



Published in final edited form as:

Eur Eat Disord Rev. 2012 May ; 20(3): e129–e136. doi:10.1002/erv.2161.

Understanding the Association of Impulsivity, Obsessions, and Compulsions with Binge Eating and Purging Behaviors in Anorexia Nervosa

Elizabeth R. Hoffman, Ph.D.¹, Danielle A. Gagne, B.A.¹, Laura M. Thornton, Ph.D.¹, Kelly L. Klump, Ph.D.², Harry Brandt, M.D.³, Steve Crawford, M.D.³, Manfred M. Fichter, M.D.⁴, Katherine A. Halmi, M.D.⁵, Craig Johnson, Ph.D.⁶, Ian Jones, M.D.⁷, Allan S. Kaplan, M.D., F.R.C.P. (C)^{8,9,10}, James E. Mitchell, M.D.¹¹, Michael Strober, Ph.D.¹², Janet Treasure, M.D.¹³, D. Blake Woodside, M.D.^{14,15}, Wade H. Berrettini, M.D.¹⁶, Walter H. Kaye, M.D.¹⁷, and Cynthia M. Bulik, Ph.D.^{1,18}

¹Department of Psychiatry, University of North Carolina, Chapel Hill, NC

²Department of Psychology, Michigan State University, East Lansing, MI

³Department of Psychiatry, University of Maryland School of Medicine, Baltimore, MD

⁴Klinik Roseneck, Hospital for Behavioral Medicine, Prien and University of Munich (LMU), Munich Germany

⁵New York Presbyterian Hospital-Westchester Division, Weill Medical College of Cornell University, White Plains, NY

⁶Eating Recovery Center, Denver, CO

⁷Department of Psychological Medicine, University of Birmingham, United Kingdom

⁸Center for Addiction and Mental Health, Toronto, Canada

⁹Toronto General Hospital Research Institute, Toronto, Canada

¹⁰Institute of Medical Science, University of Toronto, Toronto, Canada

¹¹Neuropsychiatric Research Institute and Department of Clinical Neuroscience, University of North Dakota School of Medicine and Health Sciences, Fargo, North Dakota

¹²Department of Psychiatry and Biobehavioral Sciences, David Geffen School of Medicine, University of California at Los Angeles, Los Angeles, CA

¹³Department of Academic Psychiatry, Kings College London, London, United Kingdom

¹⁴Program for Eating Disorders, Toronto General Hospital, Toronto Canada

¹⁵Department of Psychiatry, University of Toronto, Toronto, Canada

¹⁶Department of Psychiatry, University of Pennsylvania, Philadelphia, PA

¹⁷Department of Psychiatry, University of California at San Diego, San Diego, CA

¹⁸Department of Nutrition, University of North Carolina, Chapel Hill, NC

Abstract

Objective—To further refine our understanding of impulsivity, obsessions, and compulsions in anorexia nervosa (AN) by isolating which behaviors—binge eating, purging, or both—are associated with these features.

Methods—We conducted regression analyses with binge eating, purging, and the interaction of binge eating with purging as individual predictors of scores for impulsivity, obsessions, and compulsions in two samples of women with AN ($n = 1373$).

Results—Purging, but not binge eating, was associated with higher scores of impulsivity, obsessions and compulsions. Purging was also associated with worst eating rituals and with worst eating preoccupations.

Conclusion—Our results suggest that purging, compared with binge eating, may be a stronger correlate of impulsivity, obsessions, and compulsions in AN.

Keywords

anorexia nervosa; impulsivity; compulsivity; binge eating; purging

Introduction

The fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association., 2000) categorizes anorexia nervosa (AN) into two subtypes: restricting type (AN-R) and binge eating/purging type (AN-BP) distinguished by the presence of binge eating and/or purging (vomiting or misuse of laxatives, diuretics, or enemas). Several studies have found the AN-BP subtype to be associated with greater psychopathology and worse outcomes compared with the AN-R subtype (Casper, Eckert, Halmi, Goldberg, & Davis, 1980; Fornari et al., 1992; Garner, Garner, & Rosen, 1993; Laessle, Wittchen, Fichter, & Pirke, 1989; Salbach-Andrae et al., 2008). Despite these differences, there is much debate over the utility of subtyping AN due to the high frequency of crossover from AN-R to AN-BP and divergent definitions of binge eating behavior in AN, including both size and frequency of eating binges, leading to inconsistencies in classification (Anderluh, Tchanturia, Rabe-Hesketh, Collier, & Treasure, 2009; Eckert, Halmi, Marchi, Grove, & Crosby, 1995; Eddy et al., 2002; Garner, et al., 1993; Peat, Mitchell, Hoek, & Wonderlich, 2009; Strober, Freeman, & Morrell, 1997). In addition, studies including individuals classified as AN-BP often do not differentiate among individuals who endorse binge eating, purging, or both behaviors, obscuring possible differences across these presentations relative to AN-R which is often the comparison group. In this study, we attempt to further refine our understanding of impulsivity, obsessions, and compulsions in AN by isolating which behaviors—binge eating, purging, or both—are associated with these features.

The importance of identifying whether binge eating or purging behaviors are more closely associated with impulsivity rests on research demonstrating the negative effect of impulsivity on the course and outcome of eating disorders (Fichter, Quadflieg, & Hedlund, 2006; Keel, Mitchell, Miller, Davis, & Crow, 2000). Numerous studies have found that individuals with AN-BP score higher than individuals with AN-R on measures of impulsive behavior and on the novelty seeking dimension of temperament (Claes, Nederkoorn, Vandereycken, Guerrieri, & Vertommen, 2006; Claes, Vandereycken, & Vertommen, 2004; Fassino et al., 2002; Garfinkel, Moldofsky, & Garner, 1980). In addition, individuals with AN-BP endorse more high-risk behaviors associated with impulsivity such as drug abuse/dependence (Garfinkel, et al., 1980; Garner, et al., 1993; Root, Pinheiro, et al., 2010; Root, Pisetsky, et al., 2010; Salbach-Andrae, et al., 2008), alcohol abuse/dependence (Bulik et al., 2004; Casper, et al., 1980; Favaro et al., 2005; Garfinkel, et al., 1980; Root, Pinheiro, et al.,

