

Personality characteristics of women before and after recovery from an eating disorder

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ABSTRACT

Background. Previous studies of personality characteristics in women with eating disorders primarily have focused on women who are acutely ill. This study compares personality characteristics among women who are ill with eating disorders, recovered from eating disorders, and those without eating or other Axis I disorder pathology.

Method. Female participants were assessed for personality characteristics using the Temperament and Character Inventory (TCI): 122 with anorexia nervosa (AN; 77 ill, 45 recovered), 279 with bulimia nervosa (BN; 194 ill, 85 recovered), 267 with lifetime histories of both anorexia and bulimia nervosa (AN + BN; 194 ill, 73 recovered), 63 with eating disorder not otherwise specified (EDNOS; 31 ill, 32 recovered), and 507 without eating or Axis I disorder pathology.

Results. Women ill with all types of eating disorders exhibited several TCI score differences from control women, particularly in the areas of novelty-seeking, harm avoidance, self-directedness, and cooperativeness. Interestingly, women recovered from eating disorders reported higher levels of harm avoidance and lower self-directedness and cooperativeness scores than did normal control women.

Conclusions. Women with eating disorders in both the ill and recovered state show higher levels of harm avoidance and lower self-directedness and cooperativeness scores than normal control women. Although findings suggest that disturbances may be trait-related and contribute to the disorders' pathogenesis, additional research with more representative community controls, rather than our pre-screened, normal controls, is needed to confirm these impressions.

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INTRODUCTION

Several studies have documented significant associations between particular personality characteristics and the eating disorders anorexia nervosa (AN) and bulimia nervosa (BN). Specifically, women with AN have generally been found to be more harm avoidant, neurotic, perfectionistic, and obsessive when compared to healthy controls (Dally, 1969; Casper, 1990; Kleifield *et al.* 1994*a,b*; Sohlberg & Strober, 1994; Bulik *et al.* 1995*a*, 2000; O'Dwyer *et al.* 1996; Fairburn *et al.* 1999; Fassino *et al.* 2001, 2002*a,b*). Women with BN have been shown to share many of these characteristics, but also tend to be more impulsive and disinhibited than those with AN (Brewerton *et al.* 1993; Waller *et al.* 1993; Kleifield *et al.* 1994*a,b*; Bulik *et al.* 1995*a*; Wade *et al.* 1995; Pryor & Wiederman, 1996; Mizushima *et al.* 1998; Lilenfeld *et al.* 2000; Fassino *et al.* 2001, 2002*a*, 2003). These observations implicate certain personality or temperamental traits that may predispose to these illnesses.

A significant limitation of previous studies is their primary reliance on clinical samples of ill participants. As starvation and aberrant eating patterns of women with AN and BN have been shown to accentuate psychiatric symptoms (Keys, 1946), it cannot be known with certainty whether personality characteristics observed in these patients antedate the onset of their illness or are merely correlates of the disease process itself. Indeed, previous investigations of the effects of depression on personality scores in AN women found significantly fewer personality disturbances when depressive symptoms were controlled for (Kleifield *et al.* 1994*b*).

Two designs that can potentially elucidate the role of personality in the etiology of psychiatric disease are longitudinal, prospective studies of population or high-risk cohorts, and studies of remitted or recovered clinical samples. To date, no longitudinal study has investigated personality characteristics as predictors of AN or BN. However, a series of investigations by Leon and co-workers found negative emotionality to be the most significant cross-sectional and longitudinal predictor of disordered eating symptoms in a sample of high-school students (Leon *et al.* 1993, 1999). These findings suggest that at least one aspect of personality, negative emotionality,

may serve as a risk factor for general eating pathology.

Because of the prohibitive expense and complex logistics of large-scale prospective investigations of disorders with low population base-rates, longitudinal, predictive studies of eating disorders are difficult to conduct and fund. Consequently, researchers have employed 'recovery' designs in examining potential etiologic effects. The main focus of interest in these designs is the presence of pathological or extreme characteristics in participants who are clinically recovered. If traits of theoretical or clinical interest are observed, then these characteristics may have been present before illness onset and predisposed to its manifestation. Although observed differences might represent persistent/enduring traits that existed pre-morbidly, they may also be the continuation of characteristics begun during the illness, and thus represent enduring 'scar' effects of previous clinical disturbance. Nonetheless, the design provides important initial information about whether disturbances are present only during active periods of illness.

A handful of studies have used this design to examine personality characteristics in women with eating disorders (Stonehill & Crisp, 1977; O'Dwyer *et al.* 1996; Kaye *et al.* 1998; Ward *et al.* 1998; Bulik *et al.* 2000; Lilenfeld *et al.* 2000), the results of which have been inconclusive. Although some have found low levels of novelty-seeking (Casper, 1990; Ward *et al.* 1998) or high levels of harm avoidance and stress reactivity (Casper, 1990; O'Dwyer *et al.* 1996; Kaye *et al.* 1998; Lilenfeld *et al.* 2000; Stein *et al.* 2002; Bloks, *in press*) in recovered subjects, others have not (Stonehill & Crisp, 1977; Bulik *et al.* 2000).

