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Social Appearance Anxiety and Dietary Restraint as Mediators between Perfectionism and Binge Eating: A Six Month Three Wave Longitudinal Study

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Abstract

Binge eating is related to perfectionism and restrained eating. However, the mechanisms underlying these relationships are not well understood. It is possible that social anxiety, specifically social appearance anxiety (i.e., the fear of overall appearance evaluation), influences the relationship between binge eating, perfectionism, and dietary restraint. In the current study ($N = 300$ women), we tested the relationship between dietary restraint, social appearance anxiety, concern over mistakes (a component of perfectionism), and binge eating in prospective data (three time points: at baseline, at two month, and at six month follow up). We found that social appearance anxiety, dietary restraint, and concern over mistakes each predicted binge eating at baseline. Only social appearance anxiety prospectively predicted binge eating when accounting for all variables. Further, in the tested model, social appearance anxiety mediated the relationship between concern over mistakes and binge eating across six months. On the contrary, dietary restraint did not mediate the relationship between concern over mistakes and binge eating in the tested model. The finding that social appearance anxiety served as a mediator between concern over mistakes and binge eating, but that dietary restraint did not, implies that social appearance anxiety may be a more salient prospective predictor of binge eating than dietary restraint. Intervening on social appearance anxiety may be important in the treatment and prevention of binge eating.

Keywords

social anxiety; binge eating; social appearance anxiety; perfectionism; dietary restraint; disordered eating

Binge eating, the uncontrollable consumption of an unusually large amount of food for a particular situation within a two-hour time period, is a prevalent eating disorder symptom associated with significant detrimental effects on physical and mental health, such as an

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increased risk for obesity and psychiatric co-morbidity (American Psychiatric Association, 2013; Hovrud & De Young, 2015; Hudson, Hiripi, Pope Jr, & Kessler, 2007; Wilfley, Wilson, & Agras, 2003). Binge eating is a primary characteristic of both binge eating disorder and bulimia nervosa and can also occur in anorexia nervosa and other specified feeding or eating disorder, according to DSM 5 criteria (American Psychiatric Association, 2013). Better understanding the development and maintenance of binge eating is important for reducing its associated impairment and may contribute to the prevention and treatment of the eating disorders.

Research shows that multiple personality, cognitive, affective, and psychological factors interact to potentially cause or maintain binge eating (e.g., Jacobi et al., 2004; Sherry & Hall, 2009). One such model of the development and maintenance of binge eating posits that perfectionism leads to restrained eating, which leads to binge eating (Sherry & Hall, 2009; Mackinnon et al., 2011). However, there have been mixed findings regarding this model. For instance, Sherry and Hall (2009) found that dietary restraint mediated the relationship between perfectionism and binge eating over time. However, Mackinnon et al. (2011) failed to find this same relationship between restrained eating, perfectionism, and binge eating. It is possible that another variable affects the relationship between dietary restraint, perfectionism, and binge eating. One such variable may be social anxiety, which is related to each of these variables (Mackinnon et al., 2011). Integrating and testing a model that combines these variables may be an important step in elucidating the etiology and/or maintenance of binge eating. Below we review literature examining how these factors (i.e., perfectionism, dietary restraint, and social anxiety) may contribute to binge eating.

Perfectionism and Binge Eating

Although a single definition has not been agreed on, perfectionism can be conceptualized as a multi-dimensional personality construct in which individuals strive to attain the highest possible standard or expectation while simultaneously avoiding any mistake or flaw (Frost, Marten, Lahart, & Rosenblate, 1990). It has been theorized that individuals who engage in binge eating possess perfectionistic expectations and that failure to meet these expectations induces the need for escape and thus triggers binge eating (Heatherton & Baumeister, 1991). Research has supported this theory, finding that perfectionism is related to and predicts binge eating, cross-sectionally and over time (Cain, Bardone-Cone, Abramson, Vohs, & Joiner, 2008; Short, Mushquash, & Sherry, 2013; Fitzsimmons-Craft, Bardone-Cone, Brownstone, & Harney, 2012; Pratt, Telch, Labouvie, Wilson, & Agras, 2001; Sherry & Hall, 2009; Mackinnon et al., 2011). Concern over mistakes, or the excessive worry over making errors, is characterized by the all-or-nothing principle in which any flaw constitutes a complete failure. Importantly, concern over mistakes has been shown to be an aspect of perfectionism specifically related to a diagnosis of anorexia and bulimia nervosa (Bulik et al., 2003). Other research has shown that weight and shape concerns are associated with binge eating frequency, but only in the presence of high concern over mistakes (Bardone-Cone et al., 2008). These findings suggest that concern over mistakes may contribute to binge eating and support the notion that binge eating may be specifically related to concern over mistakes. Indeed, Mackinnon et al. (2011) tested a model of binge eating that supported concern over mistakes as a vulnerability factor which both predicted and was predicted by

binge eating over time. Thus, there is evidence suggesting that concern over mistakes is implicated in binge eating.

