Empirically Derived Personality Subtyping for Predicting Clinical Symptoms and Treatment Response in Bulimia Nervosa

Ann F. Haynos, Ph.D.[1], **Carolyn M. Pearson, Ph.D.**[1], **Linsey M. Utzinger, Psy.D.**[2], **Stephen A. Wonderlich, Ph.D.**[3,4], **Ross D. Crosby, Ph.D.**[3,4], **James E. Mitchell, M.D.**[3,4], **Scott J. Crow, M.D.**[1,5], and **Carol B. Peterson, Ph.D.**[1,5]

[1]Department of Psychiatry, University of Minnesota Medical Center, Minneapolis, MN

[2]Department of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Stanford, CA

[3]Neuropsychiatric Research Institute, Fargo, ND

[4]Department of Psychiatry and Behavioral Science, University of North Dakota School of Medicine and Health Sciences, Fargo, ND

[5]The Emily Program, Minneapolis, MN

Abstract

Objective—Evidence suggests that eating disorder subtypes reflecting under-controlled, over-controlled, and low psychopathology personality traits constitute reliable phenotypes that differentiate treatment response. This study is the first to use statistical analyses to identify these subtypes within treatment-seeking individuals with bulimia nervosa (BN) and to use these statistically derived clusters to predict clinical outcomes.

Methods—Using variables from the Dimensional Assessment of Personality Pathology–Basic Questionnaire, K-means cluster analyses identified under-controlled, over-controlled, and low psychopathology subtypes within BN patients ($n = 80$) enrolled in a treatment trial. Generalized linear models examined the impact of personality subtypes on Eating Disorder Examination global score, binge eating frequency, and purging frequency cross-sectionally at baseline and longitudinally at end of treatment (EOT) and follow-up. In the longitudinal models, secondary analyses were conducted to examine personality subtype as a potential moderator of response to Cognitive Behavioral Therapy-Enhanced (CBT-E) or Integrative Cognitive-Affective Therapy for BN (ICAT-BN).

Results—There were no baseline clinical differences between groups. In the longitudinal models, personality subtype predicted binge eating ($p = .03$) and purging ($p = .01$) frequency at EOT and binge eating frequency at follow-up ($p = .045$). The over-controlled group demonstrated the best outcomes on these variables. In secondary analyses, there was a treatment by subtype interaction for purging at follow-up ($p = .04$), which indicated a superiority of CBT-E over ICAT-BN for reducing purging among the over-controlled group.

Correspondence concerning this article should be addressed to Ann F. Haynos, Department of Psychiatry, University of Minnesota Medical Center, 2450 Riverside Ave., F279, Minneapolis, MN 55454. afhaynos@umn.edu.

Discussion—Empirically derived personality subtyping is appears to be a valid classification system with potential to guide eating disorder treatment decisions.

Evidence supports the use of personality subtyping for identifying meaningful phenotypes among individuals with eating disorders, including bulimia nervosa (BN). This approach has been used with various eating disorder populations[1-11], and three personality subtypes have consistently emerged: (a) an under-controlled subtype, characterized by behavioral and emotional dysregulation; (b) an over-controlled subtype, characterized by inhibition and compulsivity; and (c) a low psychopathology subtype, characterized by relatively normative scores on selected personality indicators. These personality subtypes have been shown to reliably differentiate individuals with eating disorders in clinical presentation[1-11] and initial evidence indicates they also predict treatment response[4,8].

Cross-sectional research suggests that these personality subtypes in eating disorders are associated with significant differences in psychopathology and psychosocial functioning. Individuals classified as under-controlled tend to endorse higher bulimic symptoms[1], greater externalizing behaviors[2-4], and lower positive affect and greater negative affect[1]. Compared to the over-controlled and low psychopathology subtypes, they also have more clinical impairment[2,5], greater history of sexual or physical abuse[6] and psychiatric hospitalizations[7-8], and are less likely to use healthy coping styles[9]. Individuals classified in the over-controlled subtype, on the other hand, show greater comorbidity with obsessive-compulsive disorder and perfectionism[1-2,8] and generally fall in the middle of the three groups on bulimic behavior severity, general psychopathology, mood, use of coping skills, and interpersonal deficits[1-2,5,8,10-11]. By comparison, those in the low psychopathology group tend to show the fewest comorbid problems[1,5,7-8,10-11]. It should be noted that while a few of these studies have focused solely on individuals with BN, the majority include individuals with a wide variety of eating disorder symptoms and diagnoses.

Given the significant and consistent cross-sectional differences across subtypes in psychopathology and functioning, researchers have begun investigating whether these groups predict treatment response. The few studies examining this question have demonstrated that personality subtypes predict treatment length and outcome[4,8]. Data derived from clinician ratings and self-report suggest that those in the under-controlled category fare worse in treatment compared to the over-controlled and low psychopathology groups[10]. Only one study has examined this question in a sample of patients with primarily bulimic symptomology[8]. In this study, the under-controlled group had the poorest treatment outcome and longest time to remission.