Inconsistent findings may be due to methodological limitations. First, sample sizes have been small (range 9–34), resulting in chance sample variations that may have affected results. Secondly, the length of recovery required for study inclusion has varied from immediately after weight recovery (Stonehill & Crisp, 1977) to at least 6 months (O'Dwyer *et al.* 1996) to a year or more (Stein *et al.* 2002; Bloks, *in press*), whereas in some studies (Casper, 1990; Ward *et al.* 1998; Bulik *et al.* 2000) the length of time required to be considered to be recovered was not specified *a priori*. In illnesses such as eating disorders, where recovery is often marked by brief

remissions followed by relapses (Keel & Mitchell, 1997; Strober *et al.* 1997), longer recovery times are needed in order to avoid inclusion of subjects with prodromal symptoms who will soon become ill again. The presence of personality alterations in some studies (Casper, 1990; O'Dwyer *et al.* 1996; Ward *et al.* 1998) may therefore reflect insufficient recovery times and continuing subthreshold illness.

The purpose of the present study was to compare personality characteristics of women who are acutely ill with eating disorders to those of individuals who have recovered from these disorders and healthy control individuals. Methodological improvements over previous research were incorporated wherever possible. For example, the sample is the largest of its kind to date, a 1-year symptom remission was required for defining subjects as recovered, and understudied recovered BN and eating disorder not otherwise specified (EDNOS) patients were included. Findings from this study have the potential to significantly increase understanding of the nature of personality traits in women with eating pathology.

METHOD

Participants

All participants come from the multi-site, international Price Foundation Genetic Studies of BN (Kaye *et al.* unpublished observations). The goal of this study is to identify susceptibility genes for eating disorders using an affected relative pair design. Personality characteristics of AN participants in an earlier wave of data collection for this study have been described previously (Klump *et al.* 2000). The current study extends these findings by examining disorders (i.e. BN, EDNOS) and variables (i.e. status of illness) that could not be investigated with this previous dataset.

Eating-disorder participants

Eating-disorder participants included 358 relative pairs affected with AN, BN, or EDNOS recruited from 10 sites across North America and Europe, including: University of Pittsburgh (W.K.), Cornell University (K.H.), University of California at Los Angeles (M.S.), University of Toronto (A.K., B.W.), University of Munich (M.F.), University of Pennsylvania (W.B.),

University of Pisa (A.R.), University of North Dakota (J.M.), University of Minnesota (S.C.), and Harvard University (P.K.). Specific sample ascertainment and recruitment strategies are discussed in detail elsewhere (Kaye *et al.* 2000; Kaye *et al.* unpublished observations), and thus are only briefly described here. Female and male probands were recruited through treatment facilities and advertisements at the above-mentioned sites. Although some studies have suggested differences in personality characteristics (Perkins *et al.* in press) and psychiatric co-morbidity (Fairburn *et al.* 1996; Keel *et al.* 2002) between treatment-seeking and non-treatment-seeking eating-disorder subjects, we did not find any differences between our subjects who had received some form of treatment (i.e. in-patient, out-patient, medication, etc.) and those who had never received treatment (data not shown).

Inclusion criteria for probands were as follows: (1) age between 13 and 65; (2) a modified DSM-IV lifetime diagnosis of BN purging type (i.e. binge eating and self-induced vomiting required for at least 6 months' duration); and (3) no lifetime history of mental retardation (IQ < 70), dementia, organic brain syndromes, psychotic disorders, Turner's syndrome, or medical conditions that could affect appetite, body weight, or eating (e.g. diabetes and thyroid conditions were excluded if the disease onset preceded the onset of BN). BN probands were permitted to have an additional diagnosis of AN or any other eating disorder as long as they also met the above inclusion criteria. Upon initial screening, probands were questioned about eating disorders in their male and female biological relatives. Permission to contact all relatives (i.e. first- through fourth-degree relatives) with suspicion of an eating disorder was then sought, and the relative(s) were subsequently contacted. Inclusion criteria for affected relatives included an age between 13 and 65 and a DSM-IV lifetime diagnosis of BN (purging or non-purging type), AN (restricting or binge eating/purging type), or any of the following EDNOS diagnoses: (1) EDNOS-1, defined as subthreshold AN with the presence of two out of the four AN criteria, no lifetime bingeing, and a lifetime body mass index (BMI) < 125% of ideal body weight; (2) EDNOS-2, defined as subthreshold BN with binge eating and purging occurring for less than

3 months or at a lower frequency than twice a week; or (3) EDNOS-3, defined as the presence of purging or other clearly excessive compensatory behaviors in the absence of objective binge eating, in individuals of normal weight who have either an intense fear of gaining weight/becoming fat or an undue influence of body weight or shape on self-evaluation. Affected relatives were also required to be free of the psychiatric and medical conditions excluded for probands.