Dietary Restraint and Binge Eating

Dietary restraint is thought to induce binge eating through perceived deprivation, which then leads to compensatory overeating (Polivy & Herman, 1985). Dietary restraint should be distinguished from dietary restriction. Dietary restriction is the real physiological deprivation of food, whereas dietary restraint is the perceived deprivation of food (De Young et al., 2014; Stice, Fisher, & Lowe, 2004). Studies show that common measures of dietary restraint do not accurately predict actual food intake (e.g., Stice, Fisher, & Lowe, 2004; Stice, Sysko, Roberto, & Allison, 2010). Though dietary restraint may not relate to dieting *behavior*, it represents a *cognitive* symptom that may still be important in understanding the development or maintenance of binge eating (De Young et al., 2014). For example, it has been well established that dietary restraint often precedes binge eating (e.g., Polivy & Herman, 1985; Zunker et al., 2011; Hetherington, Stoner, Andersen, & Rolls, 2000). Additionally, reducing dietary restraint is regarded as a significant component of binge eating interventions, as it facilitates the loss of control that accompanies binge eating (Fairburn, 2008).

Importantly, some researchers have shown that dietary restraint may lead to binge eating, whereas other studies have found insignificant effects when investigating the relationship between dietary restraint and binge eating (De Young et al., 2014; Elran-Barak et al., 2015; Goldschmidt, Wall, Loth, Le Grange, & Neumark-Sztainer, 2012; Mackinnon et al., 2011; Schaumberg, Anderson, Anderson, Reilly, & Gorrell, 2016). Although these conflicting findings may be due to methodological differences, they might also be contributed to the *possibility of a third variable* (Stice, 2002). More specifically, dietary restraint may lead to binge eating, but possibly only when another variable precedes restrained eating, or its relationship may be obscured by other factors (Andrés & Saldaña, 2014; Emery, King, Fischer, & Davis, 2013; Goldschmidt et al., 2012; Racine, Burt, Iacono, McGue, & Klump, 2011). For example, depression and self-esteem have been shown to influence the relationship between dietary restraint and binge eating (Goldschmidt et al., 2012). Thus, though dietary restraint may contribute to the development or maintenance of binge eating, it is also possible that other factors may be as salient in the prediction of binge eating.

Social Anxiety and Binge Eating

One additional factor that might be relevant for binge eating is social anxiety. The literature supports the idea that binge eating is related to social anxiety in general (Otrovsky, Swencionis, Wylie-Rosett, & Isasi, 2013; Sawaoka, Barnes, Blomquist, Masheb, & Grilo, 2012; Schwalberg, Barlow, Alger, & Howard, 1992). For instance, Schwalberg et al. (1992) found that 70% of obese binge eaters met criteria for a diagnosis of an anxiety disorder and that social anxiety in particular was one of the most commonly diagnosed co-morbid disorders, at rates of 36.4% in their sample of obese binge eaters. Furthermore, obese individuals with BED have higher rates of social anxiety than the general population or obese individuals without BED (Otrovsky et al., 2013). Social anxiety has also been found to

predict binge eating frequency, independent of body mass index (BMI) (Otrovsky et al., 2013; Sawaoka et al., 2012).

One specific form of social anxiety that might relate to binge eating, and that has not yet been explored, is social appearance anxiety. Social appearance anxiety is the fear of overall appearance evaluation and has been shown to be robustly related to symptoms of anorexia and bulimia nervosa, more so than other facets of social anxiety (Dakanalis et al., 2016; Levinson & Rodebaugh, 2012; Levinson et al., 2013). Further, Koskina, Van den Eynde, Meisel, Campbell, and Schmidt (2011) found that social appearance anxiety is related to global eating disturbance and dietary restraint in the context of bulimia nervosa. Despite its connection to symptoms of anorexia and bulimia nervosa, the role of social appearance anxiety in binge eating specifically has not, to our knowledge, been tested. Therefore, the relationship between social appearance anxiety and binge eating, as well as its association with other factors related to binge eating, warrants further investigation.

