (.03)	13.88***	.48 (.03)	15.49***	.22 (.04)	5.93***	.35 (.03)	10.17***	.31 (.03)	9.12***
Between-person intercept	.78 (.24)	3.26**	.73 (.26)	2.77**	55.53 (16.34)	3.40**	1.79 (.56)	3.21**	.83 (.27)	3.10**	1.50 (.46)	3.28**

[a]The dependent variables in analyses of affect and stomach discomfort are the log-transformed values (to correct for positive skew) x 10 (to avoid boundary constraints).

**p* < .05, ***p* < .01, ****p* < .001

Table A7. Summary of Fixed Effects for Interaction Terms Examining Moderators of Antecedent Growth Trajectories on Purge Versus Non-Purge Days

	Impulsivity Purge Day x Hours prior to purging x Impulsivity Interaction			**Trait Anxiety** Purge Day x Hours prior to purging x Trait anxiety Interaction		
Antecedent	**Coefficient (SE)**	**t (15)**	**Effect Size (r)**	**Coefficient (SE)**	**t (10)**	**Effect Size (r)**
Negative affect[a]	-.12 (.05)	-2.34*	.52	<-.01 (<.01)	-1.33	.39
Positive affect[a]	.07 (.07)	1.10	.27	<.01 (< .01)	.30	.09
Shape/weight concerns	-.59 (.27)	-2.23*	.50	<.01 (.01)	.36	.11
Violation of dietary rules	-.15 (.45)	-.75	.19	-.01 (.20)	-1.27	.37
Fullness[a]	.10 (.11)	.91	.23	-.01 (.01)	-1.40	.40
Stomach pain[a]	.08 (.08)	.95	.24	<.01 (<.01)	.28	.09
Nausea[a]	-.12 (.07)	-1.62	.39	<-.01 (<.01)	-1.25	.37

Note. Impulsivity was assessed using the UPPS global score; trait anxiety was assessed using the Trait subscale of the STAI.

[a]The dependent variables in analyses of affect and stomach discomfort are the log-transformed values (to correct for positive skew) x 10 (to avoid boundary constraints).

**p* < .05

Table A8. Comparisons of Initial and Final Eating Disorder Examination Scores (*N* = 22)

Eating Disorder Examination Scale	**Initial Assessment Mean (SD)**	**Final Assessment Mean (SD)**	**Paired t df = 21**	**r**
Total	3.57 (.72)	3.46 (.64)	.79	.61**
Restraint	4.02 (1.21)	4.09 (1.25)	-.40	.76***
Eating concerns	1.65 (.92)	1.30 (1.11)	1.40	.37
Weight concerns	3.96 (.91)	4.21 (.67)	-1.54	.58**
Shape concerns	3.93 (.79)	3.70 (.76)	1.65	.63**
Subjective binge frequency (weekly)	1.92 (2.16)	.89 (1.15)	2.32*	.32
Purge frequency (weekly)	4.91 (2.76)	4.20 (2.31)	1.32	.52*
Vomiting frequency (weekly)	3.99 (3.10)	3.09 (2.38)	1.96	.72***
Laxative frequency (weekly)	.89 (1.70)	1.11 (2.08)	-.80	.79***
Diuretic frequency (weekly)	.03 (.14)	.00 (.00)	1.00	---
Excessive exercise frequency (weekly)	1.45 (2.29)	1.16 (2.15)	.75	.67**

Note. *N* = 22 because two participants did not complete the final assessment interview.

**p* < .05, ***p* < .01, ****p* < .001

Table A9. Correspondence Between Eating Disorder Examination and Ecological Momentary Assessment (*N* = 20)

EDE Variable	**EMA Variable**	**r**	**paired t (df = 19)**
Purge episodes	Purge episodes	.82***	-.83
Vomiting episodes	Vomiting episodes	.86***	-.70
Laxative episodes	Laxative episodes	.97***	-.57
Diuretic episodes	Diuretic episodes	---	-1.29
Subjective binge episodes	Self-identified binge episodes	.64**	2.69*
Subjective binge episodes	Loss of control episodes	.35	-8.55***
Weight concerns subscale	Shape/Weight concerns	.21	[a]
Shape concerns subscale	Shape/Weight concerns	.42	[a]

Note. *N* = 20 because 2 participants did not complete the final assessment and 2 participants did not complete the final assessment covering the same time period as EMA due to palm pilot malfunction. EDE = Eating Disorder Examination; EMA = Ecological Momentary Assessment.

