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Psychiatric, Behavioral, and Attitudinal Correlates of Avoidant and Obsessive-Compulsive Personality Pathology in Patients with Binge-Eating Disorder

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Abstract

Objective—We examined correlates of avoidant and obsessive-compulsive personality pathology—with respect to psychiatric comorbidity, eating disorder psychopathology, and associated psychological factors—in patients with binge-eating disorder (BED).

Method—Three hundred forty-seven treatment-seeking patients who met *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)* research criteria for BED were reliably assessed with semistructured interviews to evaluate *DSM-IV* axis I disorders, personality disorders, and behavioral and attitudinal features of eating disorder psychopathology.

Results—Fifteen percent of subjects had avoidant personality disorder features, 12% had obsessive-compulsive personality disorder features, 8% had features of both disorders, and 66% had features of neither. These groups differed significantly in the frequencies of depressive and anxiety disorders, as well as on measures of psychological functioning (negative/depressive affect and self-esteem) and eating disorder attitudes (shape and weight concerns). There were no group differences on measures of eating behaviors. The avoidant and obsessive-compulsive groups had more psychiatric comorbidity than the group without these personality features, but less than the combined group. The group without these features scored significantly lower than all other groups on negative/depressive affect, and significantly higher than the avoidant and combined groups on self-esteem. The combined group had the greatest severity on shape and weight concerns.

Conclusions—Avoidant and obsessive-compulsive personality features are common in patients with BED. Among BED patients, these forms of personality psychopathology—separately and in combination—are associated with clinically meaningful diagnostic, psychological, and attitudinal differences. These findings have implications for the psychopathological relationship between BED and personality psychopathology, and may also have implications for assessment and treatment.

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Binge-eating disorder (BED) is included in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)* [1] as a research criterion set, and is defined as recurrent binge eating without regular use of the inappropriate compensatory weight control methods found in bulimia nervosa. Since these diagnostic criteria were proposed and elaborated in *DSM-IV*, about a decade and a half ago, research has demonstrated that BED is a frequently occurring disorder with prevalence rates exceeding those of anorexia nervosa and bulimia nervosa combined. It is also distributed more broadly across age, gender, and ethnic groups—and is at least as stable and as chronic as these two well-validated eating disorders [2,3]. BED has been shown to aggregate in families, and to be associated with obesity and elevated rates of medical and psychiatric comorbidities [4]. A recent critical review of the growing empirical base for this research diagnosis concluded that there is sufficient evidence to warrant its inclusion as a distinct formal diagnosis in *DSM, Fifth Edition (DSM-V)* [5], and the treatment literature now includes evidence for the specificity of BED interventions [6].

Collectively, these findings suggest the importance of further characterizing the nature of BED in order better to understand its pathogenesis and clinical manifestations—which may, in turn, inform improved prevention and treatment techniques. One avenue to understanding diagnostic categories is through examination of potential subtypes. Initial approaches with BED have included, for example, subtyping by negative/depressive affect [7]—and, more recently, by psychiatric comorbidity [8]. Peterson and colleagues [8] considered BED patients with and without mood disorders, and with and without substance use disorders. Patients with a history of mood disorders had more negative affect, lower self-esteem, higher frequency of binge eating, and higher scores on certain measures of eating psychopathology. Patients with a history of substance use disorders were found to binge eat more frequently and to be more impulsive. These investigators concluded that individuals with histories of either mood disorders or substance use disorders have a more severe form of BED—and that subtyping along these lines may have more clinical utility than simply considering mood or substance use disorders to be comorbid conditions.

The use of co-occurrence patterns to subtype patients with eating disorders dates back many years to investigations of personality disorder comorbidity [9]. Indeed, the co-occurrence of personality disorders with eating disorders has been the subject of numerous studies [10]—the vast majority of which have focused on anorexia nervosa and bulimia nervosa. As reviewed previously [10], these studies have generally found considerable comorbidity between personality disorders and eating disorders—although, for largely methodological reasons, results have varied with respect to the specific co-occurrence patterns observed [11].

