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Subtyping Children and Adolescents with Loss of Control Eating by Negative Affect and Dietary Restraint

Andrea B. Goldschmidt, M.A.[a], **Marian Tanofsky-Kraff, Ph.D.**[b,I], **Lien Goossens**[c], **Kamryn T. Eddy, Ph.D.**[d,II], **Rebecca Ringham, Ph.D.**[e], **Susan Z. Yanovski, M.D.**[b,f], **Caroline Braet, Ph.D.**[c], **Marsha D. Marcus, Ph.D.**[e], **Denise E. Wilfley, Ph.D.**[g], and **Jack A. Yanovski, M.D., Ph.D.**[b]

a *Department of Psychology, Washington University, 660 South Euclid Avenue, Campus Box 8134, St. Louis, MO, 63110, USA; goldscha@psychiatry.wustl.edu*

b *Unit on Growth and Obesity, DEB, NICHD, National Institutes of Health, Hatfield Clinical Research Center, Room 1-3330, MSC 1103, Bethesda, MD, 20892, USA; mtanofsky@usuhs.mil and yanovskj@mail.nih.gov*

c *Ghent University, Department of Developmental, Personality and Social Psychology, Henri Dunantlaan 2, 9000Ghent, Belgium; lien.goossens@ugent.be and caroline.braet@ugent.be*

d *Center for Anxiety and Related Disorders, 648 Beacon Street, 6th Floor, Boston, MA, 02215, USA, and Children's Hospital Boston, 300 Longwood Avenue, Boston, MA, 02115, USA; kamryn@gmail.com*

e *Western Psychiatric Institute and Clinic, University of Pittsburgh Medical Center, 3811 O'Hara St. Pittsburgh, PA, 15213, USA; ringhamrm@upmc.edu and marcusmd@upmc.edu*

f *National Institute of Diabetes and Digestive and Kidney Diseases, 6707 Democracy Boulevard, Room 675, Bethesda, MD 20892, USA; yanovskis@extra.niddk.nih.gov*

g *Washington University School of Medicine, Department of Psychiatry, 660 South Euclid Avenue, Box 8134, St. Louis, MO, 63110, USA; wilfleyd@psychiatry.wustl.edu*

Abstract

Objective—Research suggests that subtyping adults with binge eating disorders by dietary restraint and negative affect predicts comorbid psychopathology, binge eating severity, and treatment outcome. Little research has explored the validity and clinical utility of subtyping youth along these dimensions.

Method—Children (aged 8–18y) reporting loss of control eating (*n*=159) were characterized based upon measures of dietary restraint and negative affect using cluster analysis, and then compared regarding disordered eating attitudes and behaviors, and parent-reported behavior problems.

Results—Robust subtypes characterized by dietary restraint (*n*=114; 71.7%) and dietary restraint/high negative affect (*n*=45; 28.3%) emerged. Compared to the former group, the dietary restraint/high negative affect subtype evidenced increased shape and weight concerns, more frequent binge eating episodes, and higher rates of parent-reported problems (all *p*s<.05).

Address correspondence to: Dr. Tanofsky-Kraff, Department of Medical and Clinical Psychology, USUHS, 4301 Jones Bridge Road, Bethesda, MD 20814; TEL: 301-295-1482; FAX 301- 295-3034; e-mail: mtanofsky@usuhs.mil.
[I]Present Address: Department of Medical and Clinical Psychology, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Road, Bethesda, MD, 20814, USA
[II]Present Address: Massachusetts General Hospital/Harvard Medical School, 2 Longfellow Place, Suite 200, Boston, MA, 02114, USA

Conclusion—Similar to findings from the adult literature, the presence of negative affect may mark a more severe variant of loss of control eating in youth. Future research should explore the impact of dietary restraint/negative affect subtypes on psychiatric functioning, body weight, and treatment outcome.

1. Introduction

Research in adults with binge eating disorder (BED) and bulimia nervosa (BN) suggests the presence of two distinct subtypes, one characterized by pure dietary restraint (i.e., cognitive and/or behavioral aspects of dieting, such as desire to limit food intake in the absence of overt behavioral efforts to do so, and/or actual behavioral efforts to limit food intake, respectively; Lowe & Timko, 2004), and the other by a mixed presentation combining dietary restraint and negative affect. The latter subtype has been consistently found to co-occur with increased psychiatric symptoms in adults, including greater shape and weight concerns, increased psychopathology and personality disturbances, poorer treatment response, and, in some cases, greater severity and chronicity of binge eating (Grilo, Masheb, & Berman, 2001; Grilo, Masheb, & Wilson, 2001; Loeb, Wilson, Gilbert, & Labouvie, 2000; Stice & Agras, 1999; Stice et al., 2001; Stice & Fairburn, 2003). To date, however, no association has been found with regard to dietary restraint/negative affect subtypes and body mass index (BMI; kg/m^2) in adults (Grilo, Masheb, & Berman, 2001; Grilo, Masheb, & Wilson, 2001; Loeb, Wilson, Gilbert, & Labouvie, 2000; Stice & Agras, 1999; Stice et al., 2001; Stice & Fairburn, 2003).