2010; Root, Pisetsky, et al., 2010), diet pills use (Root, Pisetsky, et al., 2010), and stealing (Casper, et al., 1980; Favaro, et al., 2005; Garfinkel, et al., 1980; Garner, et al., 1993). Some, but not all (Eddy, et al., 2002), studies have found that individuals with AN-BP report more suicide attempts (Bulik et al., 2008; Favaro & Santonastaso, 1997; Favaro, et al., 2005; Garfinkel, et al., 1980; Garner, et al., 1993; Pryor, Wiederman, & McGilley, 1996), self-injury (Garfinkel, et al., 1980; Garner, et al., 1993), and mood swings (Garner, et al., 1993) compared with AN-R. It is unclear whether binge eating, purging, or both, are associated with the differences in impulsivity found between subtypes. Binge eating has been associated with impulse control disorders in AN (Fernandez-Aranda et al., 2008), but others found that purging, not binge eating, predicted impulsive behavior in individuals with AN and bulimia nervosa (BN) (Favaro, et al., 2005), and both binge eating and purging were associated with alcohol abuse/dependence and drug abuse/dependence in a large sample of women with AN (Root, Pinheiro, et al., 2010).

Research is mixed regarding the association between obsessions and compulsions and AN subtypes. Studies have focused on traits (i.e., obsessionality and compulsivity), behaviors (i.e., obsessions and compulsions), and disorders (i.e. obsessive compulsive disorder and obsessive compulsive personality disorder). In comparison with individuals with BN, those with AN have been found to have higher obsessive-compulsive traits, with a lifetime prevalence of obsessive-compulsive disorder (OCD) estimated widely between 10% to 79% (Godart et al., 2006; Godart, Flament, Perdereau, & Jeammet, 2002; Swinbourne & Touyz, 2007). In addition, individuals with AN score higher on harm avoidance (Bulik, Sullivan, Weltzin, & Kaye, 1995; Fassino et al., 2002; Klump et al., 2000), a temperament dimension associated with depression (Celikel et al., 2009) and also OCD (Alonso et al., 2008). Studies using the Yale-Brown Obsessive Compulsive Scale (Y-BOCS) to assess frequency of obsessions and compulsions across AN subtypes have found differing results with some reporting higher scores in AN-BP (Matsunaga et al., 1999; Speranza et al., 2001) compared with AN-R and others finding no significant difference in frequency of obsessions or compulsions across subtypes (Halmi et al., 2003). Similarly, reports of the prevalence of OCD in both subtypes have also been discrepant with some studies reporting higher lifetime prevalence in individuals with AN-BP (Fornari, et al., 1992; Speranza, et al., 2001) and others finding no significant difference in the prevalence of OCD between AN subtypes (Anderluh, et al., 2009; Godart et al., 2006; Laessle, et al., 1989; Salbach-Andrae, et al., 2008). Although one study reported that the presence of purging in AN was associated with greater obsessive-compulsive symptoms (Favaro & Santonastaso, 1996), the majority of studies evaluating obsessions and compulsions in AN have solely examined differences between individuals with AN-BP and AN-R rather than assessing the association of binge eating and purging behaviors independently with obsessive and compulsive symptoms. Heterogeneity of disordered eating symptoms within the AN-BP subtype (binge eating only, purging only, or both binge eating and purging) across study samples may account for some of the discrepant findings in this area.

The presence of purging, rather than binge eating behavior, is argued to be largely responsible for differences between AN subtypes in terms of medical risks, emotional distress, and suicide risk (Favaro & Santonastaso, 1996; Favaro, et al., 2005; Garner, et al., 1993). In AN, purging predicts negative outcome in some (Deter & Herzog, 1994; Favaro & Santonastaso, 1996; Halmi, Brodland, & Loney, 1973; W. Herzog, Schellberg, & Deter, 1997), but not all (Eddy, et al., 2002; D. B. Herzog et al., 1996), studies. Individuals with AN who purge have higher psychological distress, are older, and have a longer duration of illness (Garner, et al., 1993). This research suggests that the presence of purging, not necessarily binge eating behaviors, may be a key distinguishing factor between individuals with AN-BP and those with AN-R.

However, inconsistencies in sampling make it difficult to decipher which behaviors, binge eating or purging, are contributing to the differences reported in impulsivity, obsessions, and compulsions between AN subtypes. In order to assess the independent effects of binge eating and purging behavior, we conducted regression analyses with binge eating, purging, and the interaction of binge eating with purging as the independent measures and scores for impulsivity, obsessions, and compulsions as the dependent measures in two large samples of women with AN. Due to research focusing on the negative outcomes associated with purging behavior in AN, we hypothesized that purging would be more strongly associated with impulsivity, obsessions, and compulsions than binge eating behavior. In addition, we predicted that purging but not binge eating would be associated with the temperament dimensions of novelty seeking and harm avoidance. Through independent evaluation of purging and binge eating behaviors, we hope to elucidate meaningful differences between subtypes that are currently unclear in the literature.

Methods

Women for the present study had a lifetime history of AN and were from two multisite projects: the AN Trios study from the International Price Foundation Genetic Studies of Eating Disorders (Reba et al., 2005) and the Genetics of Anorexia Nervosa (GAN) study (Kaye et al., 2008). For both studies, each participating site had approval from their local Institutional Review Board and all participants signed informed consent.

