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# The interaction of negative psychological well-being and picky eating in relation to disordered eating in undergraduate students

Wesley R. Barnhart *, Lindsay Hamilton, Amy K. Jordan, Mercedes Pratt, Dara R. Musher-Eizenman

*Department of Psychology, Bowling Green State University, USA*

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ABSTRACT

The extant literature on picky eating focuses on children, leaving adults understudied. A sparse and mixed evidence base suggests relationships exist between picky eating and disordered eating in adults. The present study furthered this research by examining shared negative psychological correlates as moderators that may strengthen relationships between picky eating and disordered eating in undergraduate students. Participants ($N$ = 509; 76.3% female) completed a cross-sectional survey assessing picky eating (Adult Picky Eating Questionnaire), disordered eating (Binge Eating Scale and Eating Disorder Examination-Questionnaire), and negative psychological correlates including anxiety, depression, and stress (Depression, Anxiety and Stress Scale - 21 Items), inflexible eating (Inflexible Eating Questionnaire), obsessive compulsive disorder (Short Obsessive Compulsive Disorder Screener), and social eating anxiety (adapted Social Phobia Scale) symptoms. Positive relationships were observed between picky eating and binge eating, dietary restraint, eating concerns, overall eating pathology, and all negative psychological correlates. Moderation analyses examined if negative psychological correlates strengthened relationships between picky eating and disordered eating. Higher inflexible eating and anxiety and stress symptoms interacted with higher picky eating in relation to disordered eating, specifically eating concerns. Interactions between picky eating and negative psychological correlates did not explain variance in binge eating, dietary restraint, and overall eating pathology. Findings complement research demonstrating overlap between picky eating and disordered eating and highlight specific negative psychological correlates that may strengthen relationships between picky eating and disordered eating. Researchers and clinicians interested in concurrent picky eating and disordered eating should consider these negative psychological correlates given their potential to worsen disordered eating.

## 1. Introduction

Picky eating (PE) is defined as eating a limited range of foods, difficulty trying new foods, and rigidity around the preparation and sensory qualities of food during mealtime (Taylor et al., 2015). PE prevalence ranges from 5.6–59% in youth aged 1.5–12 years (Taylor et al., 2015). Although the extant literature has focused on PE in children, pickiness is thought to be a stable individual difference such that PE in childhood/adolescence is associated with PE in adulthood (Marchi & Cohen, 1990; Mascola et al., 2010; Nicklaus et al., 2005). Indeed, community prevalence data indicate approximately 35% of adults engage in PE (Kauer et al., 2015), revealing the need for research examining PE in adulthood. Because PE is thought to be distinct from, but related to, disordered eating (e.g., avoidant/restrictive food intake disorder (ARFID); American Psychiatric Association [APA], 2013), more research is needed mapping relationships between these maladaptive eating phenotypes in adulthood.

Evidence for relationships between PE and disordered eating in adulthood is mixed. Several research groups have operationalized PE using latent class and latent profile analyses. Using latent class analysis with a Western adult population recruited from a public registry of adult picky eating, Wildes et al. (2012) identified that the largest class was indeed one that included comorbid PE and disordered eating. Furthermore, compared to "pure" PE and low pathology classes, the comorbid PE and disordered eating class was associated with highest overall impairment and negative psychological outcomes (Wildes et al., 2012).

* Corresponding author at: Department of Psychology, Bowling Green State University, Psychology Building 223, 822 East Merry Avenue, Bowling Green, OH 43403, USA.
*E-mail address:* wrbarnh@bgsu.edu (W.R. Barnhart).

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More recently, Ellis et al. (2018) concluded that although those in the PE class had higher levels of eating-related impairment and depression than "moderate" eaters, "approaching" eaters demonstrated greater levels of overeating and binge eating than picky eaters. Finally, using an Eastern adult population, He et al. (2020) identified two classes of PE (picky eating and severe picky eating), both of which were positively associated with disordered eating compared to "approaching" and "moderate" eating classes. Other research has highlighted mixed findings regarding the overlap between PE and disordered eating (Ellis et al., 2016; Kauer et al., 2015; Van Tine et al., 2017; Zickgraf et al., 2016). Because PE in children is associated with increased internalizing symptoms (Jacobi et al., 2008; Mascola et al., 2010; Taylor et al., 2015; Zucker et al., 2015), we examined a range of negative psychological correlates shared by PE and disordered eating populations to better understand the complex relationship between these maladaptive eating phenotypes in adults.