Although these studies have provided useful information about phenotypic differences between personality subtypes, there are limitations to the existing research. First, several of the existing studies have utilized clinician ratings and/or Q-sort methodology to establish personality subtype, which may be biased by clinicians' subjective responses to clients, and relatively few have utilized more objective statistical methods to differentiate personality

subtype. Second, although two studies have demonstrated the predictive validity of personality subtypes in differentiating treatment outcomes, research in this area remains extremely limited. To date, only one study has examined whether personality subtyping predicts treatment outcome in a sample with bulimic symptoms[8]. In this study, treatment outcome was determined by clinician ratings of patients with bulimic symptoms (not necessarily a diagnosis of BN) receiving treatment as usual. Finally, no researchers have tested the predictive validity of personality subtypes by examining whether these subtypes moderate treatment outcome. Given that only about half of individuals with BN respond well to established treatments[12], identifying a classification system that moderates specific treatment response would help to: (a) provide information about which individuals with BN do not respond to standard treatment and (b) explore which subgroups may respond to various treatments, assisting with empirically informed treatment matching.

In the current study, we addressed these limitations by replicating and extending the research on the validity of empirically derived personality subtypes in a sample of individuals with BN receiving psychotherapy in a randomized controlled trial[14]. In our primary analyses, we had three main aims. First, we aimed to reproduce the empirically derived personality subtype classification system (i.e., under-controlled, over-controlled, low psychopathology) within a treatment-seeking sample with full- or sub-threshold BN using K-means cluster analysis. Second, we aimed to replicate prior cross-sectional findings by examining differences in pre-treatment clinical symptoms between personality subtypes. Third, we aimed to add to the literature on the predictive validity of personality subtypes by examining whether subtype predicted response to manual-based psychotherapy. In line with prior research, we predicted that the under-controlled personality group would exhibit elevated clinical symptoms relative to the over-controlled and low psychopathology groups in both cross-sectional and longitudinal analyses.

Finally, to further extend the research on the predictive validity of personality subtypes, we conducted preliminary secondary analyses to examine whether empirically derived personality subtypes moderated responses to two treatments for BN: (a) Cognitive Behavioral Therapy – Enhanced (CBT-E)[13], which focuses on altering cognitive and behavioral patterns thought to maintain bulimic symptoms; and (b) Integrative Cognitive-Affective Therapy for bulimia nervosa (ICAT-BN)[14], which focuses on affect regulation to target momentary emotions thought to maintain eating disorder symptoms. We hypothesized that: (1) following ICAT-BN, the under-controlled subtype would demonstrate better outcomes compared to the over-controlled and low psychopathology groups; (2) following CBT-E, the over-controlled and low psychopathology groups would demonstrate better outcomes compared to the under-controlled group; (3) the under-controlled group would respond better to ICAT-BN than CBT-E; and (4) the over-controlled and low psychopathology groups would respond better to CBT-E than ICAT-BN. These findings were hypothesized given that ICAT-BN is designed to target factors most relevant to the under-controlled group and individuals higher on affective lability and sensation-seeking have responded better to ICAT-BN than CBT-E in this sample[15]. Further, we believed that the structured nature of CBT-E might be an optimal fit for individuals with elevated compulsivity and/or lower emotional lability. Because of the relatively small study sample,

these analyses were considered preliminary to provide further evidence to support the utility of this classification system and to highlight future directions for its use.

Of note, recent analysis conducted within the same dataset as the current study by Accurso and colleagues[15] examined multiple predictors and moderators of response to these interventions. This study revealed that two a priori selected dimensions of personality (i.e., sensation-seeking and affect lability) moderated treatment response. To our knowledge, that study was the first to examine any aspect of personality as a treatment moderator in BN. The current analysis differs from Accurso et al.[15] in that the primary aim of this study is to test the predictive validity of the empirically derived personality subtypes, rather than to identify specific predictors or moderators of treatment per se. The overall goal of the current study is to extend previous findings supporting the utility of personality subtyping for identifying distinct eating disorder phenotypes that predict treatment response.

Methods

Participants

Participants ($n = 80$) were adults enrolled in a randomized clinical trial comparing ICAT-BN and CBT-E for treatment of BN at one of two sites (Minnesota, North Dakota). Participants met criteria for full or subthreshold DSM-IV[16] or DSM-5[17] diagnosis of BN. Subthreshold cases presented with subjective binge eating, rather than objective binge eating episodes (OBEs). The broader inclusion criteria were selected because prior research has demonstrated that individuals with subthreshold and threshold BN score similarly on eating disorder, psychiatric, and impairment measures[18-19]; therefore, we expected these groups to respond comparably in this trial. Further, broader criteria were used to increase sample heterogeneity and generalizability.

Exclusion criteria included: (1) current pregnancy or lactation; (2) BMI < 18 kg/m^2; (3) lifetime diagnosis of bipolar or psychotic disorder; (4) current substance use disorder; (5) medical or psychiatric instability including acute suicide risk; and/or (5) current psychotherapy outside of the treatment trial. Baseline characteristics of participants have been previously reported[14]. On average, participants were white (87.5%), female (90%), in their late twenties ($M = 27.3$, $SD = 9.6$), and within a normal BMI range ($M = 23.9$, $SD = 5.5$). Most participants (72.5%) met full criteria for BN and the majority (87.5%) reported OBEs at baseline. Across the sample, baseline subjective binge eating episodes occurred approximately 3x/week ($M = 12.8$, $SD = 16.2$). Institutional review boards at both study sites approved the study. Written informed consent was obtained from all participants.