The current study includes all *female* probands and affected relatives ($n=714$) from this recruitment wave. Male participants were excluded due to their low frequency in the sample ($n=15$). As noted previously, a primary objective of this study was to examine the effects of status of illness on Temperament and Character Inventory (TCI) scores. Consequently, women with eating disorders were subdivided into those who were ill during the time of assessment *versus* those who were considered to be recovered.

Although all recovered women had to be illness-free for at least 1 year, the behaviors that defined recovery naturally differed by eating-disorder type. Specifically, women with BN were considered recovered if they were binge/purge-free for at least 1 year. Women with AN were considered recovered if they were of normal body weight (i.e. above the fifth percentile of their ideal BMI) and free of all eating-disordered behaviors (i.e. dieting, restricting, bingeing, purging, etc.) for this same length of time. Women with both AN and BN were considered recovered if they met all of the criteria above. Finally, women with EDNOS were considered recovered if they were of normal body weight and free of all eating-disorder behavior.

The absence of eating-disorder behaviors for all participants was determined using information reported on an expanded version of Module H of the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID; First et al. 1997; see the description of this diagnostic measure below). This expanded version includes questions regarding the frequency in the past year of dieting, binge eating, and all forms of purging (e.g. vomiting, laxative use) as well as non-purging (e.g. excessive exercise, fasting) compensatory behaviors. Participants had to report an absence of all of these behaviors, as well as meet the other criteria outlined above, in order to be considered recovered.

Final sample sizes for these categorizations were: 122 women with AN (77 ill, 45 recovered), 279 women with BN (194 ill, 45 recovered), 267 women with lifetime histories of both AN and BN (AN+BN; 194 ill, 73 recovered), and 63 with any form of EDNOS (31 ill, 32 recovered). Roughly 97.5% of all participants were Caucasian, while the remaining 2.5% were of either Hispanic or of Asian or Pacific Islander ancestry.

Healthy control women

The Price Foundation has begun recruiting a large sample of healthy control women at each of its data collection sites for inclusion in genetic analyses. Data on 507 of these participants were available at the time of this study and were therefore included in analyses for comparison purposes. These individuals were recruited through local advertisements and were required to be between the ages of 18 and 65, of normal weight (i.e. lifetime BMI range 19–27), and of primarily Caucasian ancestry. These women initially responded to a brief telephone screen in which they were questioned about medical conditions and personal and familial history of Axis I disorders. Women reporting lifetime histories of eating disorders, psychiatric problems, problems with drugs or alcohol, or any of the medical conditions described above were excluded. Women reporting eating disorders in a family member were also excluded. After informed consent was obtained, these women were further evaluated to exclude those with any likely Axis I disorder, as assessed by the SCID Screen Patient Questionnaire–Extended SSPQ-X (First et al. 1999), and those with any significant dieting, eating-disorder behaviors, or excessive concerns with weight or shape as determined by Eating Attitudes Test-26 (EAT-26; Garner et al. 1982) scores ≥ 20 . Women who met all of the above inclusion and none of the exclusion criteria completed a battery of self-report measures that included the Temperament and Character Inventory (see below).

Measures

Eating-disorder diagnoses

Lifetime histories of eating disorders in probands and affected relatives were assessed with the Structured Inventory of Anorexic and

Bulimic Syndromes (SIAB; Fichter *et al.* 1998). The SIAB is a semi-structured clinical interview designed to gather detailed information on weight and eating history to establish DSM-IV and ICD-10 eating-disorder diagnoses. Additional information regarding eating-disorder recovery status as well as the presence or absence of eating-disorder behaviors (e.g. dieting, bingeing, purging, etc.) was obtained by an expanded version of Module H of SCID (First *et al.* 1997). The training procedures for the SIAB and SCID have been described in detail elsewhere (Kaye *et al.* in press).

Personality characteristics

Cloninger's 240-item TCI Version 9 (Cloninger *et al.* 1994) was used to assess temperament and character dimensions thought to influence susceptibility to emotional and behavioral disorders. Cloninger refers to temperament as emotional responses that are moderately heritable, stable throughout life, and mediated by neurotransmitter functioning in the central nervous system. Four temperament dimensions are assessed with the TCI including novelty-seeking (NS), harm avoidance (HA), reward dependence (RD), and persistence (P). NS assesses behavioral activation to pursue rewards and is posited to be related to decreased dopaminergic activity. High scorers on this scale are characterized by an exploratory, curious, and impulsive nature, whereas low scorers tend to be indifferent, reflective, frugal, orderly and regimented. Harm avoidance assesses the tendency to inhibit behavior to avoid punishment and is purported to be related to increased serotonergic activity. High HA scorers tend to be fearful, shy, pessimistic, and worrying. By contrast, low HA scorers have a relaxed and optimistic disposition that tends to be characterized by boldness and confidence.