A Combined Theoretical Model of Binge Eating: Concern Over Mistakes, Social Appearance Anxiety, and Dietary Restraint

As reviewed above, the literature supports a relationship between concern over mistakes, dietary restraint, and social anxiety with binge eating (e.g., Mackinnon et al., 2011; Zunker et al., 2011; Otrovsky et al., 2013). Research also indicates that these factors relate to each other, possibly causing each other over time (e.g., Mackinnon et al., 2011). Specifically, perfectionism could serve as a vulnerability factor, which may lead to binge eating through dietary restraint, reflective of perfectionistic attempts to achieve an unattainable thin-ideal (e.g., Stice, 2002; Pliner & Haddock, 1996; Boone, Soenens, & Braet, 2011). Perfectionism has been shown to be associated with dietary restraint in general (McLaren, Gauvin, & White, 2001). Alternatively, social anxiety may serve as an additional important pathway between perfectionism and binge eating. More specifically, perfectionism may lead to social anxiety, specifically social appearance anxiety, by causing an individual to hyper-monitor his or her appearance for any flaws. Binge eating may then serve as a behavior to cope with (or avoid) higher social appearance anxiety, in line with one model of binge eating that proposes that binge eating occurs as a result of anxiety and serves as a means to relieve this anxiety (e.g., Deaver et al., 2003; McManus & Waller, 1995; Rosenbaum & White, 2015). Therefore, testing a longitudinal model that integrates perfectionism, dietary restraint, and social anxiety may be important to elucidate the potential psychological mechanisms leading to binge eating.

The Current Study

Although research has investigated social anxiety, dietary restraint, and perfectionism as possible factors contributing to binge eating independently, to our knowledge, no model has tested these four constructs in relation to each other, and researchers have emphasized the importance of examining several potential factors together in a combined model (Jacobi et al., 2004). Furthermore, very few studies have investigated these relationships longitudinally or have used longitudinal designs with a time span of more than several weeks. In the current study, we tested a model that integrated dietary restraint, social appearance anxiety,

and concern over mistakes as psychological mechanisms contributing to binge eating. More specifically, we tested if social appearance anxiety, dietary restraint, and concern over mistakes were related to binge eating (a) cross-sectionally and (b) prospectively at three time points over the course of six months (baseline, two months after baseline, six months after baseline), while controlling for BMI (because binge eating and dietary restraint are associated with BMI) (e.g., Mason & Lewis, 2014; Williamson et al., 1995). We also tested (a) if social appearance anxiety mediated the relationship between concern over mistakes and binge eating over time, and (b) if dietary restraint mediated the relationship between concern over mistakes and binge eating over time, consistent with our proposed theoretical model.

We had two primary hypotheses. First, we hypothesized that concern over mistakes, social appearance anxiety, and dietary restraint would uniquely relate to binge eating both cross-sectionally and across six months. Second, we hypothesized that the relationship between concern over mistakes and binge eating would be mediated by social appearance anxiety, as well as by dietary restraint in the tested model.

Methods

Participants

Participants were 300 undergraduate women from a Midwestern university in the United States who completed the current study in exchange for course credit or entry into a lottery to win a gift certificate. College women are at high risk for developing an eating disorder and in order to measure risk, a heterogeneous distribution of binge eating scores is necessary (Pearson, 1903; Thorndike, 1949). Because college women vary widely on their range for disordered eating and are at a developmental age when disordered eating often occurs, they thus make an ideal population for this study (Taylor et al., 2006). Indeed, we had a heterogeneous sample, from low to high levels of binge eating ($M=10.60$, $SD=3.87$; Range = 5.00 to 26.00 at Time 1) (as assessed by the Eating Disorder Inventory 2; Garner, Olmsted, & Polivy, 1983). The majority of participants were Caucasian ($n=182$, 60.7%), and other ethnicities reported included Asian ($n=82$, 27.3%), Black ($n=12$, 4.0%), Hispanic ($n=8$, 2.7%), multi-racial ($n=15$, 5.0%), and ethnicity not listed, reported by one participant. Participants reported a median age of 18.00 ($SD=1.05$).

Measures

The Eating Disorder Inventory-2 (EDI-2) (Garner, Olmstead, & Polivy, 1983) measures disordered eating attitudes and behaviors associated with anorexia and bulimia nervosa through 91 self-report questions. The Drive for Thinness, Bulimia, and Body Dissatisfaction subscales were administered. The current study used the five bingeing items from the Bulimia subscale of the EDI-2 (e.g., *I stuff myself with food*, and *I have gone on eating binges where I have felt that I could not stop*) as a measure of binge eating. The EDI-2 has evidenced good internal consistency as well as good convergent and discriminant validity (Garner, Olmstead, & Polivy, 1983). Furthermore, the EDI-2 has been shown to reliably measure eating disorder symptoms in individuals with BED (Tasca et al., 2003). Internal consistency in this sample was good at each time point (α s range from 0.80–0.86).