Treatment

Participants were randomized to ICAT-BN or CBT-E by an independent biostatistician (RDC) using blocks of four and stratification by site, therapist, and diagnosis. Both treatments were delivered in 21 sessions over 17 weeks, with twice weekly sessions for the first four weeks. ICAT-BN is an emotion-focused behavioral therapy with four phases that aim to identify and target momentary negative affect, particularly as relates to eating patterns and bulimic behaviors[20]. CBT-E is an approach that utilizes psychoeducation, self-

monitoring, and behavioral exposures to address eating disorder symptomatology, including over-evaluation of shape and weight[13]. Final phases of both treatments emphasize relapse prevention.

Procedures

Participants were administered measures to assess personality traits at baseline. Measures to assess clinical symptoms were administered at: (1) baseline, prior to treatment randomization; (2) end of treatment (EOT); and (3) four-month follow-up. Additional study design information is provided in the main outcome manuscript of this randomized controlled trial[14].

Measures

Dimensional Assessment of Personality Pathology – Basic Questionnaire (DAPP-BQ)[21]—The DAPP-BQ is a self-report measure comprising 18 subscales to measure personality dimensions related to emotion dysregulation, dissocial behavior, social avoidance, and compulsiveness. The psychometric properties of this instrument are satisfactory, with internal consistency ranging from .83-.94 and test-retest reliability ranging from .81-.93[21]. The DAPP-BQ was used to confirm the empirically derived personality subtypes. To maintain consistency with the only study that has used the DAPP-BQ to identify under-controlled, over-controlled, and low psychopathology subtypes within an eating disorder sample[5], only the Stimulus-Seeking (α = .88), Oppositionality (α = .91), Self-Harm (α = .88), and Compulsivity (α = .92) subscales were used in the analyses.

Eating Disorder Examination (EDE)[22]—The EDE is a standardized semi-structured interview assessing global eating-related psychopathology. EDE global scores, indicating overall eating disorder behaviors and attitudes, and 28-day frequency counts of OBEs and purging episodes, were dependent variables in this study. The EDE has been shown to have good psychometric properties[23]. Inter-rater reliability based on intraclass correlation coefficients for the EDE global score was .99.

Statistical Analyses

K-means cluster analyses were used to identify empirically derived personality subtypes using the DAPP-BQ Stimulus-Seeking, Oppositionality, Self-Harm, and Compulsivity subscales. In contrast to certain prior analyses[1,3-4,6], latent profile analysis (LPA) was not used to derive empirical subgroups in this study because research has suggested that the accuracy of LPA is drastically reduced in smaller samples.[24] Therefore, it was considered unlikely that LPA conducted in the current sample ($n = 80$) would replicate. K-means cluster analysis is an empirical clustering technique that assigns subgroup membership according to the distance of a data point from a defined centroid, which is derived from the mean of a collection of data points on the basis of a pre-defined number of groupings. K-mean cluster analysis allows specification of the number of groups to be tested based on prior research or theory. For the current analysis, three groups were specified based on prior research supporting a three-class solution. However, two and four group classes were also tested to determine if either better specified the model and both were rejected based on either incomprehensible classification or insufficient number of cases per cluster cell. Following

cluster identification, a MANOVA was conducted to compare clusters on the indicator variables for the purposes of characterizing the groups.

Generalized linear modeling (GLM) was used to examine the relationship between the personality clusters and eating disorder symptomatology at baseline, EOT, and follow-up. Linear models were used for EDE global score, which was continuous and symmetrical at each time point, while negative binomial with log link models were used for OBE and purging frequency, which involved positively skewed count data. Age and BMI were included as covariates to maintain consistency with prior analyses[4] and education was included as a covariate because it was the only baseline demographic variable differing between personality subtypes. Using these specifications, the following models were tested in the primary analyses for each outcome (EDE global, OBE frequency, purging frequency): (1) cross-sectional analyses at baseline examining covariates and personality subtype as predictors; and (2) longitudinal analyses for EOT and follow-up examining covariates, baseline scores on the outcome variable, treatment type, and personality subtype as predictors. For secondary analyses, longitudinal GLM analyses were repeated including the treatment type by subtype interaction as an additional predictor. Pairwise comparisons were conducted to examine group differences identified by any significant main effects of the GLM analyses.

Results

Primary Analyses: Cluster Identification and Prediction of Eating Disorder Symptoms by Personality Subtype

Cluster Analysis—K-means cluster analysis yielded three groups that corresponded with previously described groupings of under-controlled ($n = 19$), over-controlled ($n = 16$), and low psychopathology ($n = 45$) personality subtypes. The under-controlled group had the highest scores on DAPP-BQ Stimulus-Seeking, Oppositionality, and Self-Harm subscales and the lowest scores on the Compulsivity subscale (See Table 1). In contrast, the over-controlled group exhibited the highest scores on the Compulsivity subscale and the lowest scores on the Stimulus-Seeking, Oppositionality, and Self-Harm subscales. The low psychopathology group was characterized by relatively low scores, falling between under- and over-controlled group scores, on all DAPP-BQ subscales. The proportion of full versus sub-threshold BN cases did not differ significantly across personality clusters, $\chi^2_{(2)} = .74$, $p = .69$.