Loss of control eating (LOC; the feeling that one cannot control what or how much one is eating) and binge eating (consumption of an unambiguously large amount of food accompanied by LOC; American Psychiatric Association, 1994) behaviors are common in children and adolescents (Glasofer et al., 2006; Tanofsky-Kraff et al., 2004). LOC while eating in childhood has been associated with overweight and excess body fat (Field et al., 2003; Stice, Presnell, Shaw, & Rohde, 2005; Stice, Presnell, & Spangler, 2002; Tanofsky-Kraff et al., 2006; Tanofsky-Kraff et al., 2004), and with a higher degree of eating-related and general psychopathology (Decaluwe & Braet, 2003; Goldschmidt et al., in press; Goossens, Braet, & Decaluwe, 2007; Morgan et al., 2002; Tanofsky-Kraff, Faden, Yanovski, Wilfley, & Yanovski, 2005). Similar to adults with binge eating (e.g., Chua, Touyz, & Hill, 2004; Fairburn et al., 1998; Fairburn, Welch, Doll, Davies, & O'Connor, 1997; Telch & Agras, 1996), negative affect and dietary restraint each has been implicated in the onset and maintenance of LOC and binge eating in youth. Children with LOC eating problems are more likely to exhibit depressive symptoms than weight-matched peers (Decaluwe & Braet, 2003; Eddy et al., 2007; Goossens, Braet, & Decaluwe, 2007; Isnard et al., 2003; Morgan et al., 2002; Tanofsky-Kraff, Faden, Yanovski, Wilfley, & Yanovski, 2005), and prospective data confirm that negative affect precedes and predicts binge eating in youth (Stice & Agras, 1998; Stice, Killen, Hayward, & Taylor, 1998; Stice, Presnell, & Spangler, 2002). According to several theories of affect regulation, binge eating may serve to modulate negative affect. For example, binge eating may provide a distraction from external stressors (Heatherton & Baumeister, 1991) or enable a "trade-off," whereby the aversive emotions preceding binge eating (e.g., anger) are replaced by less aversive emotions subsequent to binge eating (e.g., guilt; Kenardy, Arnow, & Agras, 1996). Indeed, preliminary evidence suggests that youth with LOC eating problems are more likely than those without eating problems to endorse emotional eating in general (Goossens, Braet, & Decaluwe, 2007; Tanofsky-Kraff, Theim, et al., 2007), and to report that LOC eating episodes occurred in response to a negative emotion (Tanofsky-Kraff, Goossens, et al., 2007).

The literature concerning the role of dietary restraint in the onset of LOC eating in children has been less consistent. Restraint Theory, which posits that binge eating results from perceived lapses in strict dietary restraint (Polivy & Herman, 1985), has received some support in the

empirical literature, with prospective evidence indicating that dietary restraint predicts the onset of binge eating in youth (Stice, Killen, Hayward, & Taylor, 1998; Stice, Presnell, & Spangler, 2002). Whereas by adulthood, most individuals with BN and BED report an extensive dieting history (e.g., de Zwaan et al., 1994; Kurth, Krahn, Nairn, & Drewnowski, 1995), some (Decaluwe & Braet, 2005; Field et al., 2003; Tanofsky-Kraff et al., 2004) but not all (Claus, Braet, & Decaluwe, 2006; Decaluwe & Braet, 2003; Decaluwe, Braet, & Fairburn, 2003; Glasofer et al., 2007) cross-sectional studies in children support an association between dieting and binge eating. In one study, most children recalled the onset of LOC eating prior to their first attempt at dieting (Tanofsky-Kraff, Faden, Yanovski, Wilfley, & Yanovski, 2005), and another study found that only a minority endorsed having eaten a forbidden food and/or restricting their food intake prior to an episode of LOC eating (Tanofsky-Kraff, Goossens, et al., 2007). Similarly inconsistent findings regarding the role of dieting in the etiology of BED are reported (e.g., Howard & Porzelius, 1999; Spurrell, Wifley, Tanofsky, & Brownell, 1997), and are in contrast to BN, in which dieting typically precedes and helps maintain the disorder (e.g., Pederson Mussell et al., 1997; Fairburn, Stice, Cooper, Doll, Norman, & O'Connor, 2003). Taken together, data from the child literature suggest the presence of other important variables besides, or in addition to, dieting behaviors and/or cognitions in the onset of LOC eating in youth (e.g., Claus, Braet, & Decaluwe, 2006).

Despite the literature documenting associations between LOC eating and increased negative affect and dietary restraint (Goossens, Braet, & Decaluwe, 2007; Tanofsky-Kraff et al., 2004), data regarding the validity of dietary restraint and dietary restraint/negative affect subtypes in pediatric samples are limited. Subtyping youth with LOC eating for the presence of dietary restraint and/or negative affect may have important research and clinical implications in terms of identifying individuals at risk for comorbid psychopathology, highlighting relevant intervention foci, and predicting treatment outcome. To our knowledge, only two studies have examined binge eating subtypes in a pediatric sample, and both suggest that the dietary restraint/negative affect subtyping scheme is a relatively robust phenomenon in youth as well. Indeed, the dietary restraint/negative affect subtype has been associated with significantly greater eating-related and general psychopathology across samples of adolescents with bulimia nervosa (Chen & Le Grange, 2007) and mixed symptoms of disordered eating (e.g., binge eating, vomiting, fear of weight gain; Grilo, 2004). However, because both of these studies were undertaken in adolescent samples, it remains unclear whether dietary restraint/negative affect subtypes can be replicated in pre-adolescent samples as well. Moreover, it is unknown if the subtyping scheme is prevalent in youth presenting with symptoms more consistent with BED (i.e., LOC eating in the absence of regular use of compensatory behaviors).

The aim of the current study was to determine whether the negative affect/dietary restraint subtyping scheme is replicable and valid in children and adolescents with LOC eating problems. The current sample was enriched for overweight, given that LOC eating is more prevalent among such individuals. We hypothesized that cluster analysis would identify subtypes of youth characterized by mixed dietary restraint/negative affect, and pure dietary restraint. Furthermore, based on previous findings in adults (Grilo, 2004; Grilo, Masheb, & Berman, 2001; Grilo, Masheb, & Wilson, 2001; Stice & Agras, 1999; Stice et al., 2001; Stice & Fairburn, 2003) and youth (Grilo, 2004; Chen & Le Grange, 2007), it was expected that the dietary restraint/negative affect subtype would display greater eating-related psychopathology, LOC eating severity, and parent-reported behavior problems as compared to the dietary restraint subtype.