Several negative psychological correlates may be positively associated with PE and disordered eating in adulthood. For example, higher scores on specific PE dimensions (e.g., meal disengagement and presentation) were positively associated with anxiety sensitivity (Ellis et al., 2017), and other research has demonstrated the role of sensory sensitivity in relation to PE and anxiety across development (Zickgraf & Elkins, 2018). Because eating often occurs in a social context, picky eaters might experience impairments in social functioning such as missing out on social gatherings involving food (Marcontell et al., 2003). Indeed, picky eaters with and without disordered eating reported more social anxiety around food compared with those with eating disorder symptoms alone (Ellis et al., 2017; Wildes et al., 2012). In the disordered eating literature, robust relationships exist between disordered eating and anxiety symptoms (Becker et al., 2004; Kaye et al., 2004), including social anxiety. Furthermore, social anxiety is highly comorbid in individuals with eating disorders (Kerr-Gaffney et al., 2018) due, in part, to globalized fears of negative evaluation from others (Levinson & Rodebaugh, 2012). There is also evidence of comorbidity between disordered eating and other mental health problems such as depression and obsessive compulsive disorder (e.g., Berkman et al., 2007; Eisenberg et al., 2011). Similarly, adults with PE had elevated rates of depressive symptoms compared to their non-picky eating counterparts (Ellis et al., 2018; Kauer et al., 2015) and were twice as likely to have a diagnosis of obsessive compulsive disorder (Wildes et al., 2012). Finally, individuals with eating disorders also perceive themselves as experiencing high levels of stress (Harrison et al., 2010), but in the context of PE, the literature has focused on the relation between family or caregiver stress at mealtimes (Ramos-Paúl et al., 2014; Trofholz et al., 2017) and thus it remains unknown if adults with PE also report high levels of stress.

Another key psychological correlate relevant to PE and disordered eating is psychological inflexibility (Ellis et al., 2017; Merwin et al., 2010; Trindade & Ferreira, 2014; Zickgraf & Schepps, 2016). In the context of PE, psychological inflexibility has been identified as an important correlate across multiple dimensions of PE (Ellis et al., 2017) and one study identified that inflexible eating behavior was negatively associated with dietary variety and fruit and vegetable intake (Zickgraf & Schepps, 2016). Recently, Duarte et al. (2017) created an assessment of inflexible eating, or eating that is based on rigid, subjective dietary rules as a cognitive-control strategy. Inflexible eating was associated with greater body image dissatisfaction, higher BMI, and depression and anxiety symptoms. Further, inflexible eating was a moderator between dietary restraint and disordered eating such that restraint was more problematic coupled with inflexible eating-related cognitions (Duarte et al., 2017). It is possible that people engaging in PE with inflexible eating may experience disordered eating if their selectivity is based on maladaptive control strategies.

Building on previous research (He et al., 2020; Wildes et al., 2012), we examined 1) relationships between PE, disordered eating, and negative psychological correlates including inflexible eating and anxiety, depression, obsessive compulsive disorder, social eating anxiety, and stress symptoms; and 2) examined these negative psychological correlates as moderators of relationships between PE and disordered eating. Shape and weight overvaluation were not examined given previous research has demonstrated their lack of overlap with PE (e.g., APA, 2013). Specifically, because research supports positive relationships between these negative psychological correlates and PE and disordered eating, the present study examined these correlates as moderators that may *strengthen* relationships between PE and disordered eating.

**Table 1**
Participant characteristics.

| Variable | Value |
|---|---|
| BMI | |
| M | 25.20 |
| SD | 5.67 |
| Gender (%) | |
| Female | 76.3 |
| Male | 22.7 |
| Race/ethnicity (%) | |
| White | 85.7 |
| Black or African American | 10.8 |
| Latinx/Hispanic | 3.7 |
| Arab/Middle Eastern | 0.6 |
| Native American | 1.0 |
| Not listed | 2.5 |
| Sexual orientation (%) | |
| Heterosexual | 85.3 |
| Gay | 2.2 |
| Lesbian | 1.8 |
| Bisexual | 7.2 |
| Not listed | 3.1 |
| Socioeconomic status (%) | |
| Lower class | 5.1 |
| Lower middle class | 14.7 |
| Middle class | 52.8 |
| Upper middle class | 24.9 |
| Upper class | 1.8 |
| Eating style (%) | |
| Vegetarian | 6.5 |
| Vegan | 1.2 |
| Food sensitivity or food allergy (e.g., gluten-free) | 13.7 |
| Religious restrictions | 0.2 |
| Weight loss or health improvement diet | 31.3 |
| Popular eating style (e.g., paleo, keto) | 6.5 |
| Other | 17.6 |
| Have you been diagnosed with an eating disorder? (%) | |
| Past | 6.3 |
| Current | 2.0 |
| Do you consider yourself a picky eater? (%) | |
| As a child | 53.2 |
| Current | 39.3 |

*Note.* $M$ = mean, $SD$ = standard deviation, BMI = body mass index.