Reward dependence assesses the maintenance of rewarded behavior and is hypothesized to be mediated by decreased noradrenergic activity. High scorers on the RD scale tend to be sentimental, dedicated, attached, and dependent, while low scorers are frequently characterized as practical, cold, detached, and independent. Finally, persistence assesses perseverance without intermittent reinforcement that is also purported to be related to decreased noradrenergic activity. High P scorers have a tendency to be

industrious, diligent, ambitious, perfectionistic, and overachieving, while low P scorers tend to be inactive, pragmatic, indolent, and underachieving.

According to Cloninger, character refers to self-concepts, goals, and values that develop through experience. The three TCI character dimensions are cooperativeness (C), self-directedness (SD), and self-transcendence (ST). Cooperativeness assesses the degree to which the self is viewed as a part of society; high scorers on this scale are characterized as socially tolerant, empathic, compassionate, and principled, whereas low scorers tend to be critical, opportunistic, socially intolerant, and revengeful. Self-directedness assesses the degree to which the self is viewed as autonomous and integrated. High SD scorers are therefore characterized as mature, responsible, reliable, self-accepted, and resourceful. By contrast, low SD scorers tend to be immature, fragile, unreliable, self-striving, and ineffective. Finally, ST assesses the degree to which the self is viewed as an integral part of the universe. High scorers on this scale tend to be wise, patient, creative, and forgetful, whereas low scorers are frequently characterized as impatient, unimaginative, and self-conscious.

The TCI has been normed in a large USA national probability sample and shows acceptable internal consistency (range 0.76–0.89) (Cloninger *et al.* 1994).

Depressive symptoms

Depressive symptoms in the eating-disorder women were assessed with the 21-item Beck Depression Inventory (BDI; Beck & Steer, 1987). The BDI reliably distinguishes depressed patients from controls and is considered the gold standard for questionnaire assessments of depression.

Statistical analyses

Mean differences on dependent measures between women with eating disorders and control women were examined using Generalized Estimating Equations (GEE) (Liang & Zeger, 1986; Zeger & Liang, 1986; Diggle *et al.* 1994). GEE is a statistical approach based on regression techniques that is used to investigate correlated data, such as panel studies and the affected relative-pair data used in the current study. In the current study, biologically related family

members comprised each cluster in the GEE analyses. However, because the current study included family members of varying relatedness (i.e. first-, second-, and third-degree relatives as well as unrelated controls), the GEE analyses were conducted in two steps. First, models were fit to the TCI data via the GEE method for probands and their siblings only using the exchangeable working correlation matrix to obtain an estimate of the familial correlation among these first-degree relatives. Secondly, models were re-fit to the entire dataset of relatives and unrelated healthy controls using familial correlations estimated from the probands and siblings as the user-defined working correlation matrix. The model parameters and statistics from these models were then used as the final solution. This approach to the analyses can be considered conservative, as the proband/sibling correlations are likely overestimates of the expected correlations among clusters of unrelated individuals and second- and third-degree relatives. Such overestimation is likely to result in fewer, rather than more, significant findings.

Several useful statistics are generated by the GEE method and used in the current study. Type 3 tests (Score statistics) were used for testing the significance of each independent variable in the model. Means adjusted for cluster relationships as well as model covariates were also generated by the GEE analyses; contrasts were then conducted on these adjusted means to examine group differences on dependent measures, with Score statistics again used to determine the statistical significance of these contrasts.

Previous research has indicated that some of the TCI scales are significantly correlated with age (Svrakic *et al.* 1992; Kleifield *et al.* 1994a) and levels of depression (Kleifield *et al.* 1994b), and that TCI scores may differ by geographic region (Svrakic *et al.* 1992). Consequently, we included age, BDI scores, and site at which the data were collected ('center', i.e. Pittsburgh, New York, Los Angeles, Toronto, London, Munich, Philadelphia, Fargo, Boston or Pisa) as covariates in the GEE analyses in order to control for their effects. In addition, center was added as an additional clustering variable as women from similar regions of the world may be more correlated for TCI scores than those from different regions.

All statistical analyses were conducted using the GENMOD procedure of SAS version 7.0 (SAS, 1996).

