

RESEARCH ARTICLE

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

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Abstract

Objective: To further refine our understanding of impulsivity, obsessions, and compulsions in anorexia nervosa (AN) by isolating which behaviours—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 on 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. Copyright © 2012 John Wiley & Sons, Ltd and Eating Disorders Association.

Keywords

anorexia nervosa; impulsivity; compulsivity; binge eating; purging

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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 because of the high frequency of crossover from AN-R to AN-BP and divergent definitions of binge eating behaviour 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 behaviours, obscuring possible differences across these presentations relative to AN-R that 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 behaviours—binge eating, purging, or both—are associated with these features.

The importance of identifying whether binge eating or purging behaviours 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 behaviour 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 behaviours 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 pill 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 those 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 behaviour 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.* obsessiveness and compulsivity), behaviours (*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% and 79% (Godart, Flament, Perdereau, & Jeammet, 2002; Godart *et al.*, 2006; 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), most 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 behaviours 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 behaviour, 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; Herzog, Schellberg, & Deter, 1997), but not all (Eddy *et al.*, 2002; 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 behaviours, 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 behaviours, 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 behaviour, 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. Because of research focusing on the negative outcomes associated with purging behaviour in AN, we hypothesized that purging would be more strongly associated with impulsivity, obsessions, and compulsions than binge eating behaviour. 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 behaviours, we hope to elucidate meaningful differences between subtypes that are currently unclear in the literature.

Methods

Women in 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. Proband was required to meet the following criteria: (1) modified DSM-IV lifetime diagnosis of AN, with or without amenorrhoea; (2) low weight that is/was less than the fifth percentile of body mass index (BMI) for age and gender according to the chart from the National Health and Nutrition Examination Survey (NHANES) (Hebebrand, Himmelmann, 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 3 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 3 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 $>27\text{ kg/m}^2$ to ensure sample homogeneity for genetic studies, minimizing the number of individuals with potentially obscuring obesity-related genotypes.

Genetics of Anorexia Nervosa 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 amenorrhoea, before age 46 and at least 3 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 twins) 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 3 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/m^2 ; 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 amenorrhoea, before age 46; and AN diagnostic criteria could have been met less than 3 years prior to the study but were required to have had a minimum BMI at or

lower than 18 kg/m^2 for a minimal duration of 3 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 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 1 year at normal weight and without any dieting, binge eating, or inappropriate compensatory behaviours; $n = 1076$, 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. Most 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 behaviours. Internal consistency for the SIAB, as measured by Cronbach's α , is reported to be moderate to high, ranging from .78 to .91 for five of the six components (Fichter et al., 1998). Interrater reliability range is reported to be between .86 and .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 ($>4186.8\text{ kJ}$), the SIAB's cutoff point for objective binge eating) in a relatively short period with loss of control over the eating behaviour. If the participant endorsed a frequency of at least twice a week for 3 months and had at least slight loss of control, she was scored as positive for binge eating behaviour. Participants who did not have episodes wherein they consumed $>4186.8\text{ kJ}$, who endorsed 'rarely' for binge frequency, or who had no loss of control associated with binge eating were scored as negative for binge eating behaviour.

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 nonvomiters; all others were scored as positive for vomiting, including those who indicated that they 'rarely' engaged in the behaviour. The classifications for laxative and diuretic abuse were similarly defined. Individuals who only reported 'experimental' use were not considered to engage in the behaviour. 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 nonplanning. 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 behaviour 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 $.87$, respectively, in a general population sample in the USA (Cloninger et al., 1993). The 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 behaviours typically found among individuals with OCD. Lifetime prevalence of symptoms from a checklist 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 behaviour 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 nonindependence of data because of the inclusion of family members. For these multilevel models, the individual is considered level 1 and the family is considered 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 probably 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 by the total number of tests and then dividing that product (i.e. the product of multiplying each p -value by the total number of tests) 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 behaviour. 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 were 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 using the BIS-11 and novelty seeking and harm avoidance scales of the TCI), general obsessions and compulsions (as measured using the Y-BOCS), and obsessions and compulsions related to eating (as measured using the preoccupations and rituals scales of the YBC-EDS). These findings confirm previous demonstrations of associations between purging behaviour 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–purging interaction also supports purging as the stronger correlate of impulsivity in AN. Purging together with