## 2. Methods

### 2.1. Participants

Participants were recruited from undergraduate classes at a large Midwestern university to participate in an online survey about eating behaviors. An initial sample of 579 participants were recruited; however, 70 total participants were excluded due to completing 75% or less of the survey ($n = 42$), completing the survey multiple times ($n = 17$), or failing to meet quality standards such as incorrect responses to two attention checks (e.g., "Please select the option that says, 'Somewhat disagree.'"; $n = 11$). The remaining 509 participants ranged in age from 18 to 25 years ($M = 19.96$, $SD = 2.93$) and were primarily female ($n = 390$), White ($n = 438$), heterosexual ($n = 436$), and middle class ($n = 270$). See Table 1 for additional participant characteristics.

**Table 3**
Bivariate correlations among primary study variables.

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Picky Eating[1] | – | | | | | | | | | |
| 2. Dietary Restraint[2] | 0.28** | – | | | | | | | | |
| 3. Eating Concerns[2] | 0.38** | 0.72** | – | | | | | | | |
| 4. Overall Eating Pathology[2] | 0.36** | 0.84** | 0.85** | – | | | | | | |
| 5. Binge Eating[3] | 0.34** | 0.53** | 0.67** | 0.70** | – | | | | | |
| 6. Inflexible Eating[4] | 0.30** | 0.60** | 0.55** | 0.59** | 0.39** | – | | | | |
| 7. Social Eating Anxiety Symptoms[5] | 0.37** | 0.38** | 0.57** | 0.49** | 0.40** | 0.38** | – | | | |
| 8. OCD Symptoms[6] | 0.43** | 0.25** | 0.35** | 0.32** | 0.29** | 0.26** | 0.29** | – | | |
| 9. Stress Symptoms[7] | 0.38** | 0.36** | 0.52** | 0.49** | 0.45** | 0.31** | 0.47** | 0.43** | – | |
| 10. Depression Symptoms[7] | 0.38** | 30** | 0.46** | 0.42** | 0.42** | 0.22** | 0.38** | 0.35** | 0.78** | – |
| 11. Anxiety Symptoms[7] | 0.38** | 0.31** | 0.47** | 0.41** | 0.40** | 0.25** | 0.45** | 0.41** | 0.81** | 0.76** |

*Notes*. OCD=Obsessive Compulsive Disorder. [1]Adult Picky Eating Questionnaire. [2]Eating Disorder Examination-Questionnaire. [3]Binge Eating Scale. [4]Inflexible Eating Questionnaire. [5]Social Phobia Scale adapted to reflect social anxiety in eating situations. [6]Short Obsessive Compulsive Disorder Screener. [7]Depression, Anxiety and Stress Scale – 21 Items.
** $p < .01$.

### 2.2. Measures

#### 2.2.1. Anthropometry

Body mass index (BMI; kg/m$^2$) was assessed with self-reported height in feet and weight in pounds.

#### 2.2.2. Demographics

Age, gender, socioeconomic status, year in school, race, and sexual orientation were reported. Participants also reported current/past eating disorder diagnosis, current/past picky eater status, and current adherence to a particular eating style (e.g., vegetarian, vegan, etc.). See Table 1.

#### 2.2.3. Adult Picky Eating Questionnaire

The Adult Picky Eating Questionnaire (APEQ) is a 16-item self-report measure assessing adult PE (Ellis et al., 2017). In addition to a total score, the APEQ yields four subscales: meal presentation, food variety, meal disengagement, and taste aversion. The APEQ has shown strong internal consistency and convergent validity (Ellis et al., 2017). Participants rated how closely a statement about PE described their own behavior, ranging from 1 (“Never”) to 5 (“Always”), with higher scores indicative of greater PE.

#### 2.2.4. Binge Eating Scale

The Binge Eating Scale (BES) measured behavioral, emotional, and cognitive aspects of self-reported binge eating (Gormally et al., 1982). The BES consists of 16 items, each of which includes three to four statements about a particular characteristic of binge eating (e.g., eating while bored). The BES has shown strong internal consistency (Gormall et al., 1982) and discriminant validity (Duarte et al., 2015). Participants selected statements that best described their own behavior, with higher BES scores indicative of greater binge eating severity.