The Eating Disorder Examination – Questionnaire (EDE-Q) (Fairburn & Beglin, 1994) is a 38-item questionnaire version of the Eating Disorder Examination (EDE) interview (Fairburn & Cooper, 1993) designed to measure attitudes and behaviors associated with eating disorders that have occurred over the past 28 days. The full EDE-Q was administered. We used the 5-item Restraint subscale of the EDE-Q as a measure of dietary restraint. Psychometric tests have supported the internal consistency and factor structure of the Restraint subscale, as well as the internal consistency of the EDE-Q as a whole (Peterson et al., 2007). Internal consistency in this sample at each time point was adequate (α s range from 0.79–0.84). Additionally, the EDE-Q has been shown to be a valid measure of eating disorder behaviors in non-clinical samples, and the Restraint subscale, in particular, shows minimal discrepancy with the EDE (Mond, Hay, Rodgers, Owen, & Beumont, 2004).

The Frost Multidimensional Perfectionism Scale (FMPS) (Frost, Marten, Lahart, & Rosenblate, 1990) is a 35-item self-report questionnaire that measures six dimensions of perfectionism: Concern over Mistakes, Doubts about Actions, Parental Criticism, Parental Expectation, Personal Standards, and Order and Organization. The current study used the 9-item Concern over Mistakes subscale, which measures excessive avoidance of mistakes and an all-or-nothing mentality equating any flaw to complete failure (e.g., *If I fail at work/school, I am a failure as a person*). The FMPS has been shown to have good internal consistency and good convergent validity. The Concern over Mistakes subscale, specifically, has been shown to have one of the highest reliabilities among the six dimensions, and has been shown to be particularly relevant to eating disorders (Bulik et al., 2003; Frost et al., 1990). Internal consistency in this sample was adequate to excellent at each time point (α s range from 0.89–0.93).

The Social Appearance Anxiety Scale (SAAS) (Hart et al., 2008) is a 16-item measure that assesses fear of negative evaluation specifically related to one's appearance, or the anxiety related to the fear that someone will be judged negatively based on his or her appearance. Example items include: *I worry that my appearance will make my life more difficult for me*, and *I am concerned people would not like me because of the way I look*. The SAAS has good internal consistency and high test-retest reliability as well as good convergent and divergent validity in a college-attending sample (Hart et al., 2008; Levinson & Rodebaugh, 2011). Internal consistency in this sample was excellent at each time point (α s range from 0.92–0.93).

Body Mass Index was calculated from height and weight measurements that were taken using an Omron HBF-400 scale (Omron Health Care Inc., 2009) and a height chart in the laboratory at all three time points.

Procedure

Participants were recruited to participate in a longitudinal study advertised as a study on personality and behavior. Participants completed the self-report measures listed above at three time points, over a six-month time period: baseline, Time 2 (two months after baseline), and Time 3 (six months after baseline). The majority of participants completed Time 2 ($n = 274$; 91.3%), and about two-thirds of the sample completed all three time points ($n = 190$; 63.3%). We used multiple imputation (see data analytic plan below) and therefore

were able to use data from all 300 participants. There were no significant differences on any of the above measures between those who completed all three time points and those who did not.

Data Analytic Plan

Multiple imputation was performed in Amelia II to estimate missing data (Honaker, King, & Blackwell, 2006–2008). Diagnostics indicated that the imputation had been successful. Bootstrapping and structural equation modeling analyses were conducted using the MLM estimator from the Mplus program Version 7.1 (Muthén & Muthén, 1998–2014) for standardized path estimates. The MLM estimator was chosen because it corrects for potential violations to multivariate normality. Model fit was evaluated using the: (a) comparative fit index (CFI) (Bentler, 1990), (b) Tucker-Lewis incremental fit index (TLI) (Tucker & Lewis, 1973), and (c) root mean square error of approximation (RMSEA) (Steiger & Lind, 1980). Recommendations from Hu and Bentler (1999) were used for evaluating index magnitudes for the above. Values of .95 and above were considered very good and any value over .90 as adequate for the CFI and TLI, whereas values of .05 and lower were considered very good and .08 and below as adequate for the RMSEA. For the CFI, TLI, and RMSEA, we used the Swain correction factor for small samples implemented in the RGui to account for the moderate size of the sample (Boomsma & Herzog, 2013).