Cross-sectional Analyses—Table 2 provides means and standard deviations on outcome variables organized by personality subtype. In the cross-sectional GLM, personality subtype did not differentiate scores on any clinical variable at baseline (see Table 3).

Longitudinal Analyses—Across treatments, personality subtype significantly predicted OBEs ($p = .04$) and purging ($p = .01$) frequency at EOT (see Table 4). At EOT, pairwise comparisons revealed that individuals in the over-controlled group reported significantly fewer OBEs compared to individuals in the under-controlled group ($p = .02$, $d = .54$), and fewer purging episodes compared to the under-controlled ($p = .01$, $d = .60$) and low

psychopathology ($p = .01$, $d = .53$) groups. There were no significant differences between personality subtypes on EOT EDE global scores.

At follow-up, personality subtype continued to significantly predict OBE frequency across treatments ($p = .02$; see Table 5). At follow-up, pairwise comparisons revealed that individuals in the over-controlled group reported significantly fewer OBEs at follow-up compared to the under-controlled ($p = .02$, $d = .60$) and low psychopathology ($p = .003$, $d = .38$) groups. There were no significant differences between subtypes in EDE global scores or frequency of purging at follow-up.

Secondary Analyses: Treatment Moderation by Personality Subtype

At EOT, there were no significant personality subtype by treatment interactions on any outcome variable. However, at follow-up, there was a significant personality subtype by treatment interaction for purging frequency ($p = .01$). We first examined this interaction by treatment type to determine if personality subtype determined how participants responded to each treatment. Among individuals who received CBT-E, the over-controlled group reported significantly fewer purging episodes ($M = 2.05$, $SD = 1.14$) compared to the under-controlled group ($M = 11.89$, $SD = 3.99$, $p = .02$, $d = 3.47$) and the low psychopathology group ($M = 10.30$, $SD = 2.32$, $p = .002$, $d = 4.07$) at follow-up. In contrast, for those who received ICAT-BN, differences between the personality subtypes in purging frequency at follow-up did not reach statistical significance, despite large effect sizes indicating the superiority of ICAT for the under-controlled ($M = 6.08$, $SD = 2.31$, $d = 2.50$) and low psychopathology ($M = 7.63$, $SD = 2.04$, $d = 2.64$) groups versus the over-controlled group ($M = 16.53$, $SD = 6.02$).

We next examined this interaction by personality cluster to determine if particular personality subtypes responded better to either of the treatments. Among the over-controlled group, individuals who received CBT-E reported significantly fewer purging episodes at follow-up than those who received ICAT-BN ($p = .02$, $d = 3.57$). Differences in purging frequency at follow-up between individuals receiving CBT-E and ICAT-BN did not reach statistical significance for the under-controlled ($p = .21$, $d = 1.89$) or low psychopathology ($p = .41$, $d = 1.24$) groups, despite large effect sizes indicating the superiority of ICAT-BN for these groups.

Discussion

In this study, we sought to replicate and extend the literature on the validity of an empirically derived personality subtyping classification in BN. Consistent with the literature, we identified through K-means cluster analysis distinct personality clusters reflecting under-controlled, over-controlled, and low psychopathology phenotypes. In contrast to prior studies[1-11], these subtypes did not differ on clinical symptoms at baseline. However, in line with prior research[4,8], personality subtype predicted treatment response. Specifically, individuals exhibiting the over-controlled personality subtype endorsed less frequent binge eating and purging compared to other subtypes after receiving manualized psychotherapy for BN. Secondary analyses provided additional support of the predictive validity of empirically derived personality subtypes by indicating that that these classifications moderated treatment

response. As predicted, individuals in the over-controlled group reported better outcomes following CBT-E compared to ICAT-BN and reported better treatment response to CBT-E than the under-controlled or low psychopathology groups.

The results of the cross-sectional analyses demonstrating that personality subtyping did not significantly differentiate symptoms at baseline are surprising in the context of a significant cross-sectional literature suggesting that individuals classified as under-controlled exhibit greater clinical severity across multiple domains[1-5], including bulimic behaviors[1]. The sample differences between the current study and prior studies may account for this disparity. The existing research on personality subtyping in eating disorders has been heterogeneous in sampling, with samples including non-treatment-seeking individuals[1,3,6], patients with anorexia nervosa[1,4], and adolescents[2]. This is the only study examining personality subtyping in a group of treatment-seeking adults with full and sub-threshold BN. In such a sample, baseline clinical symptoms may relate to personality differently compared to other groups. Bulimic symptoms tend to initially develop in adolescence[25] and, for most, dissipate or fail to gain regularity by late adolescence and adulthood[26]. Therefore, individuals seeking treatment for BN well into adulthood may have crossed a certain threshold of severity and/or chronicity in eating disorder symptoms, thus masking symptom differentiation based on personality. Further research is needed to investigate cross-sectional clinical differences between personality subtypes among treatment-seeking samples with BN.