#### 2.2.5. Depression, Anxiety and Stress Scale - 21 Items

The Depression, Anxiety and Stress Scale - 21 Items (DASS-21) assessed self-reported depression, anxiety, and stress symptoms across three separate subscales (Antony et al., 1998). The DASS-21 has shown strong internal consistency (Antony et al., 1998) and convergent validity (Ng et al., 2007). On a scale of 0 (“Did not apply to me at all”) to 3 (“Applied to me very much or most of the time”), with higher scores indicative of greater symptom severity, participants rated the degree to which statements applied to them over the last week.

#### 2.2.6. Eating Disorder Examination-Questionnaire

The Eating Disorder Examination Questionnaire (EDE-Q) is a 28-item self-report scale assessing disordered eating behaviors, attitudes, and cognitions (Fairburn & Beglin, 1994). The EDE-Q measures four aspects of disordered eating: dietary restraint, eating concerns, weight concerns, and shape concerns, as well as overall eating pathology. The EDE-Q has shown strong internal consistency (Lavender et al., 2010; Luce & Crowther, 1999) and convergent (Lavender et al., 2010) and discriminant validity (Aardoom et al., 2012; Grilo et al., 2015). Participants self-reported disordered eating over the past four weeks, with higher scores indicative of greater symptomatology.

#### 2.2.7. Inflexible Eating Questionnaire

The Inflexible Eating Questionnaire (IEQ) assessed self-reported adherence to rules around eating behaviors, including the tendency to feel empowered when behavior is in line with these eating rules (Duarte et al., 2017). The IEQ has shown strong internal consistency (Duarte et al., 2017; Linardon et al., 2019) and convergent and incremental validity (Linardon et al., 2019). The IEQ has 11 items with response options ranging from 1 (“Fully disagree”) to 5 (“Fully agree”). Higher scores were indicative of greater inflexible eating.

#### 2.2.8. Social Phobia Scale

Social anxiety, or the fear of scrutiny while engaging in routine activities, was measured using the Social Phobia Scale (SPS; Mattick & Clarke, 1998). Out of the original 20 items, 7 were retained and adapted to reflect social anxiety in eating situations (e.g., “I become anxious if I have to eat in front of other people.”), termed social eating anxiety. The SPS has shown strong internal consistency and discriminant validity (Mattick & Clarke, 1998). Participants rated how closely each item described them on a scale of 1 (“Not at all”) to 5 (“Extremely”), with higher scores indicative of greater social eating anxiety symptoms.

#### 2.2.9. Short Obsessive Compulsive Disorder Screener

The Short Obsessive Compulsive Disorder Screener (SOCDS) assessed self-reported obsessive compulsive disorder symptoms (Uher et al., 2007). The SOCDS has shown strong internal consistency and discriminant validity (Uher et al., 2007). The SOCDS, a 7-item scale, tasks participants with rating how much they engaged in certain thoughts or behaviors on a scale of 0 (“No”), 1 (“A bit”), or 2 (“A lot”), with higher scores indicative of greater obsessive compulsive disorder symptoms. Two items measuring the related impact and resistance of obsessive compulsive disorder symptoms were omitted from the present study.

### 2.3. Procedure

All procedures were approved by the university’s Institutional Review Board prior to data collection (IRB protocol #1530232). Participants provided online consent before completing the survey. Median survey completion time was approximately 27 min. Participants were debriefed, given contact information should they have study related questions or concerns, and earned course credit or extra credit upon conclusion of the survey.