Planned Models

First, in baseline data (cross-sectional), we used linear regression to test if concern over mistakes, social appearance anxiety, and dietary restraint uniquely contributed to binge eating. We then utilized Mplus to test a prospective autoregressive model across three time points (from baseline to Time 2 to Time 3) to assess whether these three variables (concern over mistakes, social appearance anxiety, and dietary restraint) contribute to binge eating over time, while accounting for previous levels of these variables. First, we tested the model fit of the autoregressive path model. After establishing adequate model fit, we tested for indirect effects between concern over mistake and binge eating. Specifically, we tested for double mediation, such that social appearance anxiety and dietary restraint were mediators between perfectionism and binge eating. Indirect effects were significant if confidence intervals did not include zero.

Results

Zero-order Correlations and Descriptive Statistics

For descriptive statistics of all study measures, please see Table 1. Binge eating was significantly positively correlated with concern over mistakes, dietary restraint, and social appearance anxiety at all three time points (p s $\leq .009$) (see Table 1). Concern over mistakes also positively correlated with dietary restraint and social appearance anxiety at all three time points (p s $\leq .010$). Baseline and Time 2 dietary restraint correlated with social appearance anxiety at all three time points (p s $\leq .004$); however, Time 3 dietary restraint did not correlate with baseline ($p = .193$) or Time 2 ($p = .307$) social appearance anxiety.

Do Concern Over Mistakes, Social Appearance Anxiety, and Dietary Restraint Uniquely Contribute to Binge Eating at Baseline?

In linear regression utilizing baseline data, dietary restraint (part $r = .25$, $b^* = .25$, $p < .001$) and social appearance anxiety (part $r = .25$, $b^* = .25$, $p < .001$) uniquely predicted binge eating at baseline, supporting our hypotheses (see Table 2). Contrary to our hypotheses, concern over mistakes did not uniquely predict binge eating at baseline (part $r = .09$, $b^* = .09$, $p = .12$), though there was a moderate zero-order correlation between concern over mistakes and binge eating ($r = .27$). Additionally, when social appearance anxiety was removed from the regression, but dietary restraint was still included, concern over mistakes predicted binge eating at baseline (part $r = .17$, $b^* = .17$, $p = .003$), suggesting that, as expected, social appearance anxiety might mediate the relationship between concern over mistakes and binge eating.

A Prospective Double Mediation Model of Concern over Mistakes, Restraint, Social Appearance Anxiety, and Binge Eating

First, we tested the amount of variance explained by baseline binge eating on Time 2 and Time 3 binge eating. We found that more variance in binge eating was explained at two months (Time 2; 76.8%) than at six months (Time 3; 62.4%), meaning there was a greater amount of variance left to explain at Time 3. Next, we tested an autoregressive path model including all variables (concern over mistakes, social appearance anxiety, dietary restraint, and binge eating) at all three time points (baseline, Time 2, Time 3). Model fit was adequate to excellent (CFI = 0.98, TLI = 0.93, RMSEA = 0.08). When using the Swain correction for small sample size, model fit remained adequate to excellent (CFI = 0.98, TLI = 0.93, RMSEA = 0.08). As can be seen in Figure 1, concern over mistakes at baseline prospectively predicted Time 2 social appearance anxiety ($p = .003$). Time 2 social appearance anxiety prospectively predicted Time 3 binge eating ($p = .030$). This finding supports possible mediation between concern over mistakes and binge eating through social appearance anxiety. Contrary to our hypotheses, baseline concern over mistakes did not predict Time 2 dietary restraint ($p = .682$), nor did Time 2 dietary restraint predict Time 3 binge eating ($p = .418$).

Next, we tested for possible indirect effects between concern over mistakes and binge eating. There were indirect effects between concern over mistakes and binge eating through social appearance anxiety (90% CI [0.01 to 0.02], $p = .011$), but not through dietary restraint (90% CI [-0.005 to 0.005], $p = .921$), from baseline to Time 3. When testing for indirect effects in the opposite direction (i.e., between (a) binge eating at baseline and social appearance anxiety at Time 3 and (b) between binge eating at baseline and dietary restraint at Time 3), concern over mistakes did not mediate the relationship between binge eating and social appearance anxiety across the three time points (90% CI [0.00 to 0.01], $p = .298$). Additionally, concern over mistakes did not mediate the relationship between dietary restraint and binge eating (90% CI [-0.004 to 0.012], $p = .453$).

Post-hoc analyses: Why Did Restraint Fail to Significantly Predict Binge Eating?

We removed social appearance anxiety from our model to test the hypothesis that restraint might predict binge eating when social appearance anxiety was not included in the model.