AN Trios Study

The sample for this study included individuals with AN and their parents. Probands were required to meet the following criteria: (1) modified DSM-IV lifetime diagnosis of AN, with or without amenorrhea; (2) low weight that is/was less than the fifth percentile of BMI for age and gender according to the chart from the NHANES (Hebebrand, Himmelman, Hesecker, Schafer, & Remschmidt, 1996); (3) onset of eating disorders prior to age 25; (4) weight that is/was controlled through restricted eating, excessive exercise, and/or purging, which includes vomiting, use of laxatives, diuretics, enemas, suppositories, or ipecac; (5) age between 13 and 65 years; and (6) study diagnostic criteria met at least three years prior to entry into the study, ensuring that individuals with AN who were likely to develop binge eating/purging were appropriately classified, as research has shown that most binge eating/purging develops within the first three years of illness in AN (Bulik, Sullivan, Carter, & Joyce, 1997; Eckert, et al., 1995; Eddy, et al., 2002; Strober, et al., 1997; Tozzi et al., 2005). Potential participants were also excluded if they reported maximum BMI since puberty >27 kg/m² to ensure sample homogeneity for genetic studies, minimizing the number of individuals with potentially obscuring obesity-related genotypes.

GAN Study

For inclusion, probands had to be at least 16 years old and have met criteria for a lifetime diagnosis of DSM-IV AN, with or without amenorrhea, before age 46 and at least three years prior to study entry. In addition, probands had to have at least one first, second, or third degree relative with AN (excluding parents and monozygotic twin) who was willing to participate in the study. Potential probands were excluded if they had: (1) a history of binge eating at least twice a week for at least three months; (2) a history of severe central nervous system trauma; (3) psychotic disorders or developmental disability; (4) medical, neurological or substance use disorder that could confound the diagnosis of AN or interfere with the ability to complete assessments; (5) a maximum lifetime BMI exceeding 30 kg/m²; or (6) did not speak either English or German.

The inclusion criteria for affected relatives were as follows: at least 16 years old; have met criteria for a lifetime diagnosis of DSM-IV AN, with or without amenorrhea, before age 46; and AN diagnostic criteria could have been met less than three years prior to the study, but were required to have had a minimum BMI at or below 18 kg/m² for a minimal duration of three months. In addition, affected relatives could have a history of regular binge eating which means they could have an additional diagnosis of BN. If the proband and an affected relative met the study criteria, additional affected relatives with the diagnosis of AN, BN or eating disorder not otherwise specified (EDNOS) were permitted in the study.

A total of 1373 women (638 from Trios, 735 from GAN) reported a lifetime history of AN and had provided information regarding binge eating, purging, age at interview [mean (sd) = 28.0 (9.9) years], duration of illness [mean (sd) = 10.1 (8.0) years], and status of illness in the last year (ill or recovered with recovery defined as having experienced at least one year at normal weight and without any dieting, binge eating, or inappropriate compensatory behaviors; n = 1076, 78.4% were currently ill) and were included in analyses.

Of the participants who responded to the demographic questionnaire, 156 (11.5%) had less than a high school degree, 175 (12.9%) had a high school degree, and 1022 (75.5%) had at least some college. At the time of interview, 57.6% were employed. The majority of participants had never been married (n = 885, 65.2%), approximately one quarter (n = 378, 27.8%) were currently married or indicated that they were living with their partner, and 95 (7.0%) were separated, divorced or widowed.

Assessments

Eating disorder pathology—The Structured Clinical Interview for DSM-IV Axis I Disorder (SCID-I) (First, Spitzer, Gibbon, & Williams, 1997) and The Structured Interview for Anorexia Nervosa and Bulimic Syndromes (SIAB) (Fichter, Herpertz, Quadflieg, & Herpertz-Dahlmann, 1998) were used to establish eating disorder diagnosis. The SCID-I interview was used to assess inclusion and exclusion criteria and an expanded modified version of Module H was used to establish the diagnoses of eating disorders.

The SIAB interview was used to confirm the eating disorder diagnosis and to obtain additional information on core eating disorder behaviors. Internal consistency for the SIAB, as measured by Cronbach's α , is reported to be moderate to high, ranging from .78 -.91 for five of the six components (Fichter, et al., 1998). Interrater reliability range is reported to be between .86 - .96 (Fichter, et al., 1998).

Binge eating and purging were assessed with the SIAB and were scored as dichotomous variables. Binge eating was defined as episodes of eating in which the participant ate a large amount of food (>1000 kcal, the SIAB's cutoff point for objective binge eating) in a relatively short period of time with loss of control over the eating behavior. If the participant endorsed a frequency of at least twice a week for three months and had at least slight loss of control, she was scored as positive for binge eating behavior. Participants who did not have episodes wherein they consumed >1000 kcal, who endorsed 'rarely' for binge frequency, or who had no loss of control associated with binge eating were scored as negative for binge eating behavior.

Vomiting, laxative abuse, and diuretic abuse were defined similarly. For vomiting, participants were divided into groups based on their response to the question "Did you self-induce vomiting to avoid gaining weight?" Those who endorsed the "never" response option were considered to be non-vomiters; all others were scored as positive for vomiting, including those who indicated that they "rarely" engaged in the behavior. The classifications for laxative and diuretic abuse were similarly defined. Individuals who only reported

“experimental” use were not considered to engage in the behavior. Any women who indicated vomiting, laxative abuse, or diuretic abuse was considered to have engaged in purging.