Additionally, numerous investigations of eating disorders have explored personality traits. Some of these studies have found associations between eating disorders and certain obsessive-compulsive personality traits [12,13]. One group explored the relationships between bulimia nervosa and avoidant personality disorder, finding that patients with both disorders—while not scoring higher on measures of eating symptoms or on frequencies of other mental disorders—did score higher than bulimic patients without avoidant personality disorder on various measures of psychological dysfunction [14]. Some studies have reported that both obsessive-compulsive traits [15,16] and avoidant traits [17] can have a negative impact on the course of eating disorders—although findings, along this line, have been mixed [18].

There has been relatively less research, however, on the overlap between personality psychopathology and BED. Early studies [19] which compared obese subjects with and without BED found that those with BED had higher personality disorder rates—and, in

particular, higher rates of cluster C (predominantly avoidant) and cluster B (predominantly histrionic and borderline) personality disorders. Comparing patients with BED to a general psychiatric sample, however, Wilfley and co-workers [20] found markedly elevated rates of *DSM, Revised Third Edition (DSM-III-R)*-defined [21] avoidant and obsessive-compulsive personality disorders in the BED group, but no differences with respect to cluster B disorders. These investigators also found that personality pathology was related to eating psychopathology severity at baseline, but that it did not predict outcome. Picot and Lilienfeld [22] found that avoidant and obsessive-compulsive personality disorders predominated in a treatment-seeking sample of individuals with BED—and that such personality disorder psychopathology was related to binge eating frequency, but not to body mass index (BMI). Grilo [10] concluded that the few available data suggest the strongest associations between BED and cluster C personality disorders—but that research with large samples, using diagnostic interviews, is needed to characterize better this patient group.

The aim of this study was to explore these relationships between BED and personality disturbance by examining the associations of avoidant and obsessive-compulsive personality disorder features, in particular, with psychiatric comorbidity, eating behaviors and attitudes, and associated psychological factors.

Method

Subjects

Subjects were a nearly-consecutive series of 347 treatment-seeking patients who met strict *DSM-IV* research criteria for BED. This study group consisted of 259 (75%) women and 88 (25%) men, ages 18 to 60 years ($M = 44.7$, $SD = 9.2$). A majority of subjects (81%) were Caucasian, and most (84%) had either attended or graduated from college.

Procedures and Assessments

Subjects responded to media advertisements soliciting individuals with concerns about binge eating and weight, for participation in treatment studies within an urban medical school setting. In order to be included in the study, subjects had to be between 18 and 60 years of age, and had to meet full research diagnostic criteria for BED. Individuals were excluded if they were receiving ongoing professional treatment for eating or weight problems—or if they had certain medical conditions that may influence eating or weight (e.g., diabetes, thyroid disease), or had a severe psychiatric illness that could interfere with the assessment process (e.g., psychosis, bipolar disorder). Assessments were administered by trained doctoral-level research clinicians, who were monitored to maintain reliability over time. Full IRB review and approval were obtained. After complete explanation of the study procedures, written informed consent was obtained from all subjects.

Semistructured diagnostic interviews were administered to all subjects. *DSM-IV* axis I disorders, including BED, were assessed by the Structured Clinical Interview for *DSM-IV* Axis I Disorders – Patient Edition (SCID-I/P) [23]. For this study, lifetime axis I diagnoses were utilized—although it should be noted that research criteria required that the diagnoses of dysthymic disorder and generalized anxiety disorder could be made only when subjects met current criteria. Also, a current diagnosis of BED was used to help ascertain the study group. Interrater reliability for the axis I diagnoses, as reflected by kappa coefficients, ranged from 0.57 to 1.0; kappa for current BED diagnosis was 1.0.

DSM-IV axis II personality disorders were assessed by the Diagnostic Interview for *DSM-IV* Personality Disorders (DIPD-IV) [24]. This semistructured diagnostic interview assesses for all *DSM-IV* personality disorders and criteria. The DIPD-IV requires that criteria must be present and pervasive for at least two years, and that they must be characteristic of the

person during adulthood. Kappa coefficients for the personality disorder diagnoses ranged from 0.58 to 1.0; kappa was 0.68 for avoidant personality disorder, and 0.71 for obsessive-compulsive personality disorder.