This model included concern over mistakes, dietary restraint, and binge eating only. Model fit was adequate to excellent (CFI = 0.98, TLI = 0.94, RMSEA = 0.09). When using the Swain correction for small sample size, model fit remained adequate to excellent (CFI = 0.98, TLI = 0.94, RMSEA = 0.08). The only significant relationship in this model was Time 2 concern over mistakes predicting Time 3 binge eating ($b = 0.15$; $p = .032$) and marginal relationships between baseline concern over mistakes predicting Time 2 binge eating ($b = 0.09$; $p = .054$), as well as baseline dietary restraint predicting Time 2 binge eating ($b = 0.09$; $p = .067$). Finally, we tested a model including only dietary restraint and binge eating at all time points, without concern over mistakes or social appearance anxiety included in the model. Model fit was adequate to excellent (CFI = 0.98, TLI = 0.95, RMSEA = 0.08). Model fit remained the same after performing the Swain correction for small sample sizes (CFI = 0.98, TLI = 0.95, RMSEA = 0.08). In this model, baseline dietary restraint significantly predicted Time 2 binge eating ($b = 0.11$; $p = .023$), but Time 2 dietary restraint was not a significant predictor of Time 3 binge eating ($b = 0.11$; $p = .240$).

We also tested if a possible interaction between BMI and dietary restraint explained the non-significant main effect of dietary restraint. We found that there was a significant interaction between BMI and dietary restraint at baseline ($b = -.02$; $p = .042$) (see Figure 2). Next, we tested a prospective linear regression with BMI, dietary restraint, social appearance anxiety, concern over mistakes, and the interaction between BMI and restraint at baseline predicting binge eating at Time 3. We found that BMI did not predict binge eating ($p = .999$), nor did the interaction ($p = .372$). Additionally, when controlling for BMI in the full model, our results remained the same (i.e., dietary restraint ($p = .270$) remained non-significant and social appearance anxiety ($p = .003$) was the only significant predictor of binge eating).

Discussion

We tested an integrated prospective model of three psychological mechanisms (i.e., concern over mistakes, social appearance anxiety, and dietary restraint) which may contribute to binge eating. This study was the first to test social appearance anxiety predicting binge eating prospectively and to test dietary restraint as a predictor for binge eating over a six month time period. We found that in the tested model, social appearance anxiety mediated the relationship between concern over mistakes and binge eating prospectively over six months across three measurement time points, accounting for previous levels of each of these variables. Additionally, dietary restraint prospectively predicted binge eating over a two-month period when the model included only dietary restraint and binge eating (i.e., social appearance anxiety and concern over mistakes were removed from the model). We also found that dietary restraint did not mediate the relationship between concern over mistakes and binge eating over time in the tested model.

These findings add to the current literature implicating social appearance anxiety in disordered eating, showing that social appearance anxiety also may contribute to binge eating specifically, as well as symptoms of anorexia and bulimia nervosa. Previous findings have suggested that social appearance anxiety may play an important role in the development and maintenance of eating disorders and symptoms of bulimia and anorexia (Dakanalis et al., 2015; Koskina et al., 2011; Levinson & Rodebaugh, 2012; Levinson et al.,

2013). Our findings support and extend this notion to binge eating. Furthermore, our findings contribute to our understanding of the role of restrained eating in the development of binge eating (e.g., Stice, 2002), suggesting that we should include social appearance anxiety in our models of binge eating.

Importantly, our finding that social appearance anxiety mediates the relationship between concern over mistakes and binge eating in the tested model may elucidate a previously unexplored pathway that might lead to the development of binge eating. Heatherton and Baumeister (1991) suggest that binge eating functions as a mechanism to escape awareness or avoid emotions. Specifically, it has been suggested that anxiety may precede binge eating and that binge eating may serve as a mechanism for relieving this anxiety (Deaver et al., 2003). Other research supports binge eating as a momentarily reliever of anxiety and that the shame and guilt generated by the binge then serves to reinforce this cycle (Rosenbaum & White, 2015). Our findings support this theory by showing how social anxiety may operate in the onset and maintenance of binge eating over a six month time period. Specifically, in line with the all-or-nothing principle associated with concern over mistakes, in which any mistake constitutes complete failure, it is possible that individuals high in concern over mistakes chronically hyper-monitor their appearance for any flaws. This chronic monitoring of potential flaws may then lead to a great deal of social anxiety related to an individual's appearance. This social appearance anxiety, in turn, may lead to binge eating.