Impulsivity, Obsessions, and Compulsions—Impulsivity, obsessions, and compulsions were assessed with a number of questionnaires. The Barratt Impulsiveness Scale (BIS-11) (Barratt, 1983) is a 30-item self-report assessment measuring three subscales of impulsivity: motor, cognitive, and non-planning. Participants respond to statements such as “I make up my mind quickly” by choosing one of the following responses: rarely/never, occasionally, often, and almost always. After scoring items according to the manual, the higher the summed score for all items, the higher the level of impulsiveness. Internal consistency for the BIS-11 total score is high in both general psychiatric patients (Cronbach’s $\alpha = .83$; Patton, Stanford, & Barratt, 1995) and patients with eating disorders (Cronbach’s $\alpha = .79$; Claes et al., 2006). The Temperament and Character Inventory (TCI) (Cloninger, Svrakic, & Przybeck, 1993) is a 240-item self-report assessment measuring seven dimensions of personality from which we chose to investigate two temperament dimensions based on our prior hypotheses: novelty seeking and harm avoidance. Participants respond to statements with “true” or “false.” Cloninger describes novelty seeking as a heritable temperament factor marked by increased exploration of novelty, impulsive decision-making, quick loss of temper, and avoidance of frustration, whereas harm avoidance is a heritable bias in information processing leading to inhibition of behavior to avoid punishment or uncertain outcomes (Cloninger et al., 1993). The TCI is commonly used in eating disorders research (Jacobs et al., 2009; Klump et al., 2004). Internal consistencies for novelty seeking and harm avoidance were Cronbach’s $\alpha = .78$ and Cronbach’s $\alpha = .87$ respectively in a general population sample in the United States (Cloninger et al., 1993). The Yale-Brown Obsessive Compulsive Scale (Y-BOCS) (Goodman et al., 1989) is a semi-structured interview that measures obsessive-compulsive symptom severity by rating the presence and severity of obsessive thoughts and compulsive behaviors typically found among individuals with OCD. Lifetime prevalence of symptoms from a check-list of obsessions and compulsions are assessed. Then, a series of questions are asked to assess severity and clinical significance of obsessions and compulsions when they were at their worst. The items are rated on a 0 – 4 Likert scale from “no symptoms” to “severe symptoms.” Both the obsessive and the compulsive subscales were used for this study. Internal consistency of the Y-BOCS total scale in Goodman’s original sample of individuals with OCD was high: Cronbach’s α range = (.88 - .91) for different raters (Goodman et al., 1989). The Yale-Brown-Cornell Eating Disorder Scale (YBC-EDS) (Sunday, Halmi, & Einhorn, 1995) assesses severity and types of obsessions and compulsions specific to eating disorders using a clinician-administered semi-structured interview format. Similar to the Y-BOCS, the YBC-EDS first generates a list of preoccupations and rituals related to food and eating. Then, a series of questions are asked to assess severity and clinical significance of preoccupations and rituals addressing time occupied, interference, distress, and degree of control over preoccupations/rituals currently and at their worst, rated on a 0–4 Likert scale from “no symptoms” to “severe symptoms.” The preoccupations and rituals subscales when symptoms were at their worst were used. Internal consistency in individuals with eating disorders in Sunday’s sample is high: Cronbach’s $\alpha = .83$ for preoccupations and Cronbach’s $\alpha = .89$ for rituals (Sunday et al., 1995).

Statistical Analysis

Analyses were conducted using PROC GENMOD in SAS version 9.1 (SAS/STAT® Software: Version 9, 2004). Linear regression analyses were used to evaluate the association between the continuous outcome measures of impulsivity, obsessions, and compulsions with

binge eating, purging, and the interaction of binge eating with purging. The interaction was retained only in models where the interaction was significant ($p < .05$). For all other models, the interaction was removed and the analyses applied retaining the main effects of binge eating and purging. Age at interview, duration of illness, and status of illness at interview were entered as covariates in the models. Duration of illness and age were included as covariates because positive associations between duration of illness and age and purging behavior in AN have been reported (Eddy, et al., 2002). Status of illness at interview was entered as a covariate to account for the influence of current eating disorder symptomatology on questionnaire response (Klump, et al., 2004). Generalized Estimating Equations (Diggle, Liang, & Zeger, 1994; Liang & Zeger, 1986; Zeger, Liang, & Albert, 1988) were applied to correct for non-independence of data due to the inclusion of family members. For these multilevel models, the individual is considered level 1 and the family is level 2. We used a two-step process (for details see (Klump et al., 2000; Reba, et al., 2005)) because family members had varying degrees of relatedness. This approach is considered conservative as the correlations used in the analyses were derived from siblings and are likely overestimates of the expected correlations among clusters of more distantly related individuals. Such overestimation is likely to result in fewer, rather than more, significant findings. All significance tests were two-tailed and p-values were corrected for multiple comparisons using the method of false discovery rate (Benjamini & Hochberg, 1995). False discovery rate is defined as the expected percentage of false positives among the claimed positives and can be calculated by ordering and then numbering the p-values from smallest to largest, then multiplying each p-value times the total number of tests and then dividing that by the number that the test is in the ordered list. This approach is less conservative than more traditional approaches, such as Bonferroni corrections, and has greater ability to identify results that are truly significant.

Results

Of the total sample of 1373 women (638 from Trios, 735 from GAN) with a lifetime history of AN in this analysis, both binge eating and purging were reported by 298 (21.7%) women, 466 (33.9%) reported purging but no binge eating, 34 (2.5%) reported binge eating but no purging, and 575 (41.9%) reported neither behavior. Thus, binge eating was reported by a total of 332 (24.2%) women and purging was reported by a total of 764 (55.6%) women. The association between binge eating and purging was $r_{\Phi} = .39$.

Table 1 lists the means (sd) for the various measures of impulsivity, obsessions, and compulsions for groups defined by binge eating and purging (neither binge eating nor purging, binge eating only, purging only, and binge eating and purging).

To evaluate the associations between binge eating and purging with the personality variables, models were first applied including an interaction term between binge eating and purging. No significant associations were found for the interaction. Models were rerun without the interaction term and the results from those regression analyses presented in Table 2. Binge eating was not significantly associated with any aspect of impulsivity, obsessions, or compulsions. Purging was associated with all measures of impulsivity, obsessions, and compulsions; the presence of purging was associated with higher values for every variable.

Discussion

Our results provided some clarity regarding the nature of the association between impulsivity, obsessions, and compulsions and binge eating and purging in AN. Purging, but not binge eating, was associated with all measures of impulsivity (as measured by the

BIS-11 and novelty seeking and harm avoidance scales of the TCI), general obsessions and compulsions (as measured by the Y-BOCS), and obsessions and compulsions related to eating (as measured by the preoccupations and rituals scales of the YBC-EDS). These findings confirm previous demonstrations of associations between purging behavior in AN and impulsivity (Favaro, et al., 2005; Root, Pinheiro, et al., 2010) as well as obsessionality and compulsivity (Favaro & Santonastaso, 1996). We did not find support for an association between binge eating and impulsivity, obsessions, or compulsions. Moreover, the absence of a binge eating \times purging interaction also supports purging as the stronger correlate of impulsivity in AN. Purging together with associated impulsivity, obsessions, and compulsions can adversely affect the course of illness in AN (Bulik, et al., 2008; Milos, Spindler, Ruggiero, Klaghofer, & Schnyder, 2002).