The longitudinal findings, on the other hand, were consistent with prior literature[4,8] in that they demonstrated that personality subtyping could predict treatment outcome. However, the nature of the differences between personality subtypes varied somewhat from prior studies. There have been very few investigations examining empirically derived personality subtypes as predictors of treatment response; however, the existing studies have found that those in the under-controlled subtype fare worse in treatment[4,8]. The results of the current investigation are slightly different in that individuals in the over-controlled subtype group fared better in treatment than individuals in the other categories, but the under-controlled and low psychopathology groups exhibited similar outcomes. However, consistent with prior studies[4,8], individuals in the under-controlled group exhibited the highest levels of binge eating and purging at EOT and follow-up. Again, these differences may reflect sample disparities between studies. There may be a greater advantage to relatively high levels of emotional and behavioral control in a treatment-seeking sample with BN. These findings suggest, as other studies have, that individuals with an under-controlled personality type improve less in existing established treatments than individuals with an over-controlled personality type. This provides predictive validity of personality subtyping for identifying distinct and clinically relevant phenotypes among individuals with eating disorders[10]. The results of this study, taken in concert with prior research, encourage further investigation of whether personality subtyping can be used to guide predictions and recommendations regarding treatment course for individuals with BN.

The secondary analyses provide further evidence for the predictive validity of empirically derived personality subtypes by demonstrating that these subtypes may moderate treatment outcomes. The finding that CBT-E was more effective for individuals in the over-controlled

group compared to individuals in the under-controlled and low psychopathology groups was consistent with study hypotheses, as was the finding that the over-controlled group performed better in CBT-E than ICAT-BN. This indicates that the over-controlled personality subtype, which is more inhibited and compulsive, may respond better to a highly structured treatment that focuses primarily on cognitive and behavioral, rather than emotional, targets. Although the under-controlled and low psychopathology groups had large effect sizes indicating less purging following ICAT-BN compared to CBT-E, and lower levels of purging after receiving ICAT-BN versus the over-controlled group, these differences were not statistically significant. Because the sample sizes were relatively small, especially for the under-controlled group, these statistically non-significant results could be attributed to limited power. Therefore, future analyses in larger samples might demonstrate that ICAT-BN is more optimal for the under-controlled group than CBT-E. This consideration is important given prior findings suggesting that ICAT-BN is better suited for individuals with elevated affective lability and sensation-seeking[15]. However, these results could also suggest that individuals with a range of personality presentations may benefit comparably from ICAT-BN, or that the personality classification system may not be effective for predicting response to this treatment.

The moderator analyses were intended to further validate the personality subtyping classification. Additionally, we were interested in exploring whether these subtypes could have utility in moderating treatment response, which could ultimately support a system of classifying individuals most likely to benefit from particular treatments that is founded on mechanistic processes, as opposed to possibly more arbitrary diagnostic classifications[10]. The results provide promise that this classification system could emerge as a useful moderator of treatment response. If this is the case, personality subtyping could aid in guiding treatment selection for patients with BN. This would be especially important given that ICAT-BN and CBT-E have been found to not differ in their impact on bulimic symptoms[14]. Further research with larger samples is needed to determine the extent to which personality subtypes, particularly the under-controlled and low psychopathology subtypes, moderate treatment response.

There are notable strengths of this study, including the use of statistical methodology to identify subtype clusters, longitudinal study design, and the administration of manualized treatments to all participants. However, there are also limitations. While the overall sample size was sufficient for a treatment trial, certain personality subtype groups were small, potentially limiting power to detect effects in the moderator analyses. The large effect sizes of the significant results suggest that these effects were robust enough to be identified even within a limited sample; however, these analyses should still be considered preliminary until additional research is conducted in this area. Further, the sample included individuals with subthreshold BN that may have met criteria for purging disorder[19] in order to increase the generalizability of results. Although prior research supports combining full- and sub-threshold BN groups[18-19], there is also evidence that individuals with purging disorder may differ in important ways from those who meet full criteria for BN[19]. This sample heterogeneity may have limited the ability to detect the impact of personality subtype on eating disorder symptoms. Additionally, although K-means cluster analysis allows for statistical grouping of clusters using clinically relevant indicator variables, these analyses do

not provide fit indices by which to compare alternative grouping models. Therefore, cluster-grouping decisions are somewhat subjectively dependent on a proposed model. This concern is mitigated by fact that the subgroups identified in this study mirrored previous research. Future investigations into the clinical significance of personality subtyping ought to utilize larger sample sizes, additional statistical methods, and diverse patient groups.

A final concern is that the low psychopathology cluster in this study demonstrated slightly elevated scores on personality psychopathology indices compared to a prior investigation using the DAPP to generate this classification system[1]. In the current study, this group may have reflected more of a moderate, rather than low, personality psychopathology group, as scores on personality psychopathology indicators generally fell between those in the under- and over-controlled groups. This difference could limit comparisons between the low psychopathology group identified in this study and that of other studies. Although the low psychopathology group has been associated with lower clinical symptoms overall, this group is expected to reflect relatively low psychopathology on selected personality indices, rather than low psychopathology in other domains (e.g., eating disorder symptoms). Therefore, although the finding that the low psychopathology group exhibited comparable eating disorder outcomes to the under-controlled group is unexpected, it is not incongruous with the subtyping system. Additionally, the prior study using the DAPP to generate personality clusters was conducted in a sample with anorexia nervosa, which may account for slight differences in the personality clusters. It is recommended that these groupings be replicated in additional BN samples.