These findings also lend insight into the complexity of the relationship between dietary restraint and binge eating. Although the literature supports the notion that dietary restraint precedes the onset of binge eating (Hetherington et al., 2000; Polivy & Herman, 1985; Zunker et al., 2011), it is not clear under which circumstances or under what time frame. Our results supports that dietary restraint does indeed precede binge eating over a two-month period. However, we found that in our data, although dietary restraint may contribute to the development or maintenance of binge eating, it may not be as salient as other factors. This notion was supported by our findings showing that dietary restraint was not a predictor of binge eating when social appearance anxiety was included in the model.

Furthermore, research shows that other variables may be more robust in predicting binge eating than dietary restraint or may influence the relationship between dietary restraint and binge eating (Emery et al., 2013; Goldschmidt et al., 2012; Racine, Burt, Iacono, McGue, & Klump, 2011). Our results support these previous findings, showing that social appearance anxiety may be a more salient predictor of binge eating over time than is dietary restraint. Additionally, BMI and dietary restraint interacted to predict binge eating at baseline, but not when included in the combined longitudinal model. This finding further supports the idea that social appearance anxiety may represent an important predictor of binge eating, more so than dietary restraint, even when accounting for BMI. It may be that in the longitudinal combined model, social appearance anxiety is accounting for the variance from dietary restraint and from the interaction between BMI and dietary restraint. Thus, dietary restraint may exacerbate, but not necessary lead to binge eating, whereas social appearance anxiety may play a more direct role in the development and maintenance of binge eating. However, future research will be necessary in order to test this hypothesis.

Our findings have important clinical implications. The indirect relationship between concern over mistakes and binge eating through social appearance anxiety suggests that addressing social appearance anxiety may be a relevant aspect of binge eating prevention and treatment. For instance, exposure therapy is efficacious in social anxiety treatment and could also be applied to treatment of social appearance anxiety, which then might prevent the development of binge eating. The current literature supports the effectiveness of body image exposures more generally (e.g., Hilbert & Tuschen-Caffier, 2004), and it is possible that some of these exposures indirectly reduce fear of negative evaluation regarding one's appearance (social appearance anxiety) by teaching clients to tolerate anxiety related to their bodies in social settings. Furthermore, intervening on dietary restraint in treatment is difficult, and some research suggests that intervention can increase impairment (Alberts, Thewissen, & Raes, 2012; Carter, Stewart, Dunn, & Fairburn, 1997). It may also be useful to intervene on concern over mistakes in binge eating treatment as well, as a recent study shows that addressing perfectionism in treatment can decrease both social anxiety and disordered eating symptoms (Handley, Egan, Kane, & Rees, 2015). For instance, clients could practice making mistakes on purpose. Researchers could test whether this intervention decreases social appearance anxiety, which could then decrease binge eating.

However, it is also important to recognize that clinical implications should be made cautiously. This study is the first study to test these relationships longitudinally, and given the small to medium effect studies found in the current study, these relationships should be replicated before making any strong conclusions. Furthermore, because social appearance anxiety is a previously unexplored factor in the development and maintenance of binge eating, it should be included when testing other etiological models to better understand its contribution to binge eating. We hope that future research will extend these findings, hopefully leading to the development of clinically relevant interventions.

Several limitations should be considered in the current study. First, this study used a six-month time course for our prospective model, which is somewhat arbitrary. To our knowledge, no research exists showing the preferential follow-up time to investigate prospective relationships in binge eating. Future research should investigate whether different lengths of follow-up impact outcomes, which may lead to additional insights on the prospective relationships between these variables. Additionally, our study was in college-attending women, meaning that our results may not be generalizable to older or younger populations or to males. Due to the similar prevalence rates of binge eating in males and females (Hudson, Hiripi, & Pope Jr, & Kessler, 2007), it may be of importance to study the role of concern over mistakes, social appearance anxiety, and dietary restraint as potential contributors to binge eating in men, as well as women. As this was the first study to our knowledge to investigate the role of social appearance anxiety in binge eating specifically, it may be important for further research to include social appearance anxiety in order to more definitively make conclusions about its contribution to binge eating maintenance and development. Another potential limitation is that multiple imputation was used, creating some risk for producing false results. However, some research suggests that when used correctly, imputation bears valid results and is the preferred method for handling missing data (e.g., Klebanoff & Cole, 2008; Sterne et al., 2009). Finally, this data was collected via self-report, which has inherent limitations. For example, self-report data may be especially

troublesome for measuring dietary restraint, which may vary according to the type of measure used (Stice, Fisher, & Lowe, 2004). Future researchers may want to test if this model varies when a different measure of dietary restraint is used.