For the purposes of this study, individuals were considered to have features of a personality disorder if they either met full diagnostic criteria for the disorder or were one trait shy of meeting full criteria. Therefore, subjects were considered to have avoidant personality disorder features if they met at least 3 of 7 possible criteria; and, similarly, subjects were considered to have obsessive-compulsive personality disorder features if they met at least 3 of 8 possible criteria. We elected to examine groups of subjects with personality disorder features—rather than groups in which all subjects met full diagnostic criteria—because the DIPD-IV is a relatively conservative instrument, and because we did not wish to have subjects with prominent features of either avoidant personality disorder or obsessive-compulsive personality disorder fall into our comparison group.

To assess the attitudinal and behavioral features of eating disorder psychopathology, and to confirm the BED diagnosis, the Eating Disorder Examination (EDE) [25] was administered. The EDE is a semistructured interview that assesses the core and associated psychopathology of eating disorders. This instrument focuses on the preceding 28 days, with the exception of diagnostic items for which *DSM-IV* stipulates specific time-frames or duration criteria. Included in the EDE interview is a module that assesses the *DSM-IV* research criteria for BED. The EDE assesses the frequency of different forms of overeating, including objective overeating episodes—defined as eating an unusually large quantity of food while experiencing subjective loss of control, which corresponds to the *DSM-IV* definition of a binge eating episode. In addition to providing a global score, the EDE has four subscales: Restraint, Eating Concern, Shape Concern, and Weight Concern. The Restraint subscale reflects attempts to restrict food intake in order to influence weight or shape; the Eating Concern subscale reflects the degree of concern about eating; and the Weight Concern and Shape Concern subscales measure the degree of concern about weight and shape, respectively, and the extent to which these concerns influence self-evaluation. The items assessing eating disorder features for the four subscales are rated on 7-point forced choice scales (0 to 6), with higher scores reflecting greater severity or frequency. The EDE is a well-established method for assessing eating disorder psychopathology [26] and has demonstrated good interrater and test-retest reliability in BED [27]. In the present study, interrater reliability of the EDE was examined in 42 subjects. For binge eating episode frequency, the Spearman rho coefficient was 0.99; for the EDE subscales, Spearman rho ranged from 0.87 to 0.97.

Height and weight were measured during the evaluation process, and BMI was calculated. Structured clinical interviews inquired about obesity-related historical variables, including highest adult weight, age at obesity onset, age at dieting onset, and age at binge eating onset. Age at BED onset was determined from the SCID-I/P.

Subjects also completed self-report inventories to assess associated psychological functioning. The Beck Depression Inventory (BDI), 21-item version [28], is a well-established and widely used inventory of the symptoms of depression—and, more generally, of negative affect [29]. The Rosenberg Self-Esteem Scale (RSES) [30] is a 10-item measure of global self-esteem, which is used widely and is psychometrically well-established [30]. A higher total score reflects greater self-esteem.

Statistical Analysis

Based on DIPD-IV findings, subjects were divided into those with avoidant personality disorder features but not obsessive-compulsive features, those with obsessive-compulsive

personality disorder features but not avoidant features, those with features of both personality disorders, and those with features of neither. These four subgroups were first compared with respect to the frequencies of co-occurring axis I psychiatric disorders. Comparisons were made whenever disorder frequencies were sufficiently large to permit statistical analysis. Initially, frequencies of disorder groups were examined; when these differences were statistically significant, the frequencies of specific disorders were examined further. Chi-square tests of independence were performed to test for these frequency differences.

Analysis of variance (ANOVA) was used to compare the four study groups with respect to historical variables that are relevant to disordered eating behavior, including age at obesity onset, age at dieting onset, age at binge eating onset, age at BED onset, and highest BMI. ANOVAs were also used to compare the four study groups with respect to current variables related to weight (current BMI), eating behavior and attitudes (binge frequency in days per month as well as episodes per month, and EDE global and subscale scores), and psychological functioning (BDI and RSES scores). When ANOVAs revealed significant overall group differences, Scheffe's post hoc tests were performed to determine which specific groups differed significantly.

Results

Table 1 provides frequencies of personality disorder features for all *DSM-IV* personality disorders. Within our study group of patients with BED, the most frequently occurring of these were avoidant features (23%) and obsessive-compulsive features (19%).

The overall group was divided into four subgroups, based on personality pathology type: 52 (15%) subjects had avoidant features, but not obsessive-compulsive features; 40 (12%) subjects had obsessive-compulsive features, but not avoidant features; 27 (8%) subjects had features of both personality disorders; and 228 (66%) subjects had features of neither. Statistical analysis revealed no differences between these subgroups with respect to age, gender, ethnicity, or level of education.