This study provides further support of the validity of the empirically derived personality subtyping classification of individuals with eating disorders into groups characterized by under-control, over-control, and low psychopathology. These results suggest that personality subtyping may be useful for predicting treatment response. These subtypes could ultimately enhance understanding of the treatment mechanisms and help match individuals with BN to effective treatments.

Acknowledgements

References

1. Lavender JM, Wonderlich SA, Crosby RD, Engel SG, Mitchell JE, Crow SJ, et al. Personality-based subtypes of anorexia nervosa: examining validity and utility using baseline clinical variables and ecological momentary assessment. Behav Res Ther. 2013; 51:512–7. [PubMed: 23792181]

2. Thompson-Brenner H, Eddy KT, Satir DA, Boisseau CL, Westen D. Personality subtypes in adolescents with eating disorders: validation of a classification approach. J Child Psychol Psychiatry. 2008; 49:170–80. [PubMed: 18093115]

3. Wonderlich SA, Crosby RD, Joiner T, Peterson CB, Bardone-Cone A, Klein M, et al. Personality subtyping and bulimia nervosa: psychopathological and genetic correlates. Psychol Med. 2005; 35:649–57. [PubMed: 15918341]

4. Wildes JE, Marcus MD, Crosby RD, Ringham RM, Dapelo MM, Gaskill JA, et al. The clinical utility of personality subtypes in patients with anorexia nervosa. J Consult Clin Psychol. 2011; 79:665–74. [PubMed: 21767000]

5. Perkins PS, Slane JD, Klump KL. Personality clusters and family relationships in women with disordered eating symptoms. Eat Behav. 2013; 14:299–308. [PubMed: 23910771]

6. Steiger H, Richardson J, Schmitz N, Israel M, Bruce KR, Gauvin L. Trait-defined eating-disorder subtypes and history of childhood abuse. Int J Eat Disord. 2010; 43:428–32. [PubMed: 19536883]

7. Westen D, Harnden-Fischer J. Personality profiles in eating disorders: rethinking the distinction between axis I and axis II. Am J Psychiatry. 2001; 158:547–62. [PubMed: 11282688]

8. Thompson-Brenner H, Westen D. Personality subtypes in eating disorders: validation of a classification in a naturalistic sample. Br J Psychiatry. 2005; 186:516–24. [PubMed: 15928363]

9. Gazzillo F, Lingiardi V, Peloso A, Giordani S, Vesco S, Zanna V, et al. Personality subtypes in adolescents with anorexia nervosa. Compr Psychiatry. 2013; 54:702–12. [PubMed: 23618607]

10. Wildes JE, Marcus MD. Incorporating dimensions into the classification of eating disorders: three models and their implications for research and clinical practice. Int J Eat Disord. 2013; 46:396–403. [PubMed: 23658078]

11. Turner BJ, Claes L, Wilderjans TF, Pauwels E, Dierckx E, Chapman AL, et al. Personality profiles in Eating Disorders: further evidence of the clinical utility of examining subtypes based on temperament. Psychiatry Res. 2014; 219:157–65. [PubMed: 24878298]

12. Steinhausen H-C, Weber S. The outcome of bulimia nervosa: findings from one-quarter century of research. Am J Psychiatry. 2009; 166:1331–41. [PubMed: 19884225]

13. Fairburn, CG. Cognitive behavior therapy and eating disorders. The Guilford Press; New York: 2008.

14. Wonderlich SA, Peterson CB, Crosby RD, Smith TL, Klein MH, Mitchell JE, et al. A randomized controlled comparison of integrative cognitive-affective therapy (ICAT) and enhanced cognitive-behavioral therapy (CBT-E) for bulimia nervosa. Psychol Med. 2014; 44:543–53. [PubMed: 23701891]

15. Accurso EC, Wonderlich SA, Crosby RD, Smith TL, Klein MH, Mitchell JE, et al. Predictors and moderators of treatment outcome in a randomized clinical trial for adults with symptoms of bulimia nervosa. J Consult Clin Psychol. 2016; 84:178–84. [PubMed: 26689304]

16. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 4th. American Psychiatric Association; Washington, DC: 2000. Text Revision

17. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th. American Psychiatric Publishing; Washington, D.C: 2013.

18. Crow SJ, Stewart Agras W, Halmi K, Mitchell JE, Kraemer HC. Full syndromal versus subthreshold anorexia nervosa, bulimia nervosa, and binge eating disorder: a multicenter study. Int J Eat Disord. 2002; 32:309–18. [PubMed: 12210645]

19. Keel PK. Purging disorder: subthreshold variant or full-threshold eating disorder? Int J Eat Disord. 2007; 40(Suppl):S89–94. [PubMed: 17868124]

20. Wonderlich, SA., Peterson, CB., Smith, TL., et al. Integrative Cognitive-Affective Therapy for bulimia nervosa: A treatment manual. The Guilford Press; New York: 2015.