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)
Nonplanning	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	<i>n</i>	Binge eating		Purging	
		<i>B</i> (95% confidence interval)	χ^2 (<i>p</i> -value)	<i>B</i> (95% confidence interval)	χ^2 (<i>p</i> -value)
Barrett Impulsivity Scale					
Motor	1351	.58 (−0.01, 1.18)	3.64 (.086)	1.49 (1.00, 1.98)	34.00 (.003)
Cognitive	1356	.60 (−0.01, 1.20)	3.76 (.086)	1.20 (0.69, 1.71)	20.57 (.003)
Nonplanning	1354	.58 (−0.11, 1.26)	2.70 (.130)	1.55 (0.97, 2.14)	26.03 (.003)
Temperament and Character Inventory					
Harm avoidance	1337	.22 (−0.80, 1.23)	0.17 (.677)	1.23 (0.35, 2.11)	7.47 (.014)
Novelty seeking	1336	.76 (−0.19, 1.71)	2.43 (.144)	2.13 (1.34, 2.93)	26.69 (.003)
Yale-Brown Obsessive Compulsive Scale					
Obsessions	1316	−.29 (−1.12, 0.54)	0.46 (.527)	1.50 (0.76, 2.23)	15.59 (.003)
Compulsions	1316	−.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	.34 (0.03, 0.66)	4.42 (.065)	.94 (0.62, 1.26)	30.65 (.003)
Worst rituals	1364	.18 (−0.17, 0.52)	0.97 (.365)	1.33 (1.00, 1.66)	55.02 (.003)

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 behaviour, but not binge eating, was significantly associated with the presence of impulsive behaviours in a sample of individuals with AN and BN. Behaviours indicative of impulsivity such as substance abuse/dependence, self-injury, and suicide attempts have also been associated with the presence of purging behaviour 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 behaviour, to be significantly associated with novelty seeking, a personality trait that has been associated previously with impulsive behaviour 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 on harm avoidance on the TCI. In line with this finding, individuals with OCD (without eating disorders) scored 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 behaviours 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 behaviours, and interview-based assessments of obsessions and compulsions. Although a major challenge in the past has been consistent classification of binge eating and purging because of differing cutoffs for frequency and duration of the behaviours, we employed a more inclusive definition for purging behaviour relative to DSM-IV criteria for BN (twice a week for 3 months), considering even those individuals who responded that they 'rarely' engaged in the behaviour as positive for purging. This represents a more conservative approach, as inclusion of those with lower frequency of the behaviour 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 behaviours 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 behaviours (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 3 years prior to study entry. As research has shown that most binge eating/purging develops within the first 3 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 3 years prior to study entry and did not endorse binge eating or purging behaviours at the time of interview may later develop these behaviours. 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 behaviour independently can provide valuable information about associated symptom profiles (impulsivity, obsessions, and compulsions) that may be useful to guide further assessment and treatment planning in AN.