RESULTS

Contrast results including group means and standard errors adjusted for cluster relationships and covariates are presented in Table 1. Very few age differences emerged between the eating disorder and control groups. Not surprisingly, ill eating-disorder women tended to be younger than recovered women. In addition, some recovered women (i.e. recovered BN and AN + BN women) were significantly older than healthy control women. However, in general, differences in age were minimal.

TCI comparisons across eating-disorder and control women

Contrast results comparing eating-disorder to control women are noted in the second to last column of Table 1. All of the TCI scales showed some combination of significant age, BDI score, or data collection site effects. Specifically, NS evidenced significant age ($\chi^2_{(1)}=13.06$, $p<0.001$) and BDI score ($\chi^2_{(1)}=9.53$, $p=0.002$) effects, while BDI scores ($\chi^2_{(1)}=67.46$, $p<0.001$) and a BDI score \times diagnosis interaction ($\chi^2_{(1)}=26.92$, $p<0.001$) significantly influenced HA scores. RD showed significant BDI score ($\chi^2_{(1)}=6.40$, $p=0.01$) and data collection site ($\chi^2_{(11)}=22.50$, $p=0.02$) effects; by contrast, data collection site was the only significant covariate for P ($\chi^2_{(11)}=48.01$, $p<0.001$) and ST ($\chi^2_{(11)}=33.89$, $p<0.001$). Finally, all of the covariates were significant for both C (age $\chi^2_{(1)}=14.51$, $p<0.001$; BDI score $\chi^2_{(1)}=17.73$, $p<0.001$; BDI score \times diagnosis $\chi^2_{(1)}=19.81$, $p=0.01$; data collection site $\chi^2_{(11)}=56.63$, $p<0.001$) and SD (age $\chi^2_{(1)}=27.56$, $p<0.001$; BDI score $\chi^2_{(1)}=77.44$, $p<0.001$; BDI score \times diagnosis $\chi^2_{(1)}=4.55$, $p<0.001$; data collection site $\chi^2_{(11)}=36.34$, $p<0.001$).

After controlling for these significant effects, women ill with AN, BN and AN + BN exhibited many significant differences from healthy control women, particularly on the NS, HA, C, and SD subscales. All eating-disorder women scored significantly higher on HA, and significantly lower on SD, than control women. Ill AN and BN women also scored significantly higher than

Table 1. Mean differences in age and TCI scores among eating-disorder and control women

Variable	AN		BN		AN+BN		EDNOS		Controls (n=507)	Control contrasts	ED diagnosis contrasts
	A Ill (n=77)	B Rec. (n=45)	C Ill (n=194)	D Rec. (n=85)	E Ill (n=194)	F Rec. (n=73)	G Ill (n=31)	H Rec. (n=32)			
Age	25.95 (1.30)	29.36 (1.38)	27.14 (0.71)	30.87 (1.20)	26.89 (0.75)	30.67 (1.14)	25.07 (1.47)	29.85 (1.38)	26.66 (0.54)	D, F>I	A, C, E, G<D, F
NS	17.78 (0.90)	21.43 (1.03)	22.60 (0.61)	22.08 (0.75)	21.84 (0.63)	20.16 (0.69)	21.37 (1.22)	21.59 (0.95)	19.67 (0.82)	B, C, D, E>I	A<B, C, D, E, F, G
HA	18.86 (0.90)	16.33 (0.87)	17.06 (0.64)	15.83 (0.83)	18.01 (0.63)	19.12 (0.67)	18.48 (1.02)	17.56 (1.09)	15.21 (0.77)	A, C, D, E, F, G, H>I	B<A, C, E, F; D<F
RD	17.09 (0.51)	18.01 (0.53)	17.19 (0.34)	17.11 (0.57)	16.93 (0.41)	18.34 (0.47)	16.92 (0.57)	17.86 (0.63)	16.10 (0.55)	n.s.	n.s.
P	5.75 (0.26)	5.39 (0.32)	4.77 (0.19)	5.50 (0.24)	5.24 (0.19)	5.31 (0.22)	5.16 (0.34)	5.08 (0.43)	5.01 (0.26)	n.s.	n.s.
C	34.65 (0.54)	34.37 (0.75)	34.75 (0.40)	33.56 (0.77)	33.67 (0.56)	34.22 (0.68)	33.66 (1.01)	35.33 (1.18)	34.52 (0.69)	A, C>I, D, E, F<I	A, D, E<H; B>E
SD	30.32 (0.96)	29.44 (1.12)	27.32 (0.57)	30.97 (0.83)	26.71 (0.62)	29.17 (0.81)	27.38 (1.04)	30.64 (1.33)	31.42 (1.04)	A, C, D, E, F<I	A, B, G, H>C, E
ST	13.07 (0.80)	15.29 (1.19)	16.02 (0.57)	16.47 (0.77)	15.04 (0.61)	15.02 (0.80)	15.52 (1.21)	15.82 (1.11)	14.77 (0.84)	C, D>I	A<C, D, E; D>E, F

Values are adjusted means and (standard errors).