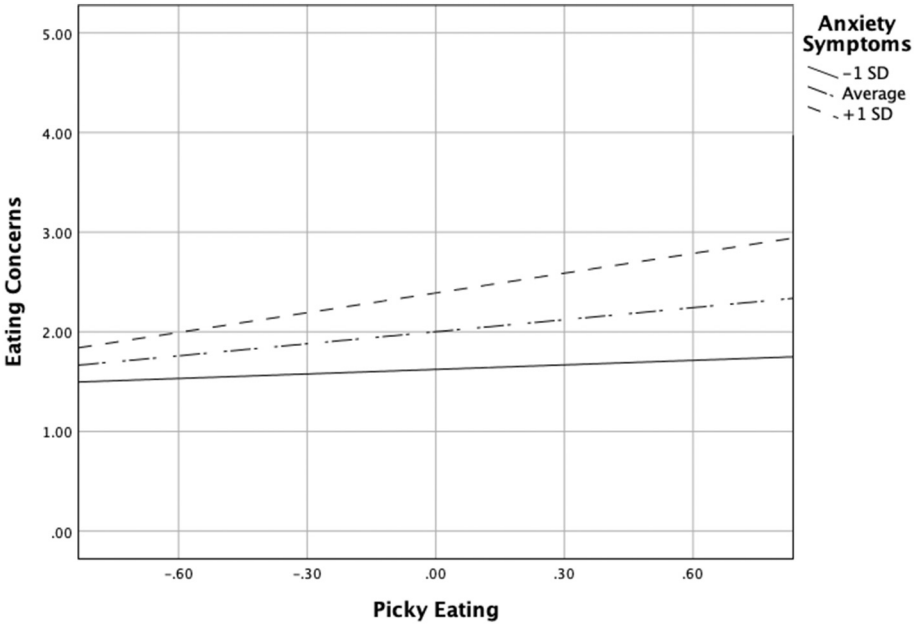


**Fig. 1.** Conditional moderation of picky eating and eating concerns by anxiety symptoms.

### 2.4. Analytic plan

Mean, standard deviation, minimum and maximum values, range, skew, and kurtosis, internal consistency (Cronbach's alpha and McDonald's omega), and bivariate correlations were examined (Supplemental Table 2 and Table 3). Missing data were low (EDE-Q (2.7%), DASS-21 (4.5%), SOCDS (0.8%), SPS (0.9%), IEQ (0.8%), APEQ (0.9%), and BES (0.8%)) and results from the Little Missing Completely at Random (MCAR) Test ($p = 1.000$) led to the assumption that missing data were MCAR; thus, analyses utilized listwise deletion. Next, assumptions of multiple regression including homoscedasticity, normality, and linearity were examined, followed with potential outliers across primary study variables.

Model 1 moderation analyses were examined (Hayes, 2018) in the PROCESS macro in SPSS 26 to discern the interaction of negative psychological correlates (i.e., inflexible eating and anxiety, depression, obsessive compulsive disorder, social eating anxiety, and stress symptoms) and PE in relation to disordered eating (e.g., binge eating, dietary restraint, eating concerns, and overall eating pathology). For each moderation analysis, PE and one negative psychological correlate were first entered into the model, and then the interaction of PE and the negative psychological correlate was entered into the model. An overall effect can be generated per model which includes the total amount of variance in the dependent variable by all independent variables (e.g., primary independent and moderator variables, interaction term, and covariates). Finally, conditional moderation effects were generated which help plot the interaction effect. In total, 6 moderation analyses were conducted per dependent variable, 24 moderation analyses in total. To better control for the number of analyses and Type I error rate, we only interpret results at the $p < .01$ level. BMI (mean centered) and gender (0 = male, 1 = female) were entered as covariates in all moderation analyses. Because BMI (Hays et al., 2002; Savage & Birch, 2010) and gender (Striegel-Moore et al., 2009) are known factors related to variance across a range of disordered eating outcomes, their inclusion assisted in controlling for potential confounds.

## 3. Results

### 3.1. Preliminary results

Pre-registration information was recorded and embargoed prior to data collection in Open Science Framework, see osf.io/g4cha, research question 2, including present aims and analyses (Jordan, 2020). Descriptive statistics, internal consistency, and bivariate correlations are presented in Supplemental Table 2 and Table 3. To assess assumptions of multiple regression, residual variability was examined and confirmed via visual inspection of scatterplots, Q-Q plots, and histograms. No concerns of multicollinearity were detected (tolerance >0.20, variance inflation factor < 5; Belsley et al., 1980). Significant bivariate correlations were observed between primary study variables (Table 3).

### 3.2. Binge eating

The overall models assessing inflexible eating ($R^2 = 0.31$, $p < .001$) and anxiety ($R^2 = 0.32$, $p < .001$), depression ($R^2 = 0.34$, $p < .001$), obsessive compulsive disorder ($R^2 = 0.27$, $p < .001$), social eating anxiety ($R^2 = 0.31$, $p < .001$), and stress ($R^2 = 0.34$, $p < .001$) symptoms contributed significant variance in binge eating. However, no significant interaction effects, nor conditional moderation effects emerged between PE and negative psychological correlates in relation to variance in binge eating (Supplemental Table 5).

### 3.3. Dietary restraint

The overall models assessing inflexible eating ($R^2 = 0.38$, $p < .001$) and anxiety ($R^2 = 0.14$, $p < .001$), depression ($R^2 = 0.14$, $p < .001$), obsessive compulsive disorder ($R^2 = 0.12$, $p < .001$), social eating anxiety ($R^2 = 0.42$, $p < .001$), and stress ($R^2 = 0.16$, $p < .001$) symptoms contributed significant variance in dietary restraint. However, after correction ($p < .01$), no significant interaction effects, nor conditional moderation effects emerged between PE and negative psychological correlates in relation to variance in dietary restraint (Supplemental Table 5).