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REFERENCES

- Alonso, P., Menchon, J. M., Jimenez, S., Segalas, J., Mataix-Cols, D., Jaurieta, N., et al. (2008). Personality dimensions in obsessive-compulsive disorder: Relation to clinical variables. *Psychiatry Research, 157*(1–3), 159–168.
- American Psychiatric Association. (2000). *Diagnostic criteria from DSM-IV-TR*. Washington, DC: American Psychiatric Association.
- Anderlueh, M., Tchanturia, K., Rabe-Hesketh, S., Collier, D., & Treasure, J. (2009). Lifetime course of eating disorders: Design and validity testing of a new strategy to define the eating disorders phenotype. *Psychological Medicine, 39*(1), 105–114.
- Barratt, E. (1983). The biological basis of impulsiveness. *Personality and Individual Differences, 4*(4), 387–391.
- Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society, 57*(1), 289–300.
- Bulik, C. M., Klump, K. L., Thornton, L., Kaplan, A. S., Devlin, B., Fichter, M. M., et al. (2004). Alcohol use disorder comorbidity in eating disorders: A multicenter study. *The Journal of Clinical Psychiatry, 65*(7), 1000–1006.
- Bulik, C. M., Sullivan, P. F., Carter, F. A., & Joyce, P. R. (1997). Initial manifestations of disordered eating behavior: dieting versus bingeing. *International Journal of Eating Disorders, 22*(2), 195–201.
- Bulik, C. M., Sullivan, P. F., Weltzin, T. E., & Kaye, W. H. (1995). Temperament in eating disorders. *International Journal of Eating Disorders, 17*(3), 251–261.
- Bulik, C. M., Thornton, L., Pinheiro, A. P., Plotnicov, K., Klump, K. L., Brandt, H., et al. (2008). Suicide attempts in anorexia nervosa. *Psychosomatic Medicine, 70*(3), 378–383.
- Casper, R. C., Eckert, E. D., Halmi, K. A., Goldberg, S. C., & Davis, J. M. (1980). Bulimia. Its incidence and clinical importance in patients with anorexia nervosa. *Archives of General Psychiatry, 37*(9), 1030–1035.
- Celikel, F. C., Kose, S., Cumurcu, B. E., Erkokmaz, U., Sayar, K., Borckardt, J. J., & Cloninger, C. R. (2009). Cloninger's temperament and character dimensions of personality in patients with major depressive disorder. *Comprehensive Psychiatry, 50*(6), 556–561.
- Claes, L., Nederkoorn, C., Vandereycken, W., Guerrieri, R., & Vertommen, H. (2006). Impulsiveness and lack of inhibitory control in eating disorders. *Eating Behaviors, 7*(3), 196–203.
- Claes, L., Vandereycken, W., & Vertommen, H. (2004). Personality traits in eating-disordered patients with and without self-injurious behaviors. *Journal of Personality Disorders, 18*(4), 399–404.
- Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry, 50*(12), 975–990.
- Deter, H. C., & Herzog, W. (1994). Anorexia-nervosa in a long-term perspective—Results of the Heidelberg-Mannheim study. *Psychosomatic Medicine, 56*(1), 20–27.
- Diggle, P., Liang, K., & Zeger, S. (1994). *Analysis of longitudinal data*. Oxford: Oxford Science.
- Eckert, E. D., Halmi, K. A., Marchi, P., Grove, W., & Crosby, R. (1995). Ten-year follow-up of anorexia nervosa: Clinical course and outcome. *Psychological Medicine, 25*(1), 143–156.
- Eddy, K. T., Keel, P. K., Dorer, D. J., Delinsky, S. S., Franko, D. L., & Herzog, D. B. (2002). Longitudinal comparison of anorexia nervosa subtypes. *International Journal of Eating Disorders, 31*(2), 191–201.
- Fassino, S., Abbate-Daga, G., Amianto, F., Leombruni, P., Boggio, S., & Rovera, G. G. (2002). Temperament and character profile of eating disorders: A controlled study with the Temperament and Character Inventory. *International Journal of Eating Disorders, 32*(4), 412–425.
- Favaro, A., & Santonastaso, P. (1996). Purging behaviors, suicide attempts, and psychiatric symptoms in 398 eating disordered subjects. *International Journal of Eating Disorders, 20*(1), 99–103.
- Favaro, A., & Santonastaso, P. (1997). Suicidality in eating disorders: Clinical and psychological correlates. *Acta Psychiatrica Scandinavica, 95*(6), 508–514.
- Favaro, A., Zanetti, T., Tenconi, E., Degortes, D., Ronzan, A., Veronese, A., & Santonastaso, P. (2005). The relationship between temperament and impulsive behaviors in eating disordered subjects. *Eating Disorders, 13*(1), 61–70.
- Fernandez-Aranda, F., Pinheiro, A. P., Thornton, L. M., Berrettini, W. H., Crow, S., Fichter, M. M., et al. (2008). Impulse control disorders in women with eating disorders. *Psychiatry Research, 157*(1–3), 147–157.
- Fichter, M. M., Herpertz, S., Quadflieg, N., & Herpertz-Dahlmann, B. (1998). Structured interview for anorexic and bulimic disorders for DSM-IV and ICD-10: Updated (third) revision. *International Journal of Eating Disorders, 24*(3), 227–249.
- Fichter, M. M., Quadflieg, N., & Hedlund, S. (2006). Twelve-year course and outcome predictors of anorexia nervosa. *International Journal of Eating Disorders, 39*(2), 87–100.
- First, M., Spitzer, R., Gibbon, M., & Williams, J. (1997). *Structured clinical interview for DSM-IV Axis I disorders, research version, patient edition*. New York: Biometrics Research, New York State Psychiatric Institute.
- Fornari, V., Kaplan, M., Sandberg, D. E., Matthews, M., Skolnick, N., & Katz, J. L. (1992). Depressive and anxiety disorders in anorexia-nervosa and bulimia-nervosa. *International Journal of Eating Disorders, 12*(1), 21–29.