Despite these limitations, some strengths of this study should be acknowledged. Although a longer time frame would have been preferable, this is the first time many of these variables have been tested longitudinally across a six-month time frame. Furthermore, this is the first study that has tested these four variables in a combined model and thus represents an important crucial step in elucidating how the relationship between perfectionism, social appearance anxiety, and dietary restraint may contribute to binge eating over time. Additionally, although not entirely generalizable, a college-attending population is useful in this context because eating disorders often develop during this time period (Taylor et al., 2006). Finally, to test how these processes develop over time, it is necessary to utilize a sample with heterogeneous levels of these variables (i.e., which would not be the case in an all clinical sample).

In conclusion, this was the first study to test social appearance anxiety, dietary restraint, and concern over mistakes longitudinally over a six-month time period and to test a combined model of binge eating that included dietary restraint, concern over mistakes, and social appearance anxiety as possible contributors to the development and maintenance of binge eating. We found that concern over mistakes, social appearance anxiety, and dietary restraint were associated with binge eating cross-sectionally, but that only social appearance anxiety directly predicted binge eating prospectively in our combined model of binge eating. We also found that social appearance anxiety mediated the relationship between concern over mistakes and binge eating, but that dietary restraint did not in the tested model. These findings build on the literature on the role of social appearance anxiety in disordered eating (Levinson & Rodebaugh, 2013) and, to our knowledge, this study was the first to investigate social appearance anxiety as a factor that may contribute to binge eating specifically. We hope that our results will lead to continued research that may inform the development of interventions targeting potential factors that lead to binge eating.

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Highlights

- Both dietary restraint and social appearance anxiety uniquely contributed to binge eating at one time point
- Social appearance anxiety mediated the relationship between concern over mistakes and binge eating over six months in the tested model
- Dietary restraint did not mediate the relationship between concern over mistakes and binge eating over six months in the tested model

Figure 1.

A prospective model of the relationship between concern over mistakes, social appearance anxiety, dietary restraint, and binge eating over six-months. All relationships were modeled. Bolded lines represent significant relationships. Autoregressive relationships are faded and dashed for clarity; Time 1 to Time 2 is two months; Time 1 to Time 3 is six months. ** $p < .01$, * $p < .05$

Figure 2.
Interaction between Body Mass Index (BMI) and Dietary Restraint at Time 1 (T1)

Table 1

Zero-order correlations and internal consistencies among binge eating, concern over mistakes, dietary restraint, and social appearance anxiety

	T1Binge	T1CM	T1DR	T1SAA	T2Binge	T2CM	T2DR	T2SAA	T3Binge	T3CM	T3DR	T3SAA
Mean (SD)	10.60 (3.87)	23.80 (7.53)	6.56 (6.48)	29.80 (12.45)	10.20 (3.81)	22.87 (7.91)	5.64 (6.22)	29.18 (12.93)	10.66 (4.22)	21.73 (7.91)	8.04 (5.71)	28.57 (12.83)
Range	5.00–27.00	9.00–43.00	0.00–28.00	10.00–70.00	5.00–27.00	9.00–45.00	0.00–29.00	10.00–65.00	5.00–30.00	9.00–44.00	0.00–29.00	10.00–73.00
T1Binge	.80											
T1CM	.26	.89										
T1DR	.34	.35	.80									
T1SAA	.33	.39	.25	.92								
T2Binge	.75	.28	.35	.31	.81							
T2CM	.24	.80	.30	.33	.33	.91						
T2DR	.29	.25	.75	.23	.34	.24	.84					
T2SAA	.29	.38	.26	.80	.37	.43	.27	.93				
T3Binge	.61	.31	.34	.40	.74	.37	.36	.37	.86			
T3CM	.20	.68	.31	.33	.35	.80	.27	.42	.37	.93		
T3DR	.20	.19	.54	.10	.29	.25	.57	.08	.29	.28	.79	
T3SAA	.24	.41	.27	.68	.34	.50	.22	.79	.50	.52	.31	.93

Notes: CM = Concern over Mistakes; DR = dietary restraint; SAA = social appearance anxiety; Binge = binge eating symptoms; T1 = Time 1; T2 = Time 2; T3 = Time 3. Cronbach's alpha are on the diagonal.

** $p < .01$,

* $p < .05$

Table 2

Regression Analyses Results at Baseline: Do Concern Over Mistakes, Social Appearance Anxiety, and Dietary Restraint Uniquely Predict Binge Eating?

Variable	part <i>r</i>	<i>b</i> *	<i>p</i> -value
Concern Over Mistakes	.09	.09	.12
SAA	.25	.25	< .001
Dietary Restraint	.25	.25	< .001

Notes: SAA = social appearance anxiety