[a]Paired t-tests were not conducted because EDE and EMA variables were on different scales.

APPENDIX B

FIGURES

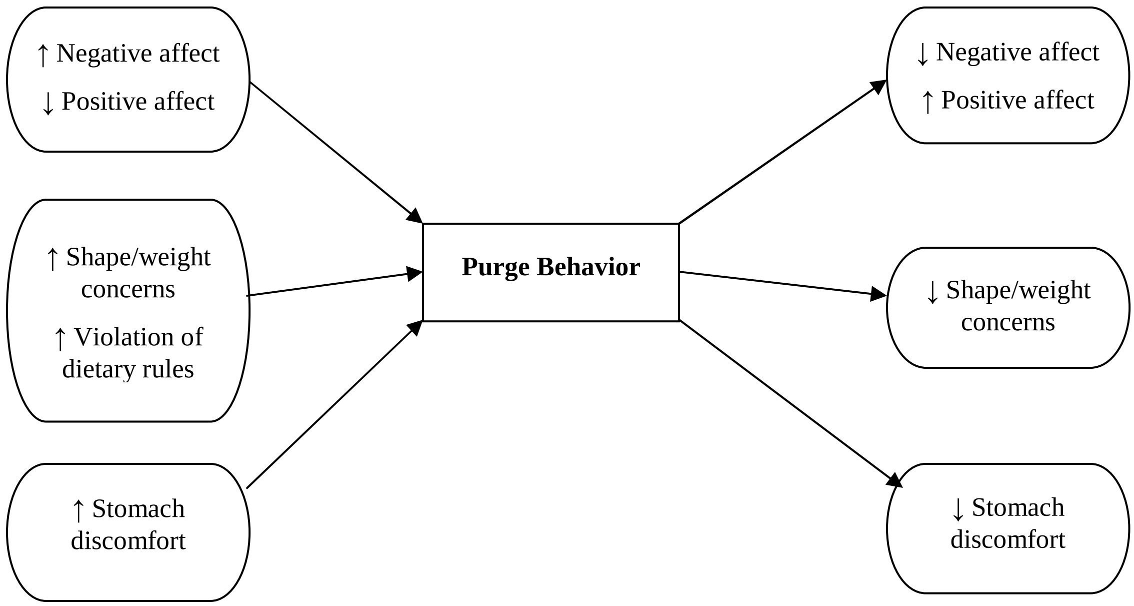


Figure B1. Hypothesized Associations among Antecedents and Consequences of Purging

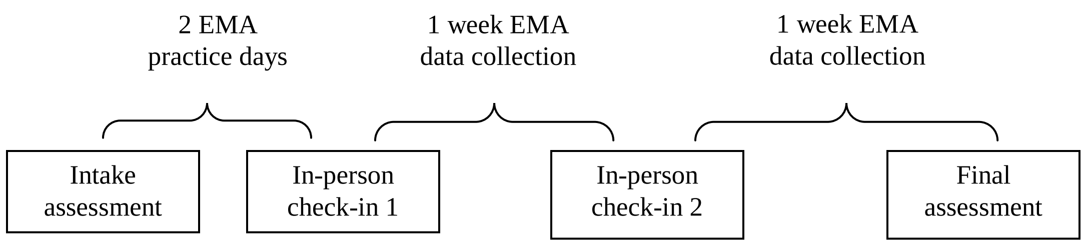


Figure B2. Schedule of In-Person and Ecological Momentary Assessments

B3a. B3b.