2. Method

2.1. Participants

Participants were a convenience sample drawn from non-intervention protocols or weight loss treatment studies at five research institutions (National Institute of Child Health and Human Development [NICHD], National Institutes of Health, Maryland; University of Ghent, Belgium; Children's Hospital Boston, Massachusetts; University of Pittsburgh Medical Center, Pennsylvania; and Washington University School of Medicine, Missouri) to take part in a multi-site investigation of factors surrounding binge eating in youth (Tanofsky-Kraff, Goossens, et al., 2007). Given findings that LOC eating in children is associated with elevated eating-related and general psychopathology irrespective of episode size (Goldschmidt et al., in press; Goossens, Braet, & Decaluwe, 2007; Tanofsky-Kraff et al., 2005), children from the larger multi-site study who reported any LOC eating (i.e., at least one episode over the past three months) were included in the present study.

2.1.1 National Institute of Child Health and Human Development [NICHD], National Institutes of Health, Maryland—Studies at the NICHD involved overweight children and adolescents being assessed for weight loss intervention studies, and overweight and non-overweight children and adolescents participating in non-intervention, metabolic studies. Participants in the weight loss treatment studies were either aged 12 to 17, overweight, and with at least one obesity-related comorbidity (e.g., hypertension, type 2 diabetes); or were 6 to 12 years old, overweight, and healthy other than having evidence of insulin resistance. Treatment-seeking individuals were excluded if they had a major pulmonary, hepatic, cardiac, or musculoskeletal disorder unrelated to obesity; a history of substance abuse or other psychiatric disorder that would impair compliance with the study protocol; had used an anorexiant in the past 6 months; or had recently lost ≥5% of their body weight.

Participants in the non-intervention studies (8 to 17 years) were healthy, other than some being overweight; medication-free for at least two weeks prior to being studied; and without significant medical disease. Children were excluded if they had a serious psychiatric disorder (e.g., psychosis) or an eating disorder other than BED, or if they were undergoing weight loss treatment.

2.1.2 University of Ghent, Belgium—All participants (8 to 18 years) were overweight, and were either seeking inpatient weight loss treatment, or participating in a non-intervention study of excess weight gain in childhood. Exclusion criteria at the University of Ghent site included mental retardation, autism, or the presence of a developmental syndrome (e.g., Prader-Willi).

2.1.3 Children's Hospital Boston, Massachusetts—Participants were overweight and at-risk-for-overweight children and adolescents (8 to 18 years) presenting for behavioral weight loss treatment at the Optimal Weight for Life Clinic. Participants were excluded for the following reasons: obesity-related disorders associated with mental retardation, psychotic disorders, or developmental disorders associated with cognitive impairment.

2.1.4 University of Pittsburgh Medical Center, Pennsylvania—All participants (8 to 12 years) were involved in a non-intervention study examining mothers of overweight children. Exclusion criteria for children included developmental delays precluding accurate completion of study assessments, use of a medication that affects body weight, or recent initiation (less than four months) of stimulant or antidepressant medications.

2.1.5 Washington University School of Medicine, Missouri—Participants were overweight and at-risk-for-overweight adolescents (12 to 17 years) presenting for a study examining an Internet-delivered weight loss intervention. Exclusion criteria included current or past diagnosis of a full-syndrome eating disorder; medical conditions resulting in significant weight changes or precluding moderate physical activity; and use of medication significantly affecting weight.

2.2 Procedures

All treatment-seeking youth were assessed prior to entering weight loss treatment. After receiving a complete description of the study, participants provided written assent and their parents provided written informed consent. All protocols were approved by Institutional Review Boards at each respective site.

2.3 Measures

2.3.1 Demographics—Participants' height and weight were measured and z-BMI (Kuczmarski et al., 2000) was calculated. Following CDC standards (Ogden, Flegal, Carrol, & Johnson, 2002), children with a z-BMI at or above 1.64 (95^{th} percentile) were identified as overweight.

2.3.2 Eating Disorder Examination 12.0—At NICHD, weight-loss treatment-seeking adolescents aged 12–17 years, and non-treatment-seeking participants who were 14 years or older completed the Eating Disorder Examination (EDE; Fairburn & Cooper, 1993). All other NICHD participants, and children from the other four sites, regardless of participant age, were administered the EDE adapted for children (ChEDE; Bryant-Waugh, Cooper, Taylor, & Lask, 1996). The EDE and ChEDE are semi-structured, interviewer-based instruments for assessing behavioral and attitudinal correlates of eating disorders that are nearly identical in form and content. Modifications found in the ChEDE include the use of simpler language to address comprehension concerns in younger children, and the addition of a card-sort task to supplement items addressing over-valuation of shape and weight. Both the adult and child versions of the interview have demonstrated very good reliability and validity (Bryant-Waugh, Cooper, Taylor, & Lask, 1996; Cooper, Cooper, & Fairburn, 1989; Decaluwe & Braet, 2004; Glasofer et al., 2006; Grilo, Masheb, Lozano-Blanco, & Barry, 2004; Rizvi, Peterson, Crow, & Agras, 2000; Rosen, Vara, Wendt, & Leitenberg, 1990; Tanofsky-Kraff et al., 2004; Watkins, Frampton, Lask, & Bryant-Waugh, 2005). The EDE yields four subscale scores (Restraint, Eating Concern, Weight Concern, and Shape Concern) and a global score measuring the overall severity of eating disorder psychopathology, all of which range in scores from 0 to 6. The EDE also contains diagnostic items that are used to arrive at a clinical diagnosis of an eating disorder. Three types of eating episodes are distinguished according to the reported amount of food ingested, and presence/absence of LOC: objective bulimic episodes (OBEs; episodes of LOC eating accompanied by consumption of an unambiguously large amount of food); subjective bulimic episodes (SBEs; episodes of LOC eating *not* accompanied by consumption of an unambiguously large amount of food, but considered excessive by respondents); and objective overeating episodes (episodes consisting of an unambiguously large amount of food that are *not* accompanied by LOC). As noted previously, only children with LOC eating (OBEs or SBEs) were included in the present study.