Although a different measure of impulsivity was used, results from this larger sample mirror those of Favaro et al. (2005) who found that purging behavior, but not binge eating, was significantly associated with the presence of impulsive behaviors in a sample of individuals with AN and BN. Behaviors indicative of impulsivity such as substance abuse/dependence, self-injury, and suicide attempts have also been associated with the presence of purging behavior specifically in AN rather than the larger AN-BP subtype (Favaro & Santonastaso, 1996; Root, Pinheiro, et al., 2010). In the present study, we also found purging, but not binge eating behavior, to be significantly associated with novelty seeking, a personality trait that has been associated previously with impulsive behavior in individuals with AN and BN (Favaro, et al., 2005). Several past studies reporting an association of binge eating with measures of impulsivity in AN did not explore the independent effects of purging in their analyses, although many individuals reporting binge eating in their samples also engaged in purging (Casper, et al., 1980; Fernandez-Aranda, et al., 2008; Garfinkel, et al., 1980). Thus, given our findings, purging may be the stronger predictor of impulsivity in AN.

In terms of obsessions and compulsions, we found that purging, but not binge eating, was significantly associated with general obsessions and compulsions measured with the Y-BOCS as well as preoccupations and rituals related to eating measured with the YBC-EDS. Purging, but not binge eating, was also significantly associated with higher scores of harm avoidance on the TCI. In line with this finding, individuals with OCD (without eating disorders) score higher on harm avoidance than healthy participants (Alonso et al., 2008). If purging is more strongly associated with obsessions and compulsions in AN, then it may be that discrepant findings in past studies of obsessions and compulsions across AN subtypes are the result of AN-BP symptom heterogeneity (Halmi, et al., 2003; Speranza et al., 2001). Based on DSM-IV criteria, these studies included individuals with binge eating, purging, or both behaviors in subtypes designated as AN-BP. It may be that studies that found no significant difference in obsessions or compulsions across subtypes (Halmi, et al., 2003) had a greater percentage of individuals engaging in binge eating only in their AN-BP sample.

Strengths of this study include the large sample size, interview-based assessment of objective binge eating and purging behaviors, and interview-based assessments of obsessions and compulsions. Although a major challenge in the past has been consistent classification of binge eating and purging due to differing cutoffs for frequency and duration of the behaviors, we employed a more inclusive definition for purging behavior relative to DSM-IV criteria for BN (twice a week for three months), considering even those individuals who responded that they “rarely” engaged in the behavior as positive for purging. This represents a more conservative approach, as inclusion of those with lower frequency of the behavior would be assumed to bias results toward the null. Using a similar classification scheme, Eddy et al. (2002) found that individuals with AN-BP were more likely to engage in several impulsive behaviors when compared with an AN-R group that only included individuals who had “never” engaged in binge eating or purging.

There are several limitations that should be considered when interpreting our results. First, participants were interviewed at one point in time and asked to retrospectively describe their eating behaviors (SIAB), worst ever obsessions and compulsions (Y-BOCS), worst ever eating preoccupations and rituals (YBC-EDS), and current impulsivity (BIS-11 and TCI). Within this sample, some individuals were currently symptomatic whereas others were considered recovered (symptom free for the year prior to interview) at the time of assessment. In order to account for the influence that status of illness may have had on responses to assessments, we included status of illness as a covariate in all analyses. Second, some affected relatives of probands in the GAN study were not diagnosed with AN at least three years prior to study entry. As research has shown that most binge eating/purging develops within the first three years of illness in AN (Bulik, et al., 1997; Eckert, et al., 1995; Eddy, et al., 2002; Strober, et al., 1997; Tozzi, et al., 2005), those individuals who were diagnosed less than three years prior to study entry and did not endorse binge eating or purging behaviors at the time of interview may later develop these behaviors. Third, this was a cross-sectional study, so no inferences can be made regarding the presence or direction of causality with respect to the association between binge eating or purging and impulsivity, obsessions, and compulsions. Lastly, participants from the GAN study represented individuals with familial AN who might have different symptom profiles than individuals with AN in the general population, limiting the generalizability of our findings.

In conclusion, purging but not binge eating is associated with impulsivity, general obsessions and compulsions, and preoccupations and rituals related to food and eating in women with AN. A recent review discussing the utility of subtyping individuals with AN concluded that one of the major issues with the current subtyping system is determination of what constitutes binge eating in individuals with AN (Peat, et al., 2009). They also contend that subtyping individuals with AN has the potential to be useful for treatment planning by clinicians, although there are currently no empirical data to support this practice. Although evaluation of binge eating (whether subjective or objective) represents an integral component of assessment and treatment, our results suggest that assessment of purging behavior can provide independently valuable information about associated symptom profiles (impulsivity, obsessions, and compulsions) that may be useful to guide further assessment and treatment planning in AN.

Acknowledgments

Sources of Support: This research has been supported by NIH grant (MH 66117). Dr. Hoffman is supported by an NIH pre-doctoral fellowship (MH 087998). Dr. Strober receives support from the Franklin Mint Endowed Chair in Eating Disorders. We express our gratitude to all the families who participated in this research. Genotyping services for the Genetic of Anorexia Nervosa Study were provided by the Center for Inherited Disease Research (CIDR). CIDR is fully funded through a federal contract from the National Institutes of Health to The Johns Hopkins University, Contract Number HHSN268200782096C.