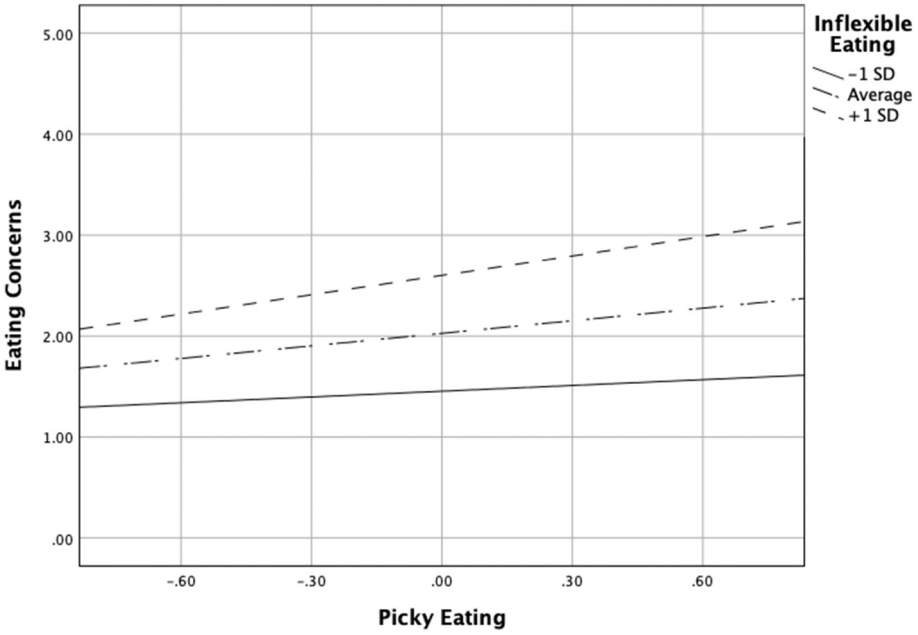


**Fig. 2.** Conditional moderation of picky eating and eating concerns by inflexible eating.

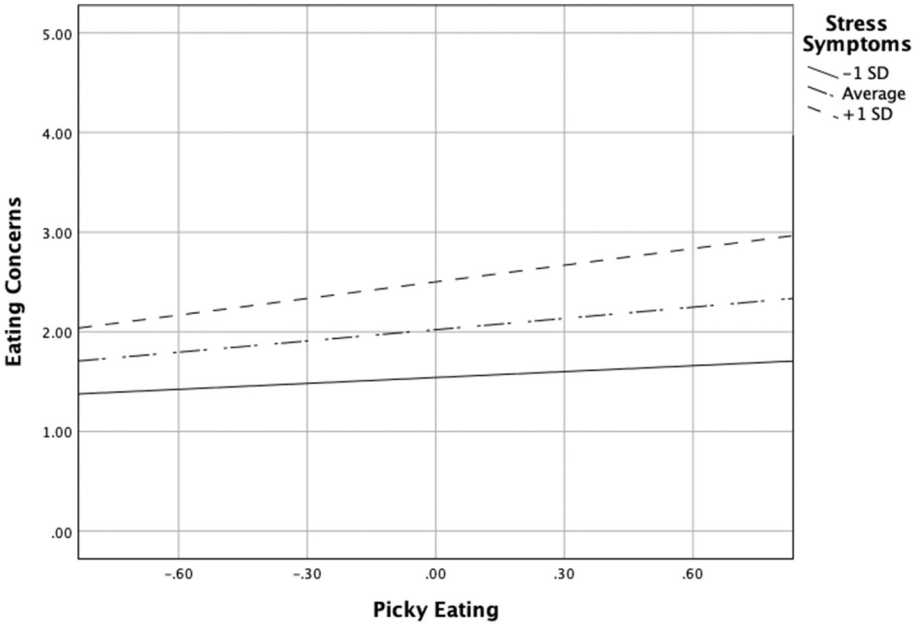


**Fig. 3.** Conditional moderation of picky eating and eating concerns by stress symptoms.

### 3.4. Eating concerns

The overall models assessing inflexible eating ($R^2 = 0.39$, $p < .001$) and anxiety ($R^2 = 0.32$, $p < .001$), depression ($R^2 = 0.30$, $p < .001$), obsessive compulsive disorder ($R^2 = 0.24$, $p < .001$), social eating anxiety ($R^2 = 0.38$, $p < .001$), and stress ($R^2 = 0.34$, $p < .001$) symptoms contributed significant variance in eating concerns. Furthermore, inflexible eating ($\Delta R^2 = 0.02$, $\Delta F(1, 498) = 14.41$, $b = 0.24$, $p < .001$) and anxiety ($\Delta R^2 = 0.02$, $\Delta F(1, 495) = 15.80$, $b = 0.39$, $p < .001$) and stress ($\Delta R^2 = 0.01$, $\Delta F(1, 495) = 8.04$, $b = 0.25$, $p = .005$) symptoms significantly interacted with PE in relation to eating concerns. Conditional moderation effects were observed such that average ($b = 0.40$, $p < .001$) and higher (+1 SD above average; $b = 0.66$, $p < .001$) anxiety symptoms interacted with higher PE in relation to eating concerns (Fig. 1); average ($b = 0.42$, $p < .005$) and higher (+1 SD above average; $b = 0.64$, $p < .001$) inflexible eating interacted with PE in relation to eating concerns (Fig. 2); and average ($b = 0.38$, $p < .001$) and higher (+1 SD above average; $b = 0.56$, $p < .001$) stress symptoms interacted with PE in relation to eating concerns (Fig. 3). Across all of these models, higher levels of the negative psychological correlates interacted with higher PE to strengthen relationships with eating concerns. Social eating anxiety and, after correction ($p < .01$), depression and obsessive compulsive disorder symptoms did not significantly interact with PE in relation to variance in eating concerns (Supplemental Table 5). BMI and gender were entered as covariates across all models and significant effects were retained (Table 4).