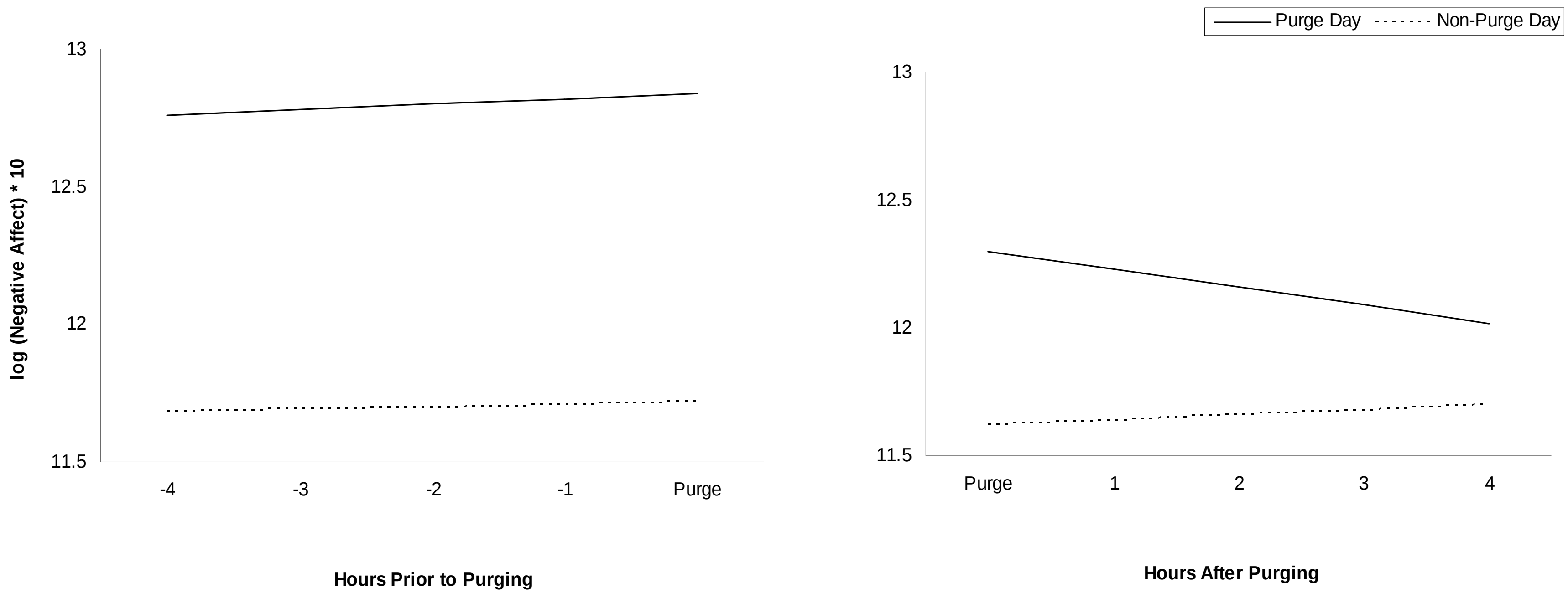
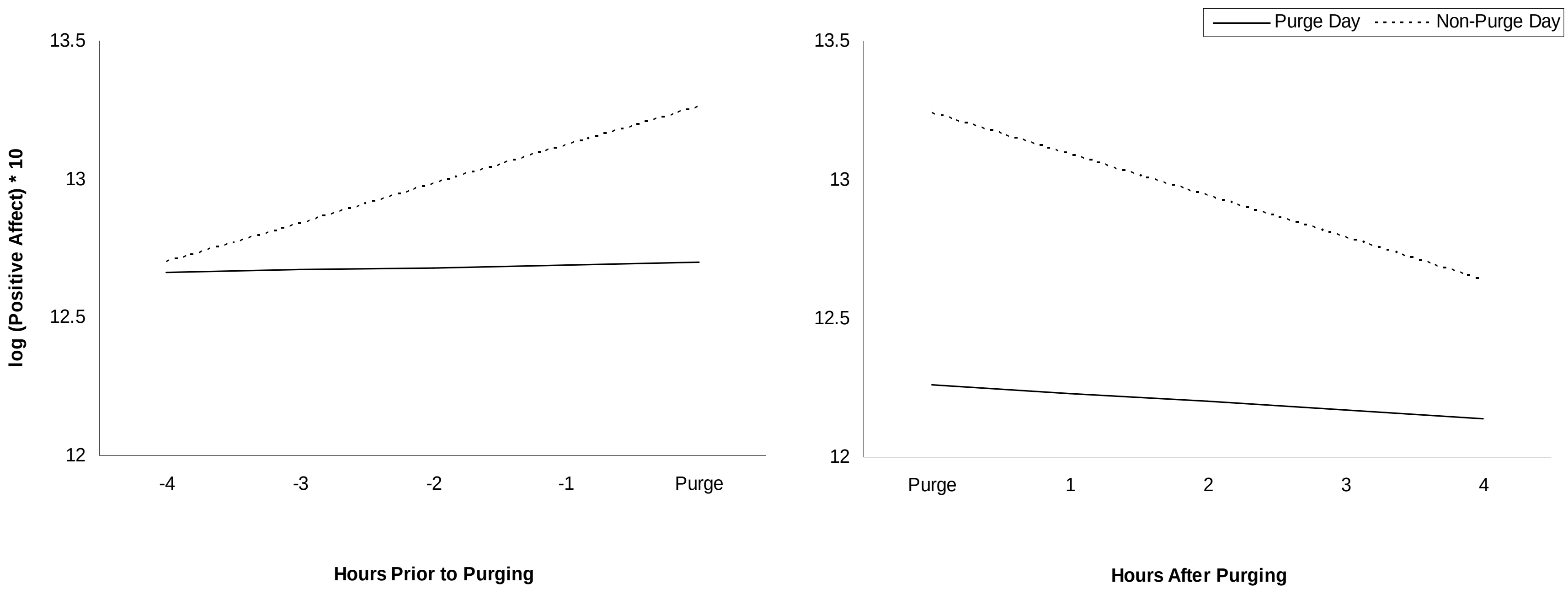