References

- Alonso P, Menchon JM, Jimenez S, Segalas J, Mataix-Cols D, Jaurrieta N, Pujol J. Personality dimensions in obsessive-compulsive disorder: relation to clinical variables. *Psychiatry Research*. 2008; 157(1–3):159–168. [PubMed: 17900706]
- American Psychiatric Association. *Diagnostic criteria from DSM-IV-TR*. Washington, D.C.: American Psychiatric Association; 2000.
- Anderluh M, Tchanturia K, Rabe-Hesketh S, Collier D, Treasure J. Lifetime course of eating disorders: design and validity testing of a new strategy to define the eating disorders phenotype. *Psychological Medicine*. 2009; 39(1):105–114. [PubMed: 18377676]
- Barratt E. The biological basis of impulsiveness. *Personality and Individual Differences*. 1983; 4(4): 387–391.

- Benjamini Y, Hochberg Y. Controlling the False Discovery Rate: A Practical and Powerful Approach to Multiple Testing. *Journal of the Royal Statistical Society*. 1995; 57(1):289–300.
- Bulik CM, Klump KL, Thornton L, Kaplan AS, Devlin B, Fichter MM, Kaye WH. Alcohol use disorder comorbidity in eating disorders: a multicenter study. *The Journal of Clinical Psychiatry*. 2004; 65(7):1000–1006. [PubMed: 15291691]
- Bulik CM, Sullivan PF, Carter FA, Joyce PR. Initial manifestations of disordered eating behavior: dieting versus bingeing. *International Journal of Eating Disorders*. 1997; 22(2):195–201. [PubMed: 9261659]
- Bulik CM, Sullivan PF, Weltzin TE, Kaye WH. Temperament in eating disorders. *International Journal of Eating Disorders*. 1995; 17(3):251–261. [PubMed: 7773262]
- Bulik CM, Thornton L, Pinheiro AP, Plotnicov K, Klump KL, Brandt H, Kaye WH. Suicide attempts in anorexia nervosa. *Psychosomatic Medicine*. 2008; 70(3):378–383. [PubMed: 18256339]
- Casper RC, Eckert ED, Halmi KA, Goldberg SC, Davis JM. Bulimia. Its incidence and clinical importance in patients with anorexia nervosa. *Archives of General Psychiatry*. 1980; 37(9):1030–1035. [PubMed: 6932187]
- Celikel FC, Kose S, Cumurcu BE, Erkorkmaz U, Sayar K, Borckardt JJ, Cloninger CR. Cloninger's temperament and character dimensions of personality in patients with major depressive disorder. *Comprehensive Psychiatry*. 2009; 50(6):556–561. [PubMed: 19840594]
- Claes L, Nederkoorn C, Vandereycken W, Guerrieri R, Vertommen H. Impulsiveness and lack of inhibitory control in eating disorders. *Eating Behaviors*. 2006; 7(3):196–203. [PubMed: 16843221]
- Claes L, Vandereycken W, Vertommen H. Personality traits in eating-disordered patients with and without self-injurious behaviors. *Journal of Personality Disorders*. 2004; 18(4):399–404. [PubMed: 15342326]
- Cloninger CR, Svrakic DM, Przybeck TR. A psychobiological model of temperament and character. *Archives of General Psychiatry*. 1993; 50(12):975–990. [PubMed: 8250684]
- Deter HC, Herzog W. Anorexia-Nervosa in a Long-Term Perspective - Results of the Heidelberg-Mannheim Study. *Psychosomatic Medicine*. 1994; 56(1):20–27. [PubMed: 8197311]
- Diggle, P.; Liang, K.; Zeger, S. *Analysis of Longitudinal Data*. Oxford: Oxford Science; 1994.
- Eckert ED, Halmi KA, Marchi P, Grove W, Crosby R. Ten-year follow-up of anorexia nervosa: clinical course and outcome. *Psychological Medicine*. 1995; 25(1):143–156. [PubMed: 7792349]
- Eddy KT, Keel PK, Dorer DJ, Delinsky SS, Franko DL, Herzog DB. Longitudinal comparison of anorexia nervosa subtypes. *International Journal of Eating Disorders*. 2002; 31(2):191–201. [PubMed: 11920980]
- Fassino S, Abbate-Daga G, Amianto F, Leombruni P, Boggio S, Rovera GG. Temperament and character profile of eating disorders: a controlled study with the Temperament and Character Inventory. *International Journal of Eating Disorders*. 2002; 32(4):412–425. [PubMed: 12386906]
- Favaro A, Santonastaso P. Purging behaviors, suicide attempts, and psychiatric symptoms in 398 eating disordered subjects. *International Journal of Eating Disorders*. 1996; 20(1):99–103. [PubMed: 8807357]
- Favaro A, Santonastaso P. Suicidality in eating disorders: clinical and psychological correlates. *Acta Psychiatrica Scandinavica*. 1997; 95(6):508–514. [PubMed: 9242846]
- Favaro A, Zanetti T, Tenconi E, Degortes D, Ronzan A, Veronese A, Santonastaso P. The relationship between temperament and impulsive behaviors in eating disordered subjects. *Eating Disorders*. 2005; 13(1):61–70. [PubMed: 16864331]
- Fernandez-Aranda F, Pinheiro AP, Thornton LM, Berrettini WH, Crow S, Fichter MM, Bulik CM. Impulse control disorders in women with eating disorders. *Psychiatry Research*. 2008; 157(1–3):147–157. [PubMed: 17961717]
- Fichter MM, Herpertz S, Quadflieg N, Herpertz-Dahlmann B. Structured Interview for Anorexic and Bulimic disorders for DSM-IV and ICD-10: updated (third) revision. *International Journal of Eating Disorders*. 1998; 24(3):227–249. [PubMed: 9741034]
- Fichter MM, Quadflieg N, Hedlund S. Twelve-year course and outcome predictors of anorexia nervosa. *International Journal of Eating Disorders*. 2006; 39(2):87–100. [PubMed: 16231345]