Table 2 summarizes the lifetime frequencies of axis I psychiatric disorders across the four study groups. Only the depressive disorders, anxiety disorders, and substance use disorders occurred at frequencies sufficiently large to permit statistical analysis. As chi-square analysis demonstrated significant group differences for depressive and anxiety disorders, specific diagnoses were examined within these two broader categories. Group differences were found for major depressive disorder, social phobia, posttraumatic stress disorder, and generalized anxiety disorder. As is evident in the table, these disorders were most frequent in the combined personality pathology subgroup, less frequent in the avoidant and the obsessive-compulsive subgroups, and least frequent in the subgroup with neither type of personality pathology.

Table 3 summarizes findings for historical variables relevant to disordered eating behavior, across the four study groups. ANOVAs revealed no significant differences between the study groups for any of these variables.

Table 4 summarizes findings, across the four study groups, for current BMI as well as other current variables related to eating behavior, eating attitudes, and psychological functioning. ANOVAs revealed no significant differences between study groups for current BMI or frequency of binge eating. ANOVAs revealed significant overall group differences for the EDE global score, as well as for the Shape Concern and Weight Concern subscales. Scheffe's post hoc tests revealed that, for both the EDE global score and the Weight Concern subscale, the combined personality psychopathology group scored significantly higher than

both the obsessive-compulsive group and the group without features of either personality disorder. On the Shape Concern subscale, the combined group scored significantly higher than all other study groups. Significant differences between study groups were also observed for the BDI and RSES scores. For the BDI, all three personality psychopathology study groups scored higher than the group without features of either personality disorder. For the RSES, the avoidant group scored significantly lower than the obsessive-compulsive group—and both the avoidant group and the combined group scored significantly lower than the group without features of either personality disorder.

Discussion

Our BED study group had rates of avoidant and obsessive-compulsive personality features that were higher than those of other personality psychopathology types. Moreover, these frequencies suggest that—in our outpatient BED study group—the rates of avoidant and obsessive-compulsive personality disorders were substantially elevated relative to rates seen in the community [31] and in general outpatient psychiatric samples [32]. Our findings are consistent with those of previous smaller studies which have observed that BED has significant comorbidity with cluster C disorders [19], and with avoidant and obsessive-compulsive personality disorders in particular [20]—but, unlike early work [19], we did not find prominent cluster B pathology.

Our comparison, across personality psychopathology subgroups, of axis I disorder co-occurrence patterns—although finding no differences with respect to lifetime substance use disorders—did find differences with respect to lifetime depressive and anxiety disorders. Consistently, the combined avoidant and obsessive-compulsive pathology subgroup showed more of this comorbidity, while the subgroup without avoidant or obsessive-compulsive pathology showed the least. These findings are generally congruent with the comorbidity literature [33] in suggesting that cluster C personality pathology is associated with anxiety and depression. Specifically, our findings suggest that, within our BED study group, the combination of avoidant and obsessive-compulsive personality pathology brings with it an additional likelihood that individuals will experience syndromic anxiety or depression.

With respect to our dimensional measure of negative/depressive affect, we found that all three personality pathology groups scored higher on the BDI than did the group without avoidant or obsessive-compulsive pathology. This finding is consistent with studies, involving other eating disorders, that have found relationships between depression (as measured by BDI score) and both avoidant and obsessive-compulsive symptomatology [34]. The pattern that we observed with respect to self-esteem—that the avoidant group scored significantly lower on the RSES than the obsessive-compulsive group, and that both the avoidant group and the combined group scored significantly lower than the group without avoidant or obsessive-compulsive features—is not surprising, given that diminished self-esteem is a key feature of the avoidant personality disorder construct.

With respect to our measures of eating behavior and BMI—both historical and current—we found no differences across the four subgroups. This set of findings tends to support the view that personality disorders—while they may occur frequently in patients with eating disorders—appear to be more closely associated with general psychopathology and functioning than with the eating disorder behaviors per se [10,18,35,36]. This view suggests a relative independence between personality disorders and eating disorders, and—to the extent that they are seen as comorbid—they cannot be said to have the shared underlying psychopathology that would be consistent with spectrum models of comorbidity [18,37,38].