Figure B3. Fitted Linear Trends of Negative Affect Prior to (B3a.) and Following (B3b.) Purging

B4a. B4b.



FigureB4. Fitted Linear Trends of Positive Affect Prior to (B4a.) and Following (B4b.) Purging

B5a. B5b.

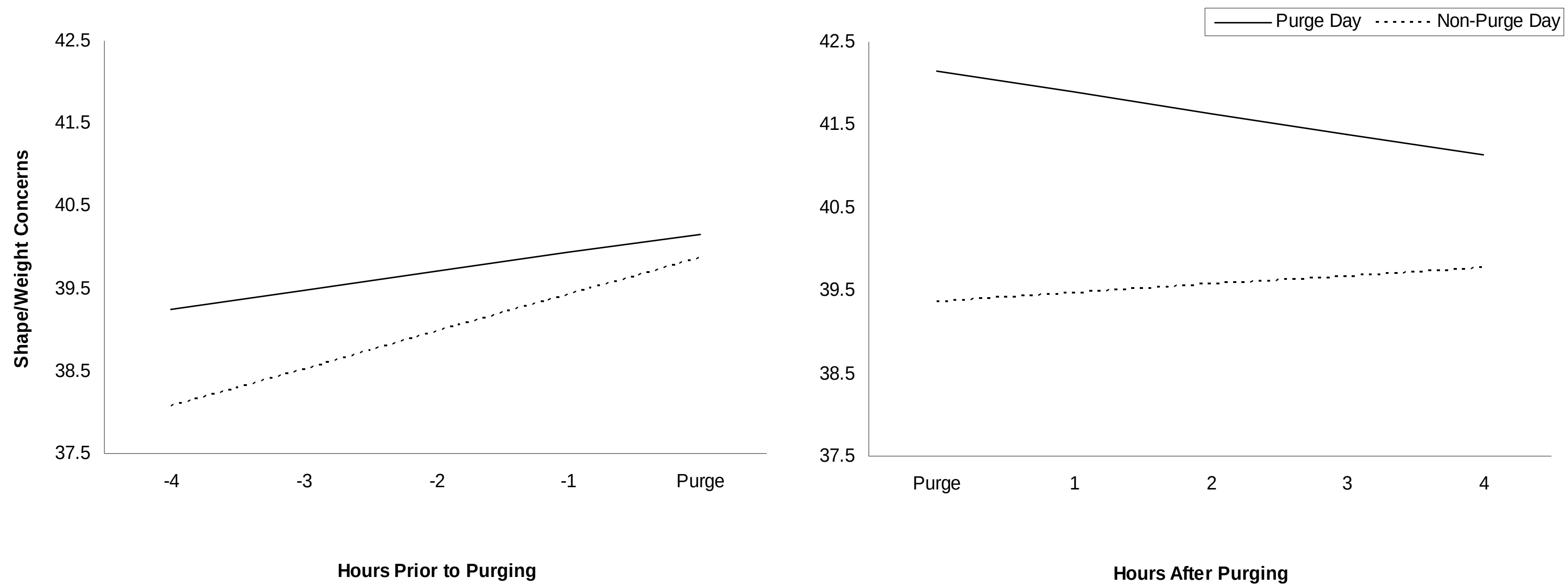
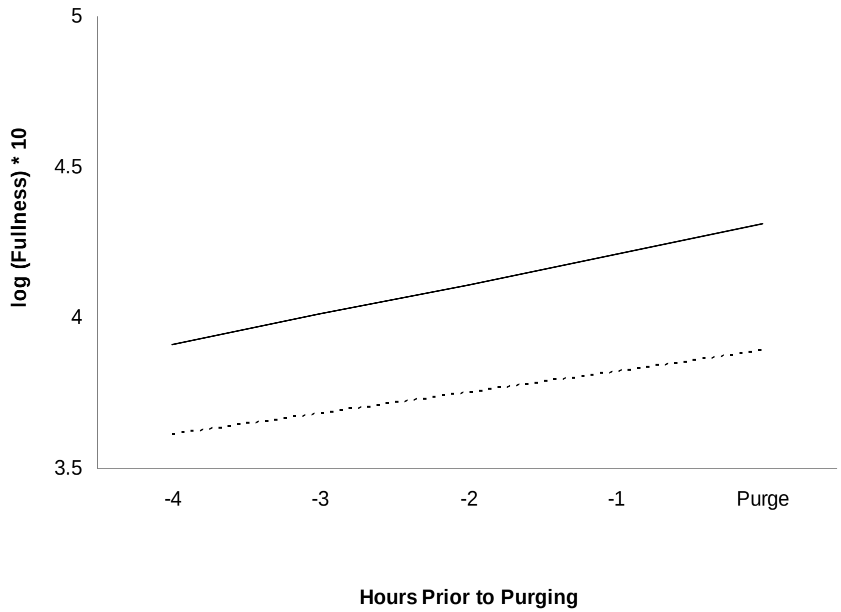