- First, M.; Spitzer, R.; Gibbon, M.; Williams, J. Structured Clinical Interview for DSM-IV Axis I Disorders, Research Version, Patient Edition. New York: Biometrics Research, New York State Psychiatric Institute; 1997.
- Fornari V, Kaplan M, Sandberg DE, Matthews M, Skolnick N, Katz JL. Depressive and Anxiety Disorders in Anorexia-Nervosa and Bulimia-Nervosa. *International Journal of Eating Disorders*. 1992; 12(1):21–29.
- Garfinkel PE, Moldofsky H, Garner DM. The heterogeneity of anorexia nervosa. Bulimia as a distinct subgroup. *Archives of General Psychiatry*. 1980; 37(9):1036–1040. [PubMed: 6932188]
- Garner DM, Garner MV, Rosen LW. Anorexia nervosa "restricters" who purge: implications for subtyping anorexia nervosa. *International Journal of Eating Disorders*. 1993; 13(2):171–185. [PubMed: 8477286]
- Godart N, Berthoz S, Rein Z, Perdereau F, Lang F, Venisse JL, Curt F. Does the frequency of anxiety and depressive disorders differ between diagnostic subtypes of anorexia nervosa and bulimia? *International Journal of Eating Disorders*. 2006; 39(8):772–778. [PubMed: 16721840]
- Godart N, Flament MF, Perdereau F, Jeammet P. Comorbidity between eating disorders and anxiety disorders: a review. *International Journal of Eating Disorders*. 2002; 32(3):253–270. [PubMed: 12210640]
- Goodman WK, Price LH, Rasmussen SA, Mazure C, Fleischmann RL, Hill CL, Charney DS. The Yale-Brown Obsessive Compulsive Scale. I. Development, use, and reliability. *Archives of General Psychiatry*. 1989; 46(11):1006–1011. [PubMed: 2684084]
- Halmi KA, Brodland G, Loney J. Prognosis in Anorexia-Nervosa. *Annals of Internal Medicine*. 1973; 78(6):907–909. [PubMed: 4713574]
- Halmi KA, Sunday SR, Klump KL, Strober M, Leckman JF, Fichter M, Kaye WH. Obsessions and compulsions in anorexia nervosa subtypes. *International Journal of Eating Disorders*. 2003; 33(3):308–319. [PubMed: 12655628]
- Hebebrand J, Himmelmann GW, Hesecker H, Schafer H, Renschmidt H. Use of percentiles for the body mass index in anorexia nervosa: diagnostic, epidemiological, and therapeutic considerations. *International Journal of Eating Disorders*. 1996; 19(4):359–369. [PubMed: 9156689]
- Herzog DB, Field AE, Keller MB, West JC, Robbins WM, Staley J, Colditz GA. Subtyping eating disorders: is it justified? *Journal of the American Academy of Child and Adolescent Psychiatry*. 1996; 35(7):928–936. [PubMed: 8768354]
- Herzog W, Schellberg D, Deter HC. First recovery in anorexia nervosa patients in the long-term course: a discrete-time survival analysis. *Journal of Consulting and Clinical Psychology*. 1997; 65(1):169–177. [PubMed: 9103746]
- Jacobs MJ, Roesch S, Wonderlich SA, Crosby R, Thornton L, Wilfley DE, Bulik CM. Anorexia nervosa trios: behavioral profiles of individuals with anorexia nervosa and their parents. *Psychological Medicine*. 2009; 39(3):451–461. [PubMed: 18578898]
- Kaye WH, Bulik CM, Plotnicov K, Thornton L, Devlin B, Fichter MM, Jones I. The genetics of anorexia nervosa collaborative study: methods and sample description. *International Journal of Eating Disorders*. 2008; 41(4):289–300. [PubMed: 18236451]
- Keel PK, Mitchell JE, Miller KB, Davis TL, Crow SJ. Predictive validity of bulimia nervosa as a diagnostic category. *American Journal of Psychiatry*. 2000; 157(1):136–138. [PubMed: 10618030]
- Klump KL, Bulik CM, Pollice C, Halmi KA, Fichter MM, Berrettini WH, Kaye WH. Temperament and character in women with anorexia nervosa. *The Journal of Nervous and Mental Disease*. 2000; 188(9):559–567. [PubMed: 11009328]
- Klump KL, Strober M, Bulik CM, Thornton L, Johnson C, Devlin B, Kaye WH. Personality characteristics of women before and after recovery from an eating disorder. *Psychological Medicine*. 2004; 34(8):1407–1418. [PubMed: 15724872]
- Laessle R, Wittchen H, Fichter M, Pirke K. The significance of subgroups of bulimia and anorexia nervosa: Lifetime frequency of psychiatric disorders. *International Journal of Eating Disorders*. 1989; 8(5):569–574.
- Liang K, Zeger S. Longitudinal data analysis using generalized linear models. *Biometrika*. 1986; 73(1):13–22.