2.3.3 Children's Depression Inventory—The Children's Depression Inventory (CDI; Kovacs, 1985) was used to assess depressive symptoms. CDI scores range from 0 to 54, and a clinical cutoff score of 19 is used to indicate probable depression (Kovacs, 1992). The CDI is well-established in terms of its test-retest reliability, internal consistency, and construct validity (Sitarenios & Kovacs, 1999). It has been found to correlate modestly with clinician

reports of depression (Kazdin, 1989), and to distinguish between children with depression and those with other forms of psychopathology (Carlson & Cantwell, 1980).

2.3.4 Child Behavior Checklist—The Child Behavior Checklist (CBCL; Achenbach, 1991) is a parent-reported measure of child competency and functioning in a range of behavioral domains. The CBCL generates eight clinical subscales, internalizing and externalizing scales, a total problems scale, and a competence scale, with scores ranging from 0 to 100. The CBCL has demonstrated good reliability and validity (Achenbach, 1991; Achenbach & Elderbrock, 1991). For the purposes of the present study, only the internalizing, externalizing, and total problems scales were examined.

2.4 Statistical Analysis

All analyses were conducted using SPSS for Windows, version 14.0 (SPSS, 2005). The sample size (n=159) provided greater than 80% power to detect a medium effect size (Lenth, 2006). Participants were subject to a k-means cluster analysis, based on EDE Restraint subscale and CDI total scores. This procedure attempts to identify relatively homogeneous groups of cases based on selected characteristics, using a predetermined number of clusters. A two-cluster solution was specified given findings from the adult literature. Raw Restraint and CDI scores were selected based on the recommendation of Stoddard (1979), because standardizing scores can eliminate important variability between clusters, and can reduce the natural weighting established by differences in measurement scales. Initial cluster centers (each case in a given cluster's average value on all clustering variables) were chosen by selecting the two cases that differed most on the chosen variables. Cluster centers were updated iteratively based on each case's Euclidean distance from its center. Once all cases were assigned to a cluster, a new center was calculated before the next cluster assignment, and the procedure repeated for up to 10 iterations. Participants with missing data on either of the clustering measures (n=13) were not assigned to a cluster. Independent samples t-tests and Pearson chi-square tests were used to explore cluster differences in age, sex, treatment-seeking status, site, and z-BMI. CDI and Restraint scores were compared as a manipulation check, to determine replication of the dietary restraint and dietary restraint/negative affect subtypes in the current sample; t-test results are presented for descriptive purposes. Separate MANCOVAs were used to compare clusters on EDE subscales, and on CBCL subscales. Given their non-normality, past month OBE and SBE frequencies were subject to log transformations, and ANCOVA was used to compare the clusters on these variables. Because of the very low reported frequency of compensatory behaviors (i.e., self-induced vomiting, laxative use, diuretic use, and driven exercise), the sample was divided into those who did and did not report any compensatory behaviors during the past month. Clusters were then compared on this variable using chi-square analyses.

In order to validate the clusters, as suggested by Rapkin and Luke (1993), the dataset was divided into two random sub-samples and the cluster analysis was re-run in each of these sub-samples. T-tests were used to compare clusters within each of these samples on the clustering variables, and planned contrasts following an ANOVA with a nested design (cluster nested within sample) were used to compare the clusters across sub-samples. The cluster analysis was also re-run on treatment-seeking and non-treatment seeking individuals, as well as individuals reporting binge eating (i.e., OBEs); t-tests were used to compare clusters within each of these samples on the clustering variables. Separate MANOVAs and MANCOVAs (when appropriate) were performed on the remaining EDE subscales, and on CBCL subscales to compare clusters within each of these sub-samples.

3 Results

3.1 Sample Characteristics

The original sample consisted of 445 children and adolescents (59.1% female), aged 8 to 18 years (*M* age=13.2±2.7), participating in the multi-site study (*M* z-BMI=1.8±0.9; Tanofsky-Kraff, Goossens, et al., 2007). From this sample, 172 children and adolescents (62.8% female; *M* age=12.8±2.9 years) were selected for the current study based on reporting LOC eating, with or without consumption of an unambiguously large amount of food. These 172 participants were 60.5% Caucasian; 28.5% African-American; 8.1% Hispanic; 1.2% Asian; and 1.7% identified themselves as "other." The majority (80.2%) of participants were overweight, with an age- and sex-adjusted body mass index (z-BMI; Ogden, Flegal, Carrol, & Johnson, 2002) greater than the 95th percentile (*M* z-BMI=2.0±0.7), and 50.6% were seeking weight-loss treatment. See Table 1 for sample characteristics.

3.2 Full Sample Cluster Analysis

In the full sample, cluster analysis produced two subtypes, one characterized by moderate dietary restraint (DR; *n*=114; 71.7%) and the second by a mixed presentation combining moderate dietary restraint and high negative affect (DR/NA; *n*=45; 28.3%). The mean CDI score of 19.8±5.0 in the DR/NA cluster corresponds to probable depression; in contrast, the mean CDI score of 6.7±3.7 in the DR cluster indicates low probability of depression (*t*=15.9; *p*<.001). The DR/NA and DR subtypes reported mean Restraint scores of 1.4±1.0 and 1.0±0.9 (*t*=2.3; *p*=.02), respectively, indicating that both groups attempted to exercise restraint approximately on 1 to 5 days in the preceding four weeks.