- Garfinkel, P. E., Moldofsky, H., & Garner, D. M. (1980). The heterogeneity of anorexia nervosa. Bulimia as a distinct subgroup. *Archives of General Psychiatry, 37*(9), 1036–1040.
- Garner, D. M., Garner, M. V., & Rosen, L. W. (1993). Anorexia nervosa "restricters" who purge: Implications for subtyping anorexia nervosa. *International Journal of Eating Disorders, 13*(2), 171–185.
- Godart, N., Berthoz, S., Rein, Z., Perdereau, F., Lang, F., Venisse, J. L., et al. (2006). Does the frequency of anxiety and depressive disorders differ between diagnostic subtypes of anorexia nervosa and bulimia? *International Journal of Eating Disorders, 39*(8), 772–778.
- Godart, N., Flament, M. F., Perdereau, F., & Jeammot, P. (2002). Comorbidity between eating disorders and anxiety disorders: A review. *International Journal of Eating Disorders, 32*(3), 253–270.
- Goodman, W. K., Price, L. H., Rasmussen, S. A., Mazure, C., Fleischmann, R. L., Hill, C. L., et al. (1989). The Yale-Brown Obsessive Compulsive Scale. I. Development, use, and reliability. *Archives of General Psychiatry, 46*(11), 1006–1011.
- Halmi, K. A., Brodland, G., & Loney, J. (1973). Prognosis in anorexia-nervosa. *Annals of Internal Medicine, 78*(6), 907–909.
- Halmi, K. A., Sunday, S. R., Klump, K. L., Strober, M., Leckman, J. F., Fichter, M., et al. (2003). Obsessions and compulsions in anorexia nervosa subtypes. *International Journal of Eating Disorders, 33*(3), 308–319.
- Hebebrand, J., Himmelmang, G. W., Hesecker, H., Schafer, H., & Renschmidt, H. (1996). Use of percentiles for the body mass index in anorexia nervosa: Diagnostic, epidemiological, and therapeutic considerations. *International Journal of Eating Disorders, 19*(4), 359–369.
- Herzog, D. B., Field, A. E., Keller, M. B., West, J. C., Robbins, W. M., Staley, J., & Colditz, G. A. (1996). Subtyping eating disorders: is it justified? *Journal of the American Academy of Child and Adolescent Psychiatry, 35*(7), 928–936.
- Herzog, W., Schellberg, D., & Deter, H. C. (1997). First recovery in anorexia nervosa patients in the long-term course: A discrete-time survival analysis. *Journal of Consulting and Clinical Psychology, 65*(1), 169–177.
- Jacobs, M. J., Roesch, S., Wonderlich, S. A., Crosby, R., Thornton, L., Wilfley, D. E., et al. (2009). Anorexia nervosa trios: Behavioral profiles of individuals with anorexia nervosa and their parents. *Psychological Medicine, 39*(3), 451–461.
- Kaye, W. H., Bulik, C. M., Plotnicov, K., Thornton, L., Devlin, B., Fichter, M. M., et al. (2008). The genetics of anorexia nervosa collaborative study: Methods and sample description. *International Journal of Eating Disorders, 41*(4), 289–300.
- Keel, P. K., Mitchell, J. E., Miller, K. B., Davis, T. L., & Crow, S. J. (2000). Predictive validity of bulimia nervosa as a diagnostic category. *The American Journal of Psychiatry, 157*(1), 136–138.
- Klump, K. L., Bulik, C. M., Pollice, C., Halmi, K. A., Fichter, M. M., Berrettini, W. H., et al. (2000). Temperament and character in women with anorexia nervosa. *The Journal of Nervous and Mental Disease, 188*(9), 559–567.
- Klump, K. L., Strober, M., Bulik, C. M., Thornton, L., Johnson, C., Devlin, B., et al. (2004). Personality characteristics of women before and after recovery from an eating disorder. *Psychological Medicine, 34*(8), 1407–1418.
- Laessle, R., Wittchen, H., Fichter, M., & Pirke, K. (1989). The significance of subgroups of bulimia and anorexia nervosa: Lifetime frequency of psychiatric disorders. *International Journal of Eating Disorders, 8*(5), 569–574.
- Liang, K., & Zeger, S. (1986). Longitudinal data analysis using generalized linear models. *Biometrika, 73*(1), 13–22.
- Matsunaga, H., Miyata, A., Iwasaki, Y., Matsui, T., Fujimoto, K., & Kiriike, N. (1999). A comparison of clinical features among Japanese eating-disordered women with obsessive-compulsive disorder. *Comprehensive Psychiatry, 40*(5), 337–342.
- Milos, G., Spindler, A., Ruggiero, G., Klaghofer, R., & Schnyder, U. (2002). Comorbidity of obsessive-compulsive disorders and duration of eating disorders. *International Journal of Eating Disorders, 31*(3), 284–289.
- Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the Barratt impulsiveness scale. *Journal of Clinical Psychology, 51*(6), 768–774.
- Peat, C., Mitchell, J. E., Hoek, H. W., & Wonderlich, S. A. (2009). Validity and utility of subtyping anorexia nervosa. *International Journal of Eating Disorders, 42*(7), 590–594.
- Pryor, T., Wiederman, M. W., & McGilley, B. (1996). Clinical correlates of anorexia nervosa subtypes. *International Journal of Eating Disorders, 19*(4), 371–379.
- Reba, L., Thornton, L., Tozzi, F., Klump, K. L., Brandt, H., Crawford, S., et al. (2005). Relationships between features associated with vomiting in purging-type eating disorders. *International Journal of Eating Disorders, 38*(4), 287–294.
- Root, T. L., Pinheiro, A. P., Thornton, L., Strober, M., Fernandez-Aranda, F., Brandt, H., et al. (2010). Substance use disorders in women with anorexia nervosa. *International Journal of Eating Disorders, 43*(1), 14–21.
- Root, T. L., Pisetsky, E. M., Thornton, L., Lichtenstein, P., Pedersen, N. L., & Bulik, C. M. (2010). Patterns of co-morbidity of eating