21. Livesley, JW., Jackson, DN. Manual for the Dimensional Assessment of Personality Pathology - Basic Questionnaire. Sigma Press; Port Huron, MI: 2002.

22. Fairburn, CG., Cooper, Z. The eating disorders examination. In: Fairburn, CG., Wilson, GT., editors. Binge eating: nature, assessment, and treatment. 12th. The Guilford Press; New York: 1993. p. 317-331.

23. Berg KC, Peterson CB, Frazier P, Crow SJ. Psychometric evaluation of the eating disorder examination and eating disorder examination-questionnaire: a systematic review of the literature. Int J Eat Disord. 2012; 45:428–38. [PubMed: 21744375]

24. Swanson SA, Lindenberg K, Bauer S, Crosby RD. A Monte Carlo investigation of factors influencing latent class analysis: an application to eating disorder research. Int J Eat Disord. 2012; 45:677–84. [PubMed: 21882219]

25. Stice E, Killen JD, Hayward C, Taylor CB. Age of onset for binge eating and purging during late adolescence: a 4-year survival analysis. J Abnorm Psychol. 1998; 107:671–5. [PubMed: 9830254]

26. Pearson CM, Smith GT. Bulimic symptom onset in young girls: A longitudinal trajectory analysis. J Abnorm Psychol. 2015; 124:1003–13. [PubMed: 26595477]

Table 1

Comparisons between personality subtype clusters on Dimensional Assessment of Personality Pathology – Basic Questionnaire indicators

| | **Personality Subtype** | | | | | | |
Indicator Variable	**Under-controlled (UC)** **M (SD)**	**Over-controlled (OC)** **M (SD)**	**Low psychopathology (LP)** **M (SD)**	***F***	***df***	***p***	**Significant Findings**
Stimulus-seeking	61.48 (8.63)	40.17 (7.73)	53.78 (6.94)	39.87	2, 87	<.001 *	UC > LP > OC
Oppositionality	61.86 (7.87)	44.39 (6.10)	53.08 (9.16)	21.29	2, 87	<.001 *	UC > LP > OC
Compulsivity	37.52 (7.81)	60.33 (9.57)	50.96 (7.30)	41.81	2, 87	<.001 *	OC > LP > UC
Self-Harm	58.90 (6.69)	55.00 (4.88)	55.92 (4.53)	3.34	2, 87	.04 *	UC > LP, OC

*
$p < .05$

Table 2

Unadjusted means and standard deviations of clinical variables across time by personality subtype

Personality Subtype	Global EDE Score			Objective Binge Episodes			Purging Episodes		
	Baseline M (SD)	EOT M (SD)	Follow-up M (SD)	Baseline M (SD)	EOT M (SD)	Follow-up M (SD)	Baseline M (SD)	EOT M (SD)	Follow-up M (SD)
Under-controlled	3.38 (1.14)	1.29 (1.11)	1.72 (1.15)	24.42 (19.53)	11.42 (22.40)	9.11 (12.24)	39.05 (37.52)	15.84 (30.77)	10.95 (16.52)
Over-controlled	3.22 (0.69)	1.47 (0.92)	1.44 (1.04)	22.38 (18.63)	2.50 (6.07)	3.19 (6.12)	27.81 (28.50)	2.50 (6.02)	9.06 (20.92)
Low psychopathology	3.24 (1.21)	1.79 (0.80)	1.71 (1.04)	22.29 (21.29)	4.40 (5.58)	7.53 (12.86)	27.89 (26.35)	6.33 (7.78)	8.71 (14.01)

Note: EDE = Eating Disorder Examination (Fairburn & Cooper, 1993); EOT = End of treatment

Table 3

Cross-sectional generalized linear models examining the impact of personality subtype on clinical variables at baseline

Dependent Variable	Independent Variables	Wald χ^2	B	SE	p
Eating Disorder Examination- global score	Age	0.10	0.00	0.01	0.75
	BMI	0.17	0.01	0.02	0.68
	Education	0.35	−0.16	0.27	0.56
	Personality subtype	0.50	0.02	0.32	0.78
Objective Binge Episode frequency	Age	1.35	−0.02	0.01	0.25
	BMI	0.27	0.01	0.02	0.60
	Education	1.07	−0.26	0.26	0.30
	Personality subtype	0.12	0.07	0.31	0.94
Purging frequency	Age	2.72	−0.03	0.02	0.10
	BMI	0.57	−0.02	0.02	0.45
	Education	0.17	−0.10	0.25	0.68
	Personality subtype	0.80	0.14	0.31	0.67

Table 4

Longitudinal generalized linear models examining the impact of personality subtype on clinical variables at end of treatment