3.2.1 Demographics—The DR/NA cluster was significantly older than the DR cluster; disproportionately more DR/NA cases were seeking treatment; and the Missouri and Belgium sites had disproportionately more DR/NA cases, and the NIH site disproportionately more DR cases, than expected given the ratio of DR/NA to DR cases in the full sample (all *p*s<.01). The clusters did not significantly differ in race/ethnicity, z-BMI, or sex (all *p*s≥.24). Age, site, and treatment-seeking status were considered as covariates in all subsequent analyses, however, neither age nor site significantly contributed to the ANCOVA and MANCOVA models, thus, only treatment-seeking status was retained as a covariate in subsequent analyses. Sex was also included as a covariate given its established association with all of the dependent variables (Crick & Zahn-Waxler, 2003; Presnell, Bearman, & Stice, 2004; Twenge & Nolen-Hoeksema, 2002; Vander Wal & Thelen, 2000). See Table 1 for cluster characteristics.

3.2.2 Subtype comparisons on psychopathology—The clusters significantly differed on shape and weight concerns, and on global severity of disordered eating symptoms (all *p*s<.05), with the DR/NA cluster scoring higher than the DR cluster on these measures; differences on eating concerns approached significance (*p*=.06). The DR/NA cluster reported a greater frequency of OBEs over the past month relative to the DR cluster (*p*=.05), whereas there were no differences in SBE frequency. The DR/NA subtype also exhibited significantly greater CBCL internalizing, externalizing, and total scores (all *p*s<.001) than the DR cluster. See Table 1 for subtype comparisons on EDE and CBCL scores.

3.3 Replication in random sub-samples

When the cluster analysis was re-run in two random sub-samples (Sample 1, *n*=80; Sample 2, *n*=79), results were identical to those obtained in the full sample cluster analysis. One cluster from Samples 1 (*n*=21; 26.3%) and 2 (*n*=24; 30.4%) exhibited a pattern of high negative affect and moderate dietary restraint, whereas the other cluster from Samples 1 (*n*=59; 73.8%) and 2 (*n*=55; 69.6%) exhibited low negative affect and moderate dietary restraint (see Table 2). These clusters will henceforth be referred to as DR/NA-1 and DR/NA-2, and DR-1 and DR-2,

respectively, referring to their levels of negative affect and dietary restraint, and the sub-samples from which they were derived. The DR/NA and DR clusters within each sample significantly differed from one another in CDI scores (all *p*s<.001), but not in Restraint scores (*p*s≥.11). DR/NA-1 significantly differed from DR-2 in CDI scores (contrast estimate=13.42; *p*<.001), but did not significantly differ from DR/NA-2 in CDI scores (contrast estimate=.11; *p*=.93). DR/NA-1 did not significantly differ in Restraint from DR/NA-2 (contrast estimate= −.12; *p*=.67) or DR-2 (contrast estimate=.24; *p*=.32).

There were no differences between DR-1 and DR/NA-1 subtypes on demographic variables. However, DR/NA-2 was significantly older (*t*=2.6; *p*=.01) and heavier (*t*=2.2; *p*=.03) than DR-2, thus, subsequent MANCOVAs controlled for these variables. Comparisons between DR and DR/NA subtypes in each of these random sub-samples are described in Table 2.

3.4 Replication in treatment-seeking and non-treatment-seeking youth

Treatment-seeking youth were significantly heavier (*t*=6.9; *p*<.001) and comprised of disproportionately more Hispanic and fewer Caucasian youth (χ^2= 19.6; *p*=.001) than non-treatment youth. When controlling for z-BMI and race/ethnicity, treatment-seeking youth reported significantly higher scores on EDE Eating Concern, Weight Concern, and Global scores (*p*s≤.03); CDI total (p<.001); and CBCL internalizing, externalizing, and total scores (*p*s≤.001).

Within the treatment-seeking sample, the first cluster (*n*=29; 39.2%) exhibited a pattern of high negative affect and moderate dietary restraint, whereas the second cluster within treatment-seekers (*n*=45; 60.8%) endorsed low negative affect and moderate dietary restraint (see Table 3). These clusters will henceforth be referred to as DR/NA-TX and DR-TX, respectively, referring to their levels of negative affect and dietary restraint, and the treatment-seeking sub-sample from which they were derived. The DR/NA-TX cluster demonstrated significantly greater CDI scores than the DR-TX cluster (*p*<.001), whereas the groups did not differ in Restraint (*p*=.76). The DR/NA-TX cluster was significantly older (*t*=3.3; *p*=.002) than the DR-TX cluster, thus, subsequent analyses controlled for age. MANCOVA comparisons on other psychosocial variables are reported in Table 3.

Within non-treatment-seeking youth, the first cluster (*n*=27; 31.8%) reported moderate negative affect and moderate dietary restraint, whereas the second cluster (*n*=58; 68.2%) endorsed low negative affect and low dietary restraint (see Table 3). These clusters will henceforth be referred to as DR/NA-NOTX and DR-NOTX, respectively, referring to their levels of negative affect and dietary restraint, and the non-treatment sub-sample from which they were derived. The two clusters significantly differed in CDI scores (*p*<.001) and in Restraint scores (*p*=.03), with the DR/NA-NOTX cluster scoring higher in these domains. There were no differences between DR-NOTX and DR/NA-NOTX subtypes on demographic variables. MANOVA comparisons on other psychosocial variables are reported in Table 3.