Figure B5. Fitted Linear Trends of Shape/Weight Concerns Prior to (B5a.) and Following (B5b.) Purging

B6a.



B6b.

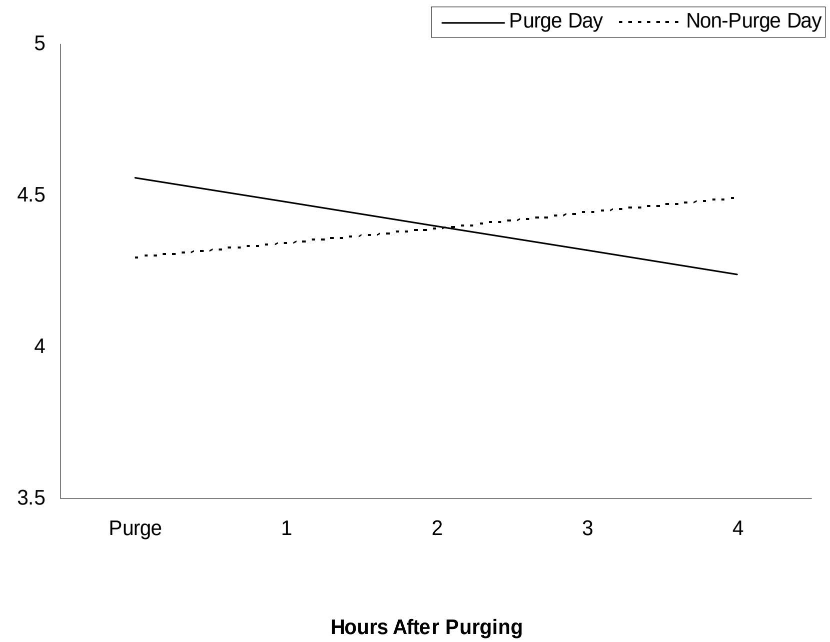


Figure B6. Fitted Linear Trends of Fullness Prior to (B6a.) and Following (B6b.) Purging

B7a. B7b.