AN, anorexia nervosa; BN, bulimia nervosa; AN+BN, subjects who have a lifetime history of AN and BN; EDNOS, eating disorder not otherwise specified; Ill, subjects who were acutely ill with an eating disorder at the time of assessments; Rec., subjects who were deemed recovered at the time of their assessments; NS, novelty-seeking; HA, harm avoidance; RD, reward dependence; P, persistence; C, cooperativeness; SD, self-directedness; ST, self-transcendence.

control women on C, while women ill with AN+BN scored significantly lower than healthy controls on this subscale. Finally, ill BN and AN+BN women were found to score significantly higher on NS compared to control women. With the exception of higher NS scores, women ill with EDNOS exhibited few significant differences from the healthy control women.

Several of these differences were also observed in women recovered from eating disorders. This was particularly true for the HA, C, SD scales. Similar to women ill with eating disorders, women recovered from BN, AN+BN, and EDNOS were found to have higher HA scores than control women. In addition, women recovered from BN and AN+BN were found to have significantly lower SD and C scores than control women, findings that are similar to those of their ill counterparts. Finally, women recovered from BN also exhibited significantly higher NS and ST scores than control women. These findings closely mimic those of women ill with BN. In general, women recovered from AN exhibited few significant differences from control women, although smaller sample sizes in this group may have limited detection of significant effects. The one TCI scale that did show differences in this group was NS. Women recovered from AN were

found to have significantly *higher* NS scores than control women. This finding contrasts with that for women ill with AN; these women exhibited lower (although not significantly so) NS scores than healthy controls, suggesting that NS may be particularly influenced by the starvation and emaciation of AN.

Taken together, findings described above suggest that women with BN and AN+BN exhibit consistent TCI scale differences from healthy control women that are present in both the ill and recovered state. Findings for women with AN and EDNOS were much more variable. Although several significant differences were found in the ill state (particularly for AN), these differences were generally not observed in women recovered from AN and EDNOS.

Comparisons across eating-disorder diagnoses

Several differences across eating-disorder diagnoses also emerged. Not surprisingly, women ill with BN scored the highest on NS, whereas women ill with AN scored the lowest. By contrast, women ill with any form of AN (i.e. AN or AN+BN) exhibited the highest HA scores, while those recovered from AN and those recovered from BN exhibited the lowest. This last set of findings suggest some normalization of

HA scores after recovery in women with AN and BN. However, as noted above, women recovered from BN continue to exhibit significant HA score differences from control women. Similar to previous studies, we found that women ill with BN and AN + BN had the lowest SD scores of all eating-disorder subtypes. Women ill with AN scored the lowest of all eating-disorder groups on ST. Finally, all eating-disorder groups scored similarly on RD, P, and C, although women with EDNOS exhibited some differences on C, with higher C scores in the recovered state being most notable.

DISCUSSION

These findings are important because they show that the distribution of several personality characteristics in women ill with eating disorders and those who are in the recovered state are different from normal control women. Conclusions from these data must be tentative, as our use of a normal control sample may have resulted in more differences across groups than would have been obtained had a more representative control group been used. Findings therefore require replication with community samples before definitive conclusions can be drawn.

Bearing this caveat in mind, the most notable differences across groups were higher scores on HA and lower SD and C scores. Women with BN, AN + BN, and EDNOS tended to be more anxious and inhibited than control women, regardless of status of illness. Likewise, all women with BN and AN + BN exhibited increased C scores, which reflect a general tendency to be socially detached, intolerant, and critical of others. Finally, a tendency towards ineffectiveness, immaturity, and a general conformity to external pressure seems to be characteristic of women with BN and AN + BN in both the ill and recovered state. These increased SD scores are likely due to the presence of Cluster B personality disturbances, as data from our (Santa-Maria *et al.* unpublished observations) and other projects (Johnson *et al.* 1989; Johnson *et al.* 1990; Johnson & Wonderlich, 1992; Bulik *et al.* 1995a) suggest an increased rate of these personality disorders in women with BN pathologies.

Impulsivity appears to be characteristic of BN women in general, as increased NS scores were

found for both ill and recovered BN women. Other behavioral indicators of impulsivity, such as substance abuse, have also been found in women with BN in our sample (Bulik *et al.* in press). Interestingly, this impulsivity does not appear to be an artifact of the Axis I disorders, as differences in impulsivity across eating-disorder groups remain after controlling for the presence of substance use and impulse control disorders (Barnes *et al.* unpublished observations).