3.5 Replication in youth reporting binge eating

Within youth reporting OBEs (*n*=96), the first cluster (*n*=30; 31.2%) reported high negative affect and moderate dietary restraint, whereas the second cluster (*n*=66; 68.8%) reported low negative affect and moderate dietary restraint. These clusters will henceforth be referred to as DR/NA-OBE and DR-OBE, respectively, referring to their levels of negative affect and dietary restraint, and the “pure” binge eating sample from which they were derived. The DR/NA-OBE cluster demonstrated significantly greater CDI scores than the DR-OBE cluster (*p*<.001), whereas the groups did not differ in Restraint (*p*=.11). The DR/NA-OBE cluster was significantly older (*t*=3.9; *p*<.001) and heavier (*t*=2.2; *p*=.03) than the DR-OBE cluster, thus,

subsequent analyses in youth reporting binge eating controlled for z-BMI and age. MANCOVA results are reported in Table 4.

4. Discussion

The current study examined the validity of subtyping youth with LOC eating problems along dietary restraint and negative affect dimensions. Cluster analysis yielded two subtypes: pure dietary restraint (DR), and mixed dietary restraint and high negative affect (DR/NA). These subtypes were replicated in two randomly selected sub-samples of the dataset, in treatment-seeking youth, and in youth reporting "pure" binge eating. In the overall sample, the DR/NA subtype exhibited greater eating-related psychopathology and parent-reported behavior problems as compared to the DR subtype; similar results were generally observed across sub-samples. No differences between subtypes were found with regard to body weight.

The cluster arrangements that emerged in the full sample were relatively robust, as indicated by their replication in random samplings of the data, in treatment-seeking individuals, and in youth reporting binge eating. Further, in both the full sample and in the sub-sample replications, the proportion of individuals in each cluster (i.e., approximately 70% in the DR cluster, versus 30% in the DR/NA cluster) was comparable to distributions found in the adult literature (Grilo, Masheb, & Berman, 2001; Grilo, Masheb, & Wilson, 2001; Stice & Agras, 1999; Stice et al., 2001; Stice & Fairburn, 2003). Therefore, our findings indicate that, similar to adults with BED and BN (Grilo, Masheb, & Berman, 2001; Grilo, Masheb, & Wilson, 2001; Stice & Agras, 1999; Stice et al., 2001; Stice & Fairburn, 2003), youth may be subtyped based upon dietary restraint and negative affect. While both clusters endorsed relatively low levels of restraint, both scored above normative Restraint subscale means for overweight youth (Decaluwe & Braet, 2004), indicating that modest dietary restraint may be a core feature of LOC eating in youth. Moreover, given the findings that, similar to the adult literature (Grilo, Masheb, & Berman, 2001; Grilo, Masheb, & Wilson, 2001; Stice & Agras, 1999; Stice et al., 2001; Stice & Fairburn, 2003), the DR/NA subtype in the full sample exhibited more frequent binge eating, and greater disordered eating psychopathology and parent-reported behavior problems than the DR subtype, our data suggest that the presence of negative affect may signal a more severe variant of LOC eating in children and adolescents and that this additional impairment may be related, at least in part, to negative affect. Indeed, the higher shape and weight concerns observed in the DR/NA cluster relative to the DR cluster may imply greater risk for a full-syndrome eating disorder among this sub-group, given that such concerns have been identified as a risk factor for eating disorders (Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004). It is notable that the difficulties experienced by youth with concomitant depressive symptoms and LOC eating were not limited to the eating disorder arena, but also were evident in their tendencies to internalize and externalize emotions based upon parent-reports.

When analyses were repeated based upon treatment-seeking status, a somewhat different pattern was observed in non-treatment youth compared to treatment-seeking children and the sample as a whole: for the non-treatment sample, one cluster was characterized by moderate dietary restraint and moderate negative affect, the other by low dietary restraint and low negative affect. Both clusters in the non-treatment sample evidenced relatively low CDI scores, however, the mean CDI score for the full non-treatment sample was also quite low, and significantly lower than the mean CDI score for the treatment-seeking sample (as were scores on most other measures of psychopathology). This is consistent with our finding that, in the full study sample, the DR/NA subtype was significantly more likely to be seeking treatment than the DR subtype, suggesting that depressive symptoms may be in part responsible for motivating families to seek weight control treatment for children. For those children exhibiting LOC eating and both low depressive symptoms and low levels of dietary restraint (i.e., the non-treatment-seeking DR subtype), there may be a separate pathway to LOC eating that

involves neither negative affect nor restraint (e.g., impulsivity; Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006); further research is needed to delineate risk factors for LOC eating in this group. Clinically, children who have not yet reached the point where they seek professional treatment may be a more optimal group with whom to intervene for preventive efforts, given that their LOC eating status may promote weight gain or development of a full-syndrome eating disorder (Kotler, Cohen, Davies, Pine, & Walsh, 2001; Tanofsky-Kraff et al., 2006). Their modest levels of depressive symptomatology are unlikely to interfere with treatment, in contrast to the poorer treatment outcome observed in some studies of binge eating adults with high negative affect (Stice & Agras, 1999; Stice et al., 2001).

Our findings may have important clinical implications. Practitioners are advised to assess for depressive symptoms in children and adolescents presenting with binge or LOC eating problems, since the presence of negative affect concurrent with eating disorder behaviors appears to indicate a more severely impaired subset of these youth. It may be necessary for clinical attention to focus on other presenting symptoms as well. However, it is unclear whether youth with high negative affect and moderate dietary restraint can be expected to respond as well as those with pure dietary restraint to psychological treatments designed to treat LOC eating, given that some adult studies have found poorer binge eating treatment outcome in the negative affect/dietary restraint subtype as noted above (Stice & Agras, 1999; Stice et al., 2001). Future studies examining treatment outcome in the different subtypes of youth with binge or LOC eating problems are needed to determine whether the DR/NA subtype is in need of more intensive or differential care.