- Matsunaga H, Miyata A, Iwasaki Y, Matsui T, Fujimoto K, Kiriike N. A comparison of clinical features among Japanese eating-disordered women with obsessive-compulsive disorder. *Comprehensive Psychiatry*. 1999; 40(5):337–342. [PubMed: 10509614]
- Milos G, Spindler A, Ruggiero G, Klaghofer R, Schnyder U. Comorbidity of obsessive-compulsive disorders and duration of eating disorders. *International Journal of Eating Disorders*. 2002; 31(3): 284–289. [PubMed: 11920989]
- Patton JH, Stanford MS, Barratt ES. Factor structure of the Barratt impulsiveness scale. *Journal of Clinical Psychology*. 1995; 51(6):768–774. [PubMed: 8778124]
- Peat C, Mitchell JE, Hoek HW, Wonderlich SA. Validity and utility of subtyping anorexia nervosa. *International Journal of Eating Disorders*. 2009; 42(7):590–594. [PubMed: 19598270]
- Pryor T, Wiederman MW, McGilley B. Clinical correlates of anorexia nervosa subtypes. *International Journal of Eating Disorders*. 1996; 19(4):371–379. [PubMed: 9156690]
- Reba L, Thornton L, Tozzi F, Klump KL, Brandt H, Crawford S, Bulik CM. Relationships between features associated with vomiting in purging-type eating disorders. *International Journal of Eating Disorders*. 2005; 38(4):287–294. [PubMed: 16261604]
- Root TL, Pinheiro AP, Thornton L, Strober M, Fernandez-Aranda F, Brandt H, Bulik CM. Substance use disorders in women with anorexia nervosa. *International Journal of Eating Disorders*. 2010; 43(1):14–21. [PubMed: 19260043]
- Root TL, Pisetsky EM, Thornton L, Lichtenstein P, Pedersen NL, Bulik CM. Patterns of co-morbidity of eating disorders and substance use in Swedish females. *Psychological Medicine*. 2010; 40(1): 105–115. [PubMed: 19379530]
- Salbach-Andrae H, Lenz K, Simmendinger N, Klinkowski N, Lehmkuhl U, Pfeiffer E. Psychiatric comorbidities among female adolescents with anorexia nervosa. *Child Psychiatry and Human Development*. 2008; 39(3):261–272. [PubMed: 17987378]
- SAS/STAT® Software: Version 9. Cary, NC: SAS Institute Inc.; 2004.
- Speranza M, Corcos M, Godart N, Loas G, Guilbaud O, Jeammet P, Flament M. Obsessive compulsive disorders in eating disorders. *Eating Behaviors*. 2001; 2(3):193–207. [PubMed: 15001030]
- Strober M, Freeman R, Morrell W. The long-term course of severe anorexia nervosa in adolescents: survival analysis of recovery, relapse, and outcome predictors over 10–15 years in a prospective study. *International Journal of Eating Disorders*. 1997; 22(4):339–360. [PubMed: 9356884]
- Sunday SR, Halmi KA, Einhorn A. The Yale-Brown-Cornell Eating Disorder Scale: a new scale to assess eating disorder symptomatology. *International Journal of Eating Disorders*. 1995; 18(3): 237–245. [PubMed: 8556019]
- Swinbourne JM, Touyz SW. The co-morbidity of eating disorders and anxiety disorders: a review. *European Eating Disorders Review*. 2007; 15(4):253–274.
- Tozzi F, Thornton LM, Klump KL, Fichter MM, Halmi KA, Kaplan AS, Kaye WH. Symptom fluctuation in eating disorders: correlates of diagnostic crossover. *The American Journal of Psychiatry*. 2005; 162(4):732–740. [PubMed: 15800146]
- Zeger SL, Liang KY, Albert PS. Models for longitudinal data: a generalized estimating equation approach. *Biometrics*. 1988; 44(4):1049–1060. [PubMed: 3233245]

Table 1

Means (sd) for the various measures of impulsivity, obsessions, and compulsions for participants who have no history of binge eating or purging, a history of binge eating only, a history of purging only, and a history of both binge eating and purging.

Variable	No Binge Eating or Purging	Binge Eating Only	Purging Only	Binge Eating and Purging
Barrett Impulsivity Scale				
Motor	18.9 (3.7)	19.8 (3.9)	20.5 (4.6)	21.0 (4.4)
Cognitive	16.8 (4.4)	17.7 (4.5)	18.0 (4.4)	18.5 (4.5)
Non-Planning	22.0 (4.7)	22.5 (4.3)	23.6 (5.3)	24.1 (5.2)
Temperament and Character Inventory				
Harm Avoidance	20.4 (7.5)	21.0 (7.8)	21.7 (7.7)	21.9 (7.4)
Novelty Seeking	15.2 (6.6)	16.1 (7.1)	17.3 (7.1)	18.0 (6.8)
Yale-Brown Obsessive Compulsive Scale				
Obsessions	6.1 (6.2)	7.3 (6.5)	7.9 (6.3)	7.3 (6.3)
Compulsions	6.6 (6.5)	7.5 (7.0)	8.9 (6.5)	7.9 (6.5)
Yale-Brown-Cornell Eating Disorder Scale				
Worst Preoccupations	12.2 (3.1)	13.0 (2.0)	13.1 (2.5)	13.4 (2.3)
Worst Rituals	11.6 (3.3)	11.8 (2.9)	12.9 (2.6)	13.1 (2.6)

Table 2

Results from regression analyses predicting various measures of impulsivity, obsessions, and compulsions from binge eating and purging in women with AN. All p-values were corrected using the method of false discovery rate.

Variable	N	Binge Eating		Purging	
		B (95% CI)	χ^2 (p-value)	B (95% CI)	χ^2 (p-value)
Barrett Impulsivity Scale					
Motor	1351	0.58 (-0.01, 1.18)	3.64 (.086)	1.49 (1.00, 1.98)	34.00 (.003)
Cognitive	1356	0.60 (-0.01, 1.20)	3.76 (.086)	1.20 (0.69, 1.71)	20.57 (.003)
Non-Planning	1354	0.58 (-0.11, 1.26)	2.70 (.130)	1.55 (0.97, 2.14)	26.03 (.003)
Temperament and Character Inventory					
Harm Avoidance	1337	0.22 (-0.80, 1.23)	0.17 (.677)	1.23 (0.35, 2.11)	7.47 (.014)
Novelty Seeking	1336	0.76 (-0.19, 1.71)	2.43 (.144)	2.13 (1.34, 2.93)	26.69 (.003)
Yale-Brown Obsessive Compulsive Scale					
Obsessions	1316	-0.29 (-1.12, 0.54)	0.46 (.527)	1.50 (0.76, 2.23)	15.59 (.003)
Compulsions	1316	-0.73 (-1.60, 0.14)	2.70 (.130)	1.89 (1.13, 2.66)	22.99 (.003)
Yale-Brown-Cornell Eating Disorder Scale					
Worst Preoccupations	1364	0.34 (0.03, 0.66)	4.42 (.065)	0.94 (0.62, 1.26)	30.65 (.003)
Worst Rituals	1364	0.18 (-0.17, 0.52)	0.97 (.365)	1.33 (1.00, 1.66)	55.02 (.003)