Nonetheless, NS does not appear to be impervious to the effects of all acute eating-disorder symptoms. Women ill with AN had the lowest NS scores of all eating-disorder groups, while recovered AN women had NS scores that were comparable to those of women with BN. These findings indicate that starvation may temporarily decrease an individual's relative openness to new experiences. In addition, they suggest that women with AN may have higher NS scores pre-morbidly than previously believed, or experience increased levels of excitement-seeking after recovery, possibly as a result of treatment aimed at decreasing these individuals' noted inhibition and cautiousness. It is also possible that women with AN who have higher NS scores pre-morbidly are more likely to recover than women with lower levels of this personality characteristic.

A seemingly anomalous finding was the general lack of personality disturbances in women recovered from AN. Unlike women recovered from BN and AN + BN, these women did not exhibit differences in HA or SD scores from healthy control women. Previous research in this area has been mixed, with two studies showing personality disturbances in recovered AN women (Casper, 1990; O'Dwyer *et al.* 1996), and three others showing no differences (Stonehill & Crisp, 1977; Ward *et al.* 1998; Bulik *et al.* 2000). In our sample, women who had recovered from AN were very similar to acutely ill AN women in co-morbidity profiles. With the possible exception of Cluster C disorders, which showed a slightly higher prevalence in women ill with AN (Santamaria *et al.* unpublished observations), women ill and recovered from AN did not differ in their levels of mood, anxiety, substance use, Cluster A, or Cluster B disorders (data not shown). These findings suggest that differences in co-morbidity or the level of

co-morbidity cannot account for our discrepant findings for these two subject groups.

Qualitative differences between AN and other eating-disorder groups could explain these differences in effects. Recent meta-analytic (Keel & Klump, 2003) and molecular genetic (Devlin *et al.* 2002; Bulik *et al.* in press) studies suggest different cultural (Keel & Klump, 2003), and genetic (Devlin *et al.* 2002; Bulik *et al.* 2003; Bulik *et al.* in press) risk factors for AN *versus* BN. Consequently, while TCI scores are important behavioral phenotypes for BN that are present in all states of illness, a separate set of personality and behavioral characteristics may be important for AN. Recent molecular genetic analyses using the first wave of Price Foundation data confirm these impressions, as obsessionality and drive for thinness, rather than TCI dimensions, were the most important and discriminating phenotypic and genetic correlates for AN (Devlin *et al.* 2002).

In sum, findings from the present study are significant in suggesting consistent personality disturbances in women with BN and AN+BN that are present during the acute phase of the disorder and possibly also after recovery. Effect sizes for comparisons between controls and the recovered BN and AN+BN group on HA and RD were all large ($d > 0.84$) with the exception of moderate effect sizes for all of the comparisons for C ($d = 0.56-0.66$). These findings suggest that observed differences are clinically meaningful.

However, the persistence of these characteristics in the recovered state is only suggested by our data, as we used a control group screened for no Axis I pathology who may have had fewer personality deviations than unscreened controls. Although our control means appear to be very similar to those of other unscreened community samples (Cloninger *et al.* 1994; Klump *et al.* 2000), we cannot know for certain whether our control sample is representative of the general population for TCI profiles. We essentially may have found more differences between eating-disorder groups and controls than would have been obtained had a more representative sample of controls been used. This possibility awaits additional research.

Our findings therefore represent a *preliminary* corroboration of other studies that have suggested that personality disturbances in women

with eating disorders may be trait-related and contribute to the pathogenesis of the disorder. For example, previous twin and longitudinal research have found constructs related to HA to be significant genetic risk factors for disordered eating. Leon and colleagues (Leon *et al.* 1993; Leon *et al.* 1999) found negative emotionality, a construct related to HA (Waller *et al.* 1991), to be the strongest predictor of the development of disordered eating over a 4-year period. In addition, twin studies by Klump *et al.* (Klump *et al.* 2002*b*) and Wade *et al.* (Wade *et al.* 2000) found shared genetic and environmental transmission between disordered eating symptoms and harm-avoidance-related dimensions. The existence of these personality disturbances in the absence of other Axis I disorder co-morbidity (e.g. anxiety; see Kaye *et al.* unpublished observations) highlights the specific role these traits might play in eating-disorder development.

Confirmation of this specific role awaits future research directly comparing TCI scores across eating-disorder and other psychiatric control samples. Our inability to conduct such comparisons makes it unclear whether our TCI score elevations, particularly on HA and SD, are specific to eating disorders or are present in a range of pathologies. A review of published norms for other psychiatric groups suggests that our eating-disorder subjects tend to have lower HA scores than depressed or substance abuse patients, and higher levels of NS than patients with anxiety disorders (Cloninger *et al.* 1994). Nonetheless, future research directly comparing eating-disorder patients to other types of psychiatric patients is needed to gain a clearer understanding of the specificity of the relationships between personality characteristics and eating pathology.