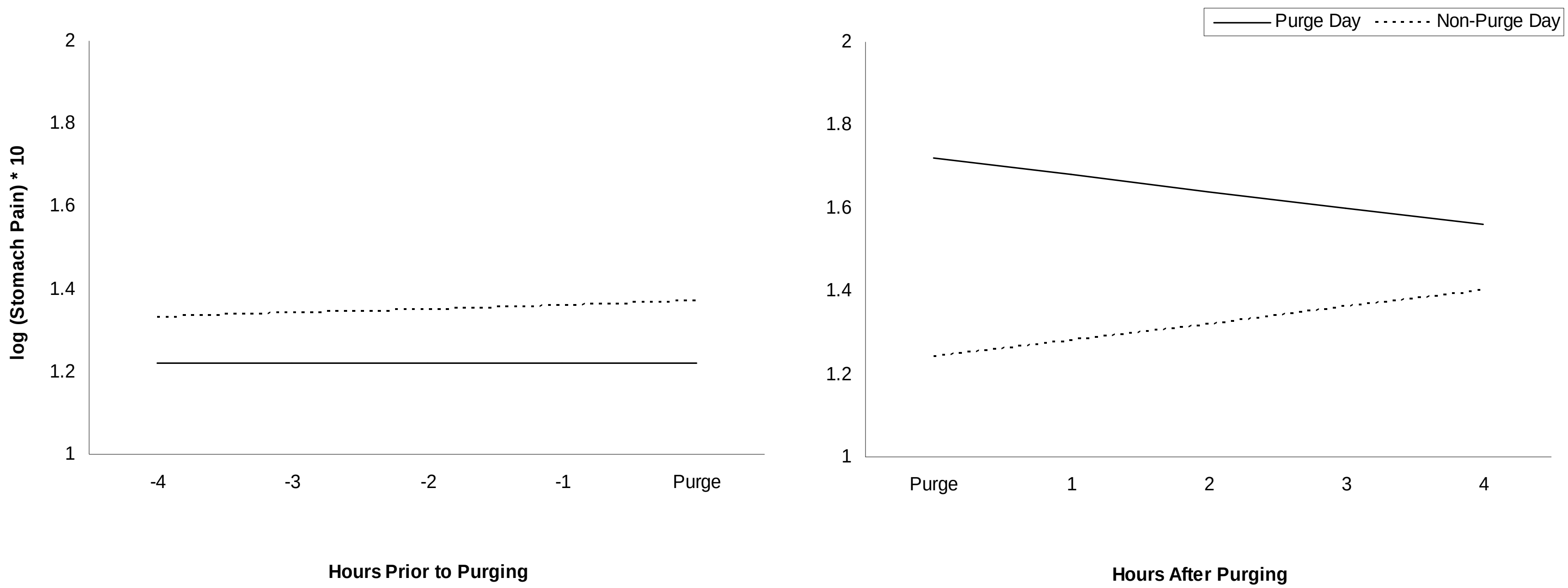


Figure B7. Fitted Linear Trends of Stomach Pain Prior to (B7a.) and Following (B7b.) Purging

B8a. B8b.