- disorders and substance use in Swedish females. *Psychological Medicine*, 40(1), 105–115.
- Salbach-Andrae, H., Lenz, K., Simmendinger, N., Klinkowski, N., Lehmkuhl, U., & Pfeiffer, E. (2008). Psychiatric comorbidities among female adolescents with anorexia nervosa. *Child Psychiatry and Human Development*, 39(3), 261–272.
- SAS/STAT[®] Software: Version 9. (2004). Cary, NC: SAS Institute Inc.
- Speranza, M., Corcos, M., Godart, N., Loas, G., Guilbaud, O., Jeammet, P., & Flament, M. (2001). Obsessive compulsive disorders in eating disorders. *Eating Behaviors*, 2(3), 193–207.
- Strober, M., Freeman, R., & Morrell, W. (1997). 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*, 22(4), 339–360.
- Sunday, S. R., Halmi, K. A., & Einhorn, A. (1995). The Yale-Brown-Cornell eating disorder scale: A new scale to assess eating disorder symptomatology. *International Journal of Eating Disorders*, 18(3), 237–245.
- Swinbourne, J. M., & Touyz, S. W. (2007). The co-morbidity of eating disorders and anxiety disorders: A review. *European Eating Disorders Review*, 15(4), 253–274.
- Tozzi, F., Thornton, L. M., Klump, K. L., Fichter, M. M., Halmi, K. A., Kaplan, A. S., et al. (2005). Symptom fluctuation in eating disorders: correlates of diagnostic crossover. *The American Journal of Psychiatry*, 162(4), 732–740.
- Zeger, S. L., Liang, K. Y., & Albert, P. S. (1988). Models for longitudinal data: A generalized estimating equation approach. *Biometrics*, 44(4), 1049–1060.

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