Several limitations of this investigation should be noted. Our study design was cross-sectional, precluding conclusions about causality of depressive and eating disorder symptoms. Prospective studies indicate that negative affect may predict binge eating onset in adolescents (Stice & Agras, 1998; Stice, Killen, Hayward, & Taylor, 1998) and, simultaneously, binge eating predicts further increases in depressive symptoms (Stice & Bearman, 2001; Stice, Burton, & Shaw, 2004; Stice, Hayward, Cameron, Killen, & Taylor, 2000). However, it is unclear how other forms of psychopathology (e.g., shape and weight concerns, internalizing and externalizing symptoms) may interact with one another in the onset and/or outcome of these problems. Further, the use of a sample in which few participants met criteria for BED precludes generalization to youth with full-syndrome eating disorders. Finally, behavior problems were reported by parents only; given the generally poor agreement between parents and children on measures of behavior problems (e.g., Jensen et al., 1999), future studies should include child-reports of their own behavioral problems as well. Strengths of this study include the use of a large and diverse sample in terms of treatment-seeking status, location, and cultural background. Other study strengths include the use of interview methodology for assessing eating disordered behavior and attitudes, and standardized measurement, rather than self-reports, of height and weight to calculate BMI.

In summary, the present study extends the adult literature by indicating that dietary restraint and dietary restraint/high negative affect subtypes can be identified in youth with LOC eating problems. Further examination of these subtypes in youth is warranted in order to understand their associations with functioning in other domains, with other forms of psychopathology, and with treatment response. Prospective studies are required to determine whether youth belonging to the dietary restraint/negative affect subtype are at greater risk for developing a full-syndrome eating disorder or other psychiatric disorders and thus might benefit from preventive interventions.

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Table 1

Full sample characteristics and comparisons between dietary restraint and dietary restraint/negative affect subtypes on demographic and psychosocial variables (*M*±*SD*, unless otherwise indicated)

Variable	Full sample (*n*=172)[a]	DR/NA (*n*=45)	DR (*n*=114)	Statistic
		Demographic Variables		
Female, % (*n*)	62.8 (108)	55.6 (25)	63.2 (72)	χ^2=0.8
Age, y	12.8±2.9	13.9±2.5	12.5±2.9	*t*=3.0**
z-BMI	2.0±0.7	2.1±0.6	1.9±0.8	*t*=1.3
White	60.5 (104)	60.0 (27)	56.1 (64)	
Black	28.5 (49)	33.3 (15)	29.8 (34)	
Race, % (*n*) Hispanic	8.1 (14)	6.7 (3)	9.6 (11)	χ^2=2.5
Asian	1.2 (2)	0.0 (0)	1.8 (2)	
Other	1.7 (3)	0.0 (0)	2.6 (3)	
Treatment seeking, % (*n*)	50.6 (87)	66.7 (30)	37.7 (43)	χ^2=10.9**
Eating Related Psychopathology				
EDE Restraint	1.1±0.9	1.4±1.0	1.0±0.9	*t*=2.3*
EDE Eating Concern	0.8±0.8	1.1±1.0	0.7±0.7	*F*=3.6
EDE Shape Concern	2.2±1.4	2.8±1.4	2.0±1.4	*F*=6.6*
EDE Weight Concern	2.3±1.2	2.8±1.1	2.1±1.2	*F*=5.7*
EDE Global	1.6±0.9	2.0±0.9	1.4±0.8	*F*=8.5**
SBE frequency[b]	1.2±2.8	1.1±2.6	1.4±3.0	*F*=0.0
OBE frequency[b]	2.3±4.9	4.2±7.6	1.6±3.5	*F*=4.0*
Compensatory behaviors, % (*n*) reporting[c]	6.4 (11)	4.4 (2)	7.0 (8)	χ^2=0.5
General Psychopathology				
CDI Total	10.4±7.2	19.8±5.0	6.7±3.7	*t*=15.9***
CBCL Internalizing	55.7±13.3	62.8±11.3	51.9±12.4	*F*=19.9***
CBCL Externalizing	52.1±13.0	58.8±12.0	49.0±12.4	*F*=14.4***
CBCL Total	55.6±12.9	63.1±11.2	51.8±11.8	*F*=21.9***

* *p*<.05;

** *p*<.01;

*** *p*<.001

Note: DR/NA=dietary restraint/negative affect subtype; DR=dietary restraint subtype; z-BMI=body mass index z-score accounting for age and sex (Ogden, Flegal, Carrol, & Johnson, 2002); EDE=Eating Disorder Examination; OBE=objective bulimic episode; SBE=subjective bulimic episode; CDI=Children's Depression Inventory; CBCL=Child Behavior Checklist.

[a] 13 participants from the full sample were excluded from the cluster analysis because of missing data.

[b] Reported eating episode frequencies are for the month prior to assessment only.

[c] Compensatory behaviors include self-induced vomiting, laxative use, diuretic use, and driven exercise. The rates reported pertain to the number of participants endorsing use of any of these behaviors in the month prior to assessment.