Dependent Variable	Model	Independent Variables	Wald χ^2	B	SE	p
Eating Disorder Examination (EDE)- global score	Model 1	Age	0.85	0.01	0.01	0.36
		BMI	0.17	0.01	0.02	0.68
		Education	1.11	−0.23	0.21	0.29
		Baseline EDE global score	5.55	0.20	0.09	0.02[*]
		Treatment	0.01	0.02	0.19	0.91
		Personality subtype	2.30	0.32	0.25	0.35
	Model 2	Age	1.21	0.01	0.01	0.27
		BMI	0.14	0.01	0.02	0.71
		Education	1.60	−0.29	0.23	0.21
		Baseline EDE global score	5.09	0.20	0.09	0.02[*]
		Treatment	0.16	0.36	0.47	0.69
		Personality subtype	1.73	0.50	0.35	0.42
		Personality subtype[*]Treatment	0.64	−0.47	0.58	0.73
Objective Binge Episode (OBE) frequency	Model 1	Age	1.52	0.02	0.02	0.22
		BMI	4.63	−0.05	0.02	0.03[*]
		Education	0.04	−0.06	0.28	0.84
		Baseline OBE episodes	11.87	0.02	0.01	0.001[*]
		Treatment	0.41	−0.18	0.28	0.52
		Personality subtype	6.80	0.59	0.35	0.03[*]
	Model 2	Age	0.74	0.01	0.02	0.39
		BMI	4.96	−0.06	0.03	0.03[*]
		Education	0.00	0.01	0.28	0.99
		Baseline OBE episodes	12.61	0.03	0.01	<0.001[*]
		Treatment	2.37	−1.58	0.74	0.12
		Personality subtype	10.96	0.19	0.43	0.004[*]
		Personality subtype[*]Treatment	4.13	1.67	0.84	0.13
Purging frequency	Model 1	Age	0.64	0.01	0.02	0.42
		BMI	3.62	−0.04	0.02	0.06
		Education	1.31	0.32	0.28	0.25
		Baseline purging episodes	14.26	0.02	0.01	<0.001[*]
		Treatment	0.01	−0.03	0.27	0.92
		Personality subtype	9.65	0.78	0.34	0.01[*]
	Model 2	Age	0.24	0.01	0.02	0.63

Dependent Variable	Model	Independent Variables	Wald χ^2	B	SE	p
		BMI	3.47	−0.04	0.02	0.06
		Education	1.85	0.39	0.29	0.17
		Baseline purging episodes	16.22	0.02	0.01	<0.001[*]
		Treatment	0.35	−0.96	0.67	0.55
		Personality subtype	12.59	0.47	0.44	0.002[*]
		Personality subtype*Treatment	2.26	1.09	0.79	0.32

[*]
$p < .05$

Table 5

Longitudinal generalized linear models examining the impact of personality subtype on clinical variables at follow-up

Dependent Variable	Model	Independent Variables	Wald χ^2	B	SE	p
Eating Disorder Examination (EDE)- global score	Model 1	Age	0.07	0.01	0.01	0.80
		BMI	0.01	0.02	0.02	0.93
		Education	1.31	−0.29	0.25	0.25
		Baseline EDE global score	9.14	0.31	0.10	0.003[*]
		Treatment	0.43	0.15	0.23	0.51
		Personality subtype	1.34	0.26	0.30	0.61
	Model 2	Age	0.01	0.00	0.01	0.94
		BMI	0.01	0.00	0.02	0.93
		Education	0.64	−0.21	0.26	0.42
		Baseline EDE global score	9.55	0.31	0.10	0.002[*]
		Treatment	0.14	−0.31	0.55	0.71
		Personality subtype	1.36	0.06	0.40	0.51
		Personality subtype[*]Treatment	0.87	0.55	0.68	0.65
Objective Binge Episode (OBE) frequency	Model 1	Age	2.27	0.02	0.02	0.13
		BMI	3.63	−0.05	0.02	0.06
		Education	1.06	−0.27	0.26	0.30
		Baseline OBE episodes	23.24	0.03	0.01	<0.001[*]
		Treatment	0.42	0.17	0.27	0.52
		Personality subtype	6.19	0.86	0.36	0.045[*]
	Model 2	Age	1.49	0.02	0.02	0.22
		BMI	4.40	−0.05	0.02	0.04[*]
		Education	0.29	−0.15	0.27	0.59
		Baseline OBE episodes	23.05	0.03	0.01	<0.001[*]
		Treatment	0.09	−1.20	0.74	0.76
		Personality subtype	10.46	0.48	0.45	0.01[*]
		Personality subtype[*]Treatment	4.14	1.53	0.85	0.13
Purging frequency	Model 1	Age	0.11	−0.01	0.02	0.74
		BMI	0.09	0.01	0.03	0.76
		Education	2.97	−0.48	0.28	0.09
		Baseline purging episodes	7.55	0.01	0.01	0.01[*]
		Treatment	0.01	−0.03	0.29	0.91
		Personality subtype	0.01	−0.04	0.38	0.99
	Model 2	Age	0.43	−0.01	0.02	0.51
		BMI	0.08	−0.01	0.03	0.78

Dependent Variable	Model	Independent Variables	Wald χ^2	B	SE	p
		Education	0.26	−0.15	0.30	0.61
		Baseline purging episodes	10.63	0.02	0.01	0.001 *
		Treatment	1.61	−2.09	0.70	0.01 *
		Personality subtype	1.40	−0.77	0.48	0.50
		Personality subtype*Treatment	9.75	2.39	0.84	0.01 *

*
$p < .05$