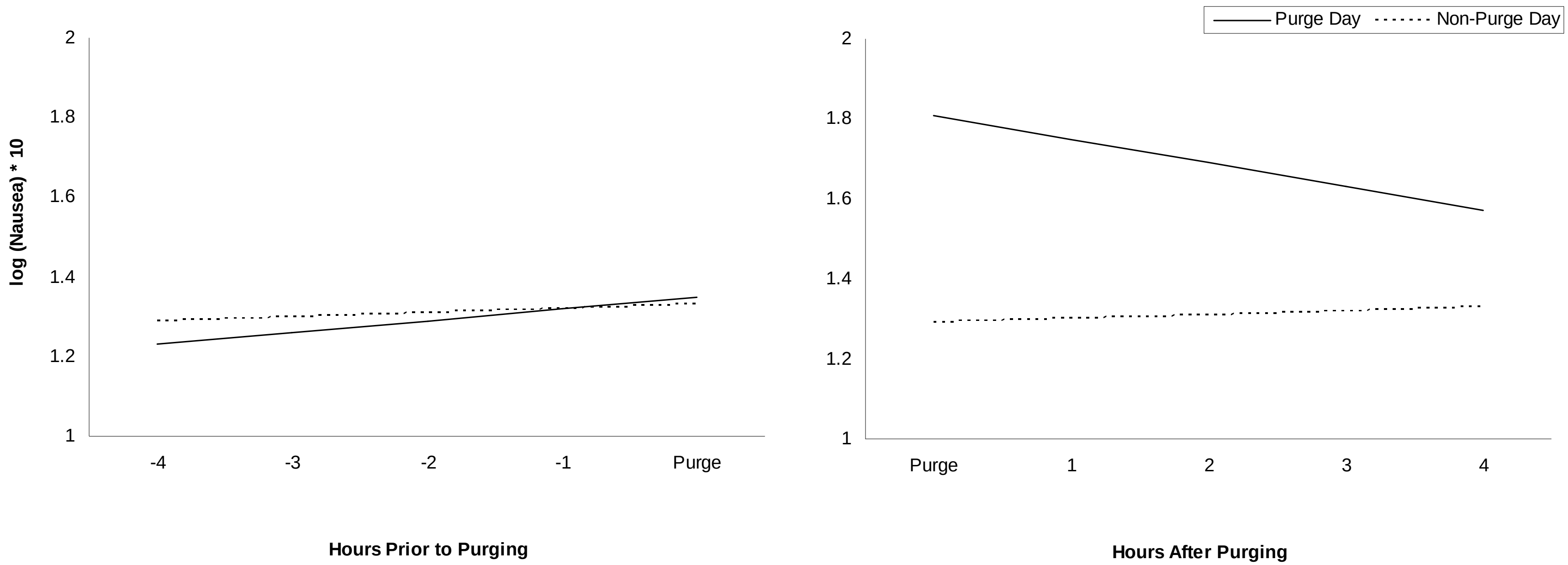


Figure B8. Fitted Linear Trends of Nausea Prior to (B8a.) and Following (B8b.) Purging