Table 2

Comparisons between dietary restraint and dietary restraint/negative affect subtypes on psychosocial variables within two random samples (*M*±*SD*)

	Sample 1 (*n*=80)			Sample 2 (*n*=79)		
	DR/NA-1 (*n*=21)	DR-1 (*n*=59)		DR/NA-2 (*n*=24)	DR-2 (*n*=55)	
Measure	***M*±*SD***	***M*±*SD***	**Statistic**	***M*±*SD***	***M*±*SD***	**Statistic**
EDE Restraint	1.3±1.1	0.9±0.8	*t*=1.6	1.4±0.9	1.1±1.0	*t*=1.5
EDE Eating Concern	1.0±0.9	0.8±0.8	*F*=1.4	1.2±1.1	0.7±0.7	*F*=2.0
EDE Shape Concern	2.5±1.2	2.2±1.4	*F*=0.7	3.1±1.6	1.8±1.4	$F=6.6^{*}$
EDE Weight Concern	2.5±1.0	2.3±1.1	*F*=0.5	3.0±1.1	1.9±1.3	$F=7.6^{**}$
EDE Global	1.8±0.8	1.5±0.8	*F*=2.0	2.2±0.9	1.3±0.9	$F=6.5^{*}$
CDI Total	19.9±5.3	6.9±3.6	$t=10.4^{***}$	19.8±4.9	6.4±3.8	$t=13.1^{***}$
CBCL Internalizing	65.7±13.1	52.2±14.1	$F=15.8^{***}$	60.3±9.0	51.6±10.4	$F=6.5^{*}$
CBCL Externalizing	60.8±11.5	50.3±14.5	$F=9.2^{**}$	57.1±12.4	47.5±9.6	$F=8.8^{**}$
CBCL Total	65.7±12.4	53.5±12.5	$F=14.2^{***}$	61.0±10.0	50.0±10.9	$F=9.7^{**}$

$^{*}p<.05$;

$^{**}p<.01$;

$^{***}p<.001$

Note: DR/NA-1=dietary restraint/negative affect subtype in Sample 1; DR-1=dietary restraint subtype in Sample 1; DR/NA-2=dietary restraint/negative affect subtype in Sample 2; DR-2=dietary restraint subtype in Sample 2; EDE=Eating Disorder Examination; CDI=Children's Depression Inventory; CBCL=Child Behavior Checklist.

Table 3

Comparisons between dietary restraint and dietary restraint/negative affect subtypes on psychosocial variables within treatment-seeking and non-treatment-seeking youth (*M*±*SD*)

	Treatment-seeking youth (*n*=74)			Non-treatment-seeking youth (*n*=85)		
	DR/NA-TX (*n*=29)	DR-TX (*n*=45)		DR/NA-NOTX (*n*=27)	DR-NOTX (*n*=58)	
Measure	***M*±*SD***	***M*±*SD***	**Statistic**	***M*±*SD***	***M*±*SD***	**Statistic**
EDE Restraint	1.3±0.9	1.2±0.9	*t*=0.3	1.3±1.1	0.8±0.9	$t=2.3^{*}$
EDE Eating Concern	1.2±1.0	1.1±0.9	*F*=0.1	0.6±0.8	0.6±0.7	*F*=0.2
EDE Shape Concern	3.1±1.3	2.5±1.3	*F*=1.4	1.8±1.5	1.8±1.4	*F* =0.0
EDE Weight Concern	3.0±1.0	2.5±1.1	*F*=3.8	1.8±1.2	1.9±1.2	*F* =0.1
EDE Global	2.1+0.7	1.8±0.8	*F*=1.6	1.4±0.9	1.2±0.9	*F* =0.3
CDI Total	21.3±4.4	7.4±3.4	$t=15.2^{***}$	14.9±4.6	5.1±3.1	$t=11.4^{***}$
CBCL Internalizing	65.5±11.1	55.5±9.9	$F=11.2^{**}$	55.9±10.9	49.0±13.6	$F=5.0^{*}$
CBCL Externalizing	61.7±11.4	52.0±9.8	$F=12.9^{**}$	54.2±12.8	45.5±12.9	$F=8.2^{**}$
CBCL Total	66.0±9.5	55.2±9.4	$F=14.4^{***}$	56.9±11.8	48.7±12.8	$F=7.7^{**}$

* $p<.05$;

** $p<.01$;

*** $p<.001$

Note: DR/NA-TX=dietary restraint/negative affect subtype in treatment-seeking youth; DR-TX=dietary restraint subtype in treatment-seeking youth; DR/NA-NOTX=dietary restraint/negative affect subtype in non-treatment-seeking youth; DR-NOTX=dietary restraint subtype in non-treatment-seeking youth; EDE=Eating Disorder Examination; CDI=Children's Depression Inventory; CBCL=Child Behavior Checklist.

Table 4

Comparisons between dietary restraint and dietary restraint/negative affect subtypes on psychosocial variables within youth reporting binge eating (*M*±*SD*)

	Youth reporting binge eating (*n*=66)		
	DR/NA-OBE (*n*=30)	**DR-OBE (*n*=66)**	
Measure	***M*±*SD***	***M*±*SD***	**Statistic**
EDE Restraint	1.3±1.0	1.0±.09	t=1.6
EDE Eating Concern	1.2±1.0	0.8±0.8	F=1.2
EDE Shape Concern	3.0±1.4	2.1±1.5	F=2.2
EDE Weight Concern	2.9±1.0	2.1±1.2	F=5.3*
EDE Global	2.1±0.8	1.5±0.9	F=4.0*
CDI Total	21.1±5.0	7.6±3.8	t=14.6
CBCL Internalizing	65.7±11.6	53.0±12.0	F=14.3***
CBCL Externalizing	61.0±12.1	51.1±12.6	F=10.7**
CBCL Total	65.4±10.4	54.4±11.0	F=11.9**

* p<.05;

** p<.01;

*** p<.001

Note: DR/NA-OBE=dietary restraint/negative affect subtype in youth reporting objective bulimic episodes; DR-OBE=dietary restraint subtype in youth reporting objective bulimic episodes; EDE=Eating Disorder Examination; CDI=Children's Depression Inventory; CBCL=Child Behavior Checklist.