**Table 4**
Negative psychological correlates as moderators of relationships between picky eating and disordered eating.

| | *beta* | *se* | *t*-value | *p*-value | *LLCI* | *ULCL* |
|---|---|---|---|---|---|---|
| **Binge Eating** | | | | | | |
| Anxiety Symptoms | 3.40 | 0.53 | 6.40 | 0.00** | 2.36 | 4.45 |
| Picky Eating | 2.68 | 0.49 | 5.48 | 0.00** | 1.72 | 3.63 |
| Depression Symptoms | 3.81 | 0.46 | 8.23 | 0.00** | 2.90 | 4.72 |
| Picky Eating | 2.52 | 0.48 | 5.27 | 0.00** | 1.58 | 3.46 |
| Inflexible Eating | 2.40 | 0.34 | 7.01 | 0.00** | 1.72 | 3.10 |
| Picky Eating | 3.10 | 0.47 | 6.53 | 0.00** | 2.15 | 4.00 |
| OCD Symptoms | 2.57 | 0.69 | 3.75 | 0.00** | 1.22 | 3.92 |
| Picky Eating | 3.20 | 0.51 | 6.24 | 0.00** | 2.20 | 4.20 |
| Social Eating Anxiety Symptoms | 2.69 | 0.40 | 6.68 | 0.00** | 1.90 | 3.49 |
| Picky Eating | 2.84 | 0.48 | 5.86 | 0.00** | 1.89 | 3.80 |
| Stress Symptoms | 3.91 | 0.48 | 8.24 | 0.00** | 2.98 | 4.84 |
| Picky Eating | 2.50 | 0.48 | 5.20 | 0.00** | 1.55 | 3.44 |
| **Dietary Restraint** | | | | | | |
| Anxiety Symptoms | 0.50 | 0.11 | 4.39 | 0.00** | 0.28 | 0.72 |
| Picky Eating | 0.42 | 0.10 | 4.06 | 0.00** | 0.22 | 0.63 |
| Depression Symptoms | 0.49 | 0.10 | 4.84 | 0.00** | 0.29 | 0.69 |
| Picky Eating | 0.44 | 0.10 | 4.18 | 0.00** | 0.23 | 0.64 |
| Inflexible Eating | 0.93 | 0.06 | 15.10 | 0.00** | 0.81 | 1.0 |
| Picky Eating | 0.24 | 0.09 | 2.87 | 0.00* | 0.08 | 0.41 |
| OCD Symptoms | 0.45 | 0.14 | 3.15 | 0.00* | 0.17 | 0.73 |
| Picky Eating | 0.47 | 0.11 | 4.39 | 0.00** | 0.26 | 0.68 |
| Social Eating Anxiety Symptoms | 0.51 | 0.08 | 6.04 | 0.00** | 0.34 | 0.68 |
| Picky Eating | 0.38 | 0.10 | 3.73 | 0.00** | 0.18 | 0.58 |
| Stress Symptoms | 0.61 | 0.10 | 6.01 | 0.00** | 0.41 | 0.81 |
| Picky Eating | 0.38 | 0.10 | 3.67 | 0.00** | 0.18 | 0.58 |
| **Eating Concerns** | | | | | | |
| Anxiety Symptoms | 0.58 | 0.08 | 7.33 | 0.00** | 0.43 | 0.74 |
| Picky Eating | 0.40 | 0.07 | 5.49 | 0.00** | 0.26 | 0.55 |
| Interaction | 0.39 | 0.10 | 3.97 | 0.00** | 0.20 | 0.58 |
| −1 Standard Deviation | 0.15 | 0.10 | 1.53 | 0.13 | −0.04 | 0.35 |
| Avg. Anxiety Symptoms | 0.40 | 0.07 | 5.49 | 0.00** | 0.26 | 0.55 |
| +1 Standard Deviation | 0.66 | 0.10 | 6.93 | 0.00** | 0.47 | 0.85 |