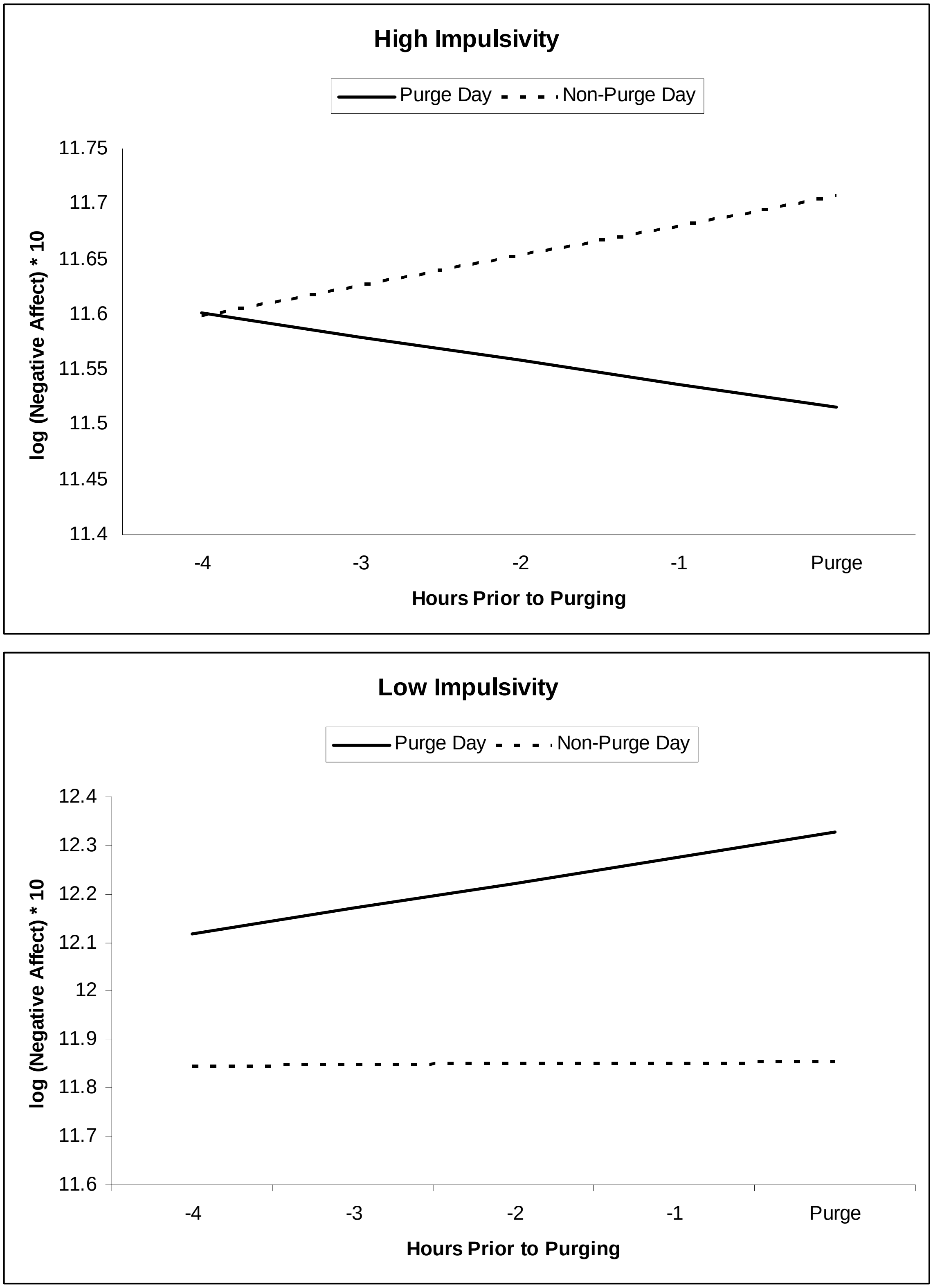


Figure B9. Impulsivity as a Moderator of the Trajectory of Negative Affect

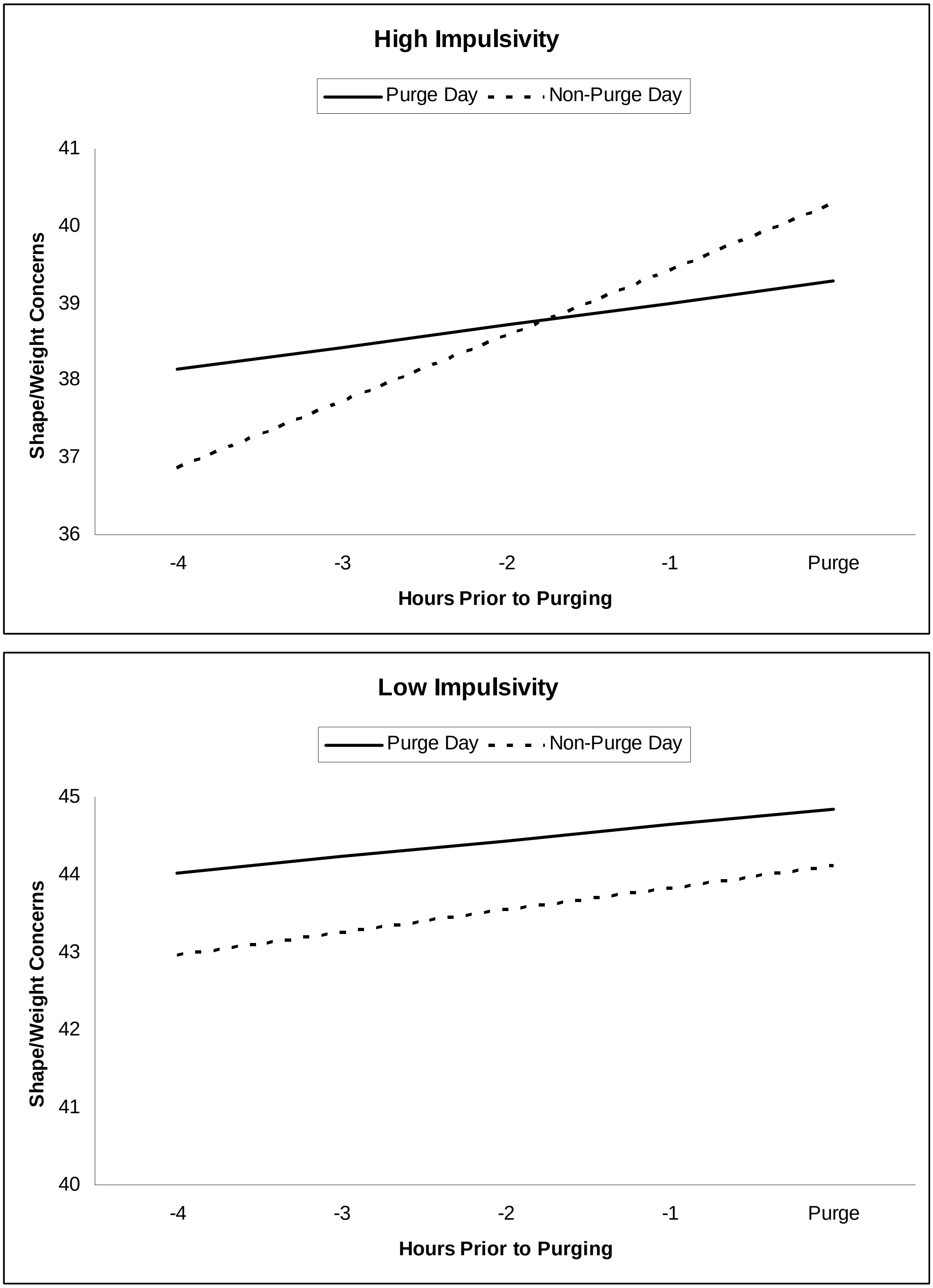


Figure B10. Impulsivity as a Moderator of the Trajectory of Shape/Wight Concerns