Our study also revealed novel differences in personality characteristics across eating-disorder diagnoses. Women with AN+BN exhibited the largest personality disturbances, on average, whereas women with EDNOS showed the fewest. These findings are not surprising given that AN+BN women have had two separate eating disorders in their lifetime. This, coupled with their higher levels of Axis I and II disorder co-morbidity (Bulik *et al.* in press; Kaye *et al.* unpublished observations; Santamaria *et al.* unpublished observations; Tozzi *et al.* unpublished observations) suggest that

these women may exhibit higher levels of overall pathology. The lower levels of disturbances in EDNOS likely reflects less severe pathology, as these women have never met full criteria for either AN or BN.

Similar to previous studies (Brewerton *et al.* 1993; Waller *et al.* 1993; Kleifield *et al.* 1994*a, b*; Bulik *et al.* 1995*a*; Wade *et al.* 1995; Pryor & Wiederman, 1996; Mizushima *et al.* 1998; Lilenfeld *et al.* 2000; Fassino *et al.* 2001, 2002*a*, 2003), we found women ill with BN to have the highest NS scores of all eating-disorder groups. By contrast, women ill with any form of AN diagnosis (i.e. AN or AN + BN) were found to have the lowest levels of this personality trait. Findings pertaining to the TCI character scales were also revealing. Women ill with any BN diagnosis (i.e. BN or AN + BN) were found to have the lowest SD scores of all eating-disorder groups. These low scores likely reflect the presence of Cluster B personality disorders (Johnson *et al.* 1989; Johnson *et al.* 1990; Johnson & Wonderlich, 1992), consistent with previous research that has found low SD scores to be predictive of personality pathology (Bulik *et al.* 1995*a*). Finally, women ill with AN had the lowest ST scores of all eating-disorder groups, possibly reflecting a greater desire to maintain control over one's life in these women relative to those with other eating-disorder diagnoses.

Our study has some notable strengths. It is the largest published investigation of recovered eating-disorder women. We examined several well-defined eating-disorder phenotypes, some of which had never before been examined in a 'recovery' design (i.e. AN + BN). Finally, we used strict and systematic criteria for defining status of illness that required one of the longest recovery periods to date.

Our study also has some limitations. As noted above, we were unable to include a psychiatric control group, limiting our ability to determine the specificity of personality disturbances for eating pathology. In addition, our use of a control group that was screened to be free of Axis I pathology may have resulted in larger group differences than would have been obtained with an unscreened community sample. Although TCI values for our control group are similar to those of several unscreened community control norms (Cloninger *et al.* 1994; Klump *et al.* 2000), our findings require replication with

unscreened community controls to confirm observed effects.

We did not have access to information on the psychosocial or interpersonal functioning of our subjects, and thus our definition of recovery focused solely on eating-disorder symptoms. Although our definition follows standard practice in eating-disorders research (Keel *et al.* 2000), future research should examine whether inclusion of these constructs influences the personality profiles of women deemed 'recovered' and 'ill'.

Participants were only included in our study if they had at least one biological relative with an eating disorder. This requirement was necessary for the genetic linkage analyses that comprise the primary aim of the larger investigation. Although we controlled for family relatedness in all analyses via GEE, we were unable to control for the possibility that individuals from families with several affected members may be more severely ill (including having more personality disturbances) than those with a single affected member. Future research should examine more representative samples of eating-disorder subjects to determine the generalizability of our findings.

We only examined personality dimensions assessed by the TCI. Additional studies are needed to determine whether traits measured by other personality inventories show disturbances in recovered women. Finally, the current study utilized a 'recovery' design that is limited in its ability to identify predisposing risk factors. Although costly, the field would benefit from longitudinal designs examining personality characteristics as prospective risk factors for eating pathology.

In summary, our primary findings suggest two broad conclusions. First, personality differences exist between healthy control women and women with eating disorders that may represent enduring temperamental traits that contribute to eating-disorder pathogenesis.

Secondly, HA and related traits may be particularly important risk factors for eating disorders, as these traits have shown phenotypic and etiologic relationships with eating pathology (Leon *et al.* 1993, 1999; Wade *et al.* 2000; Klump *et al.* 2002*a*). This possibility highlights the need for future studies aimed at clarifying the meaning of anxious, inhibited personality

styles for the etiology of eating pathology. One goal of the Price Foundation's Genetic Studies of AN and BN is to further elucidate this by examining whether HA and related traits are part of the genetic diathesis for the development of eating disorders. This will be accomplished through association studies examining serotonergic as well as other candidate genes, and linkage analyses that will use covariates such as HA and other quantitative traits to clarify regions of the genome that may harbor susceptibility loci for these disorders. These investigations will lead to greater understanding of the meaning and significance of personality disturbances for the etiology of eating pathology.

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DECLARATION OF INTEREST

None.

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