With respect to certain eating attitudes, on the other hand, we did find significant differences across subgroups. Specifically, we observed that the combined pathology subgroup had higher scores on the Weight Concern subscale of the EDE than both the obsessive-compulsive pathology subgroup and the subgroup without either type of personality pathology—and higher scores on the Shape Concern subscale than all three of the other subgroups. Here, it is interesting to note that—although our results are at odds with those of Wilfley and colleagues [20] insofar as we did not find a relationship between personality disorder pathology and binge frequency—our results agree with those from that study insofar as we did find a relationship between personality pathology and certain attitudinal features of eating disorder psychopathology.

Our finding that individuals with combined avoidant and obsessive-compulsive pathology have especially heightened concerns about shape and weight is interesting because exposures to concerns of this type have been implicated as risk factors for developing BED [39]. Indeed, it may be that the interpersonal difficulties and impaired self-esteem associated with avoidant personality disorder, together with the perfectionism and rigidity associated with obsessive-compulsive personality disorder, conspire along with the socially anxious nature of these individuals to make them vulnerable to overvaluing their shape and weight—which is a clinically significant feature in some patients with BED [40]. In this light, avoidant and obsessive-compulsive personality features can be seen both as potential risk factors for BED and as maintaining factors [12]. Although these personality features do not appear to worsen the defining behaviors of BED, it is certainly possible that avoidant and obsessive-compulsive features—especially in combination—may complicate the course of this disorder through their associations with intensified concerns about shape and weight [41]. This view may suggest a pathoplastic effect for these forms of personality psychopathology upon the eating disorder [37]. This view also suggests the potential utility of specific treatment approaches—such as interpersonal therapy and cognitive behavioral therapies—that either target these maladaptive interpersonal patterns, or else promote affect regulation and coping skills to counter these deficits and to inhibit the triggers for symptomatic behaviors [6].

We note several strengths and limitations of our study, as a context for interpreting these results. Strengths include the use of diagnostic and structured interviews that were reliably administered, by trained and experienced doctoral-level research clinicians, to a large series of patients with BED. With respect to study limitations, our findings pertain to individuals meeting strict research criteria for BED, and to those responding to advertisements seeking participants for treatment studies. Therefore, our results may not generalize to those with sub-threshold binge eating, to community samples, or to those who might be uninterested in research participation. Due to our exclusion criteria, these results may not generalize to BED patients with co-occurring psychosis or bipolar disorder, although such exclusions were extremely rare. Similarly, our results may not generalize to those with certain co-occurring medical illnesses, such as diabetes or thyroid disease. Also, our results pertain to a broad range of adults with BED, but may not pertain to those under 18 or over 60 years of age. Finally, our assessments were cross-sectional, and cannot discern causal or etiologic relationships. Longitudinal studies are needed to understand better the interactions between personality pathology, eating attitudes, and eating behavior over time [18]—and treatment studies are needed to determine the significance of personality pathology as a predictor or modulator of outcomes.

Despite these limitations, some conclusions can be drawn from the data. We found higher rates of avoidant and obsessive-compulsive personality psychopathology in our study group of individuals with BED than have been reported for community [31] and general psychiatric outpatient [32] samples. These forms of personality pathology were associated

with significantly higher rates of depressive and anxiety disorders. Although avoidant and obsessive-compulsive personality features were not associated with any differences in eating behavior or weight, they were associated with elevated levels of concern about shape and weight. Our results underscore the potential value of assessing personality in patients with BED, as well as the need to be attentive to co-occurring depression or anxiety in those with avoidant or obsessive-compulsive personality features. Indeed, findings from a recent controlled treatment study have suggested that cluster C personality disorders (in particular, avoidant personality disorder), but not axis I psychiatric disorders (including major depressive disorder), were significant predictors of attrition as well as of several treatment outcomes [42]. In patients with combinations of these two types of cluster C personality pathology, our findings here further suggest that BED treatment approaches might be aimed not only at core eating attitudes and behaviors but also at potential maintaining processes, such as interpersonal difficulties [6].

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Table 1

Frequencies of Personality Disorder Features in 347 Patients with BED

	N	%
Paranoid	23	7
Schizoid	8	2
Schizotypal	2	1
Antisocial	7	2
Borderline	20	6
Histrionic	5	1
Narcissistic	10	3
Avoidant	79	23
Dependent	8	2
Obsessive-compulsive	67	19

Table 2

Frequencies of Lifetime Psychiatric Disorders in 347 Patients with BED: Comparison by Personality Psychopathology Type

	Avoidant (N = 52)		Obsessive-comp. (N = 40)		Both (N = 27)		Neither (N = 228)		χ^2 (df = 3)
	N	%	N	%	N	%	N	%	
Depressive disorders	35	67	25	63	23	85	107	47	20.0 ***
Major depressive dis.	30	58	21	53	19	70	95	42	11.3 *
Dysthymic disorder ^a	4	8	4	10	4	15	12	5	4.2
Anxiety disorders	28	54	20	50	18	67	71	31	21.3 ***
Panic disorder	7	14	6	15	7	26	35	15	2.3
Social phobia	6	12	3	8	8	30	20	9	11.5 **
Obsessive-comp. dis.	2	4	2	5	2	7	3	1	5.2
Posttraumatic stress dis.	5	10	4	10	5	19	9	4	10.3 *
Generalized anxiety dis. ^a	8	15	7	18	7	26	11	5	19.3 ***
Substance use disorders	16	31	10	25	10	37	58	25	2.1

^aDiagnoses are based on subjects meeting current criteria.* $P < .05$.** $P < .01$.*** $P < .001$.

Historical Variables related to Eating Behavior, Eating Disorder, and BMI in 347 Patients with BED: Comparison by Personality Psychopathology Type

Table 3

	Avoidant (N = 52)		Obsessive-comp. (N = 40)		Both (N = 27)		Neither (N = 228)		F
	M	SD	M	SD	M	SD	M	SD	
Age at obesity onset	16.7	9.5	18.3	9.6	16.0	9.7	15.4	9.6	1.1
Age at dieting onset	19.8	9.4	18.4	7.3	17.6	6.8	18.7	9.0	0.4
Age at binge eating onset	20.6	10.9	25.5	11.6	23.6	10.9	22.8	12.2	1.2
Age at BED onset	23.1	10.8	28.5	10.9	24.4	11.6	25.9	13.3	1.4
Highest BMI	41.1	9.0	38.3	7.9	38.3	7.9	39.4	8.5	1.0

Note. For analyses of variance, *df* range: (3, N = 335) to (3, N = 347).

Current Variables related to BMI, Eating Behavior, Eating Attitudes, and Psychological Functioning in 347 Patients with BED: Comparison by Personality Psychopathology Type

Table 4

	Avoidant (N = 52)		Obsessive-comp. (N = 40)		Both (N = 27)		Neither (N = 228)		F
	M	SD	M	SD	M	SD	M	SD	
Current BMI	37.8	8.4	36.9	7.7	36.2	8.0	37.2	7.0	0.3
Binge freq. (days/month)	14.9	7.0	14.0	8.2	12.4	5.5	14.6	6.9	0.9
Binge freq. (episodes/mo.)	17.2	9.5	17.0	14.1	14.0	7.4	17.4	10.7	0.8
EDE – Global score	2.9	1.0	2.6 ^a	1.0	3.4 ^b	0.9	2.6 ^a	0.9	5.8 ^{**}
Restraint	1.7	1.5	1.7	1.2	2.0	1.3	1.9	1.3	0.7
Eating Concern	2.2	1.3	2.1	1.3	2.9	1.4	2.0	1.9	2.1
Shape Concern	4.1 ^a	0.9	3.5 ^a	1.3	4.9 ^b	0.9	3.5 ^a	1.1	14.3 ^{***}
Weight Concern	3.5	0.9	3.0 ^a	1.3	3.9 ^b	1.0	3.1 ^a	1.0	6.6 ^{***}
BDI score	21.2 ^a	7.8	19.7 ^a	9.4	22.2 ^a	8.3	14.8 ^b	8.3	14.4 ^{***}
RSES score	24.0 ^a	5.3	27.9 ^{b,c}	6.3	24.9 ^{ab}	3.7	30.0 ^c	5.4	21.6 ^{***}

Note: For analyses of variance, *df* range: (3, N = 341) to (3, N = 347). Different superscripts indicate that the groups differ significantly ($P < .05$), based on Scheffé's post hoc tests.

**
 $P < .01$.

***
 $P < .001$.