| Covariate: Gender | 0.30 | 0.11 | 2.78 | 0.01* | 0.09 | 0.52 |
| Covariate: BMI | 0.04 | 0.01 | 4.63 | 0.00** | 0.02 | 0.05 |
| Depression Symptoms | 0.55 | 0.07 | 7.73 | 0.00** | 0.41 | 0.70 |
| Picky Eating | 0.42 | 0.07 | 5.70 | 0.00** | 0.28 | 0.57 |
| Inflexible Eating | 0.61 | 0.05 | 12.52 | 0.00** | 0.51 | 0.70 |
| Picky Eating | 0.42 | 0.07 | 6.23 | 0.00** | 0.28 | 0.55 |
| Interaction | 0.24 | 0.06 | 3.80 | 0.00** | 0.11 | 0.36 |
| −1 Standard Deviation | 0.19 | 0.09 | 2.06 | 0.04 | 0.01 | 0.37 |
| Avg. Inflexible Eating | 0.42 | 0.07 | 6.23 | 0.00** | 0.28 | 0.55 |
| +1 Standard Deviation | 0.64 | 0.09 | 7.46 | 0.00** | 0.47 | 0.80 |
| Covariate: Gender | 0.25 | 0.10 | 2.48 | 0.01 | 0.05 | 0.45 |
| Covariate: BMI | 0.03 | 0.01 | 3.95 | 0.00** | 0.02 | 0.05 |
| OCD Symptoms | 0.51 | 0.11 | 4.83 | 0.00** | 0.30 | 0.72 |
| Picky Eating | 0.49 | 0.08 | 6.26 | 0.00** | 0.34 | 0.65 |
| Social Eating Anxiety Symptoms | 0.66 | 0.06 | 11.43 | 0.00** | 0.55 | 0.77 |
| Picky Eating | 0.35 | 0.07 | 5.11 | 0.00** | 0.22 | 0.49 |
| Stress Symptoms | 0.67 | 0.07 | 9.33 | 0.00** | 0.53 | 0.81 |
| Picky Eating | 0.38 | 0.07 | 5.22 | 0.00** | 0.24 | 0.52 |
| Interaction | 0.25 | 0.09 | 2.84 | 0.01* | 0.08 | 0.43 |
| −1 Standard Deviation | 0.20 | 0.10 | 2.02 | 0.04 | 0.01 | 0.39 |
| Avg. Stress Symptoms | 0.38 | 0.07 | 5.22 | 0.00** | 0.24 | 0.52 |
| +1 Standard Deviation | 0.56 | 0.09 | 5.90 | 0.00** | 0.37 | 0.74 |
| Covariate: Gender | 0.24 | 0.11 | 2.20 | 0.03 | 0.03 | 0.45 |
| Covariate: BMI | 0.04 | 0.01 | 4.44 | 0.00** | 0.02 | 0.05 |
| **Overall Eating Pathology** | | | | | | |
| Anxiety Symptoms | 0.60 | 0.10 | 6.32 | 0.00** | 0.41 | 0.79 |
| Picky Eating | 0.51 | 0.09 | 5.80 | 0.00** | 0.34 | 0.68 |
| Depression Symptoms | 0.64 | 0.08 | 7.73 | 0.00** | 0.48 | 0.81 |
| Picky Eating | 0.49 | 0.09 | 5.73 | 0.00** | 0.32 | 0.66 |
| Inflexible Eating | 0.78 | 0.05 | 14.46 | 0.00** | 0.67 | 0.88 |
| Picky Eating | 0.44 | 0.07 | 5.92 | 0.00** | 0.29 | 0.58 |
| OCD Symptoms | 0.56 | 0.12 | 4.59 | 0.00** | 0.32 | 0.80 |
| Picky Eating | 0.58 | 0.09 | 6.32 | 0.00** | 0.40 | 0.76 |
| Social Eating Anxiety Symptoms | 0.61 | 0.07 | 8.78 | 0.00** | 0.48 | 0.75 |
| Picky Eating | 0.47 | 0.08 | 5.63 | 0.00** | 0.31 | 0.64 |
| Stress Symptoms | 0.77 | 0.08 | 9.19 | 0.00** | 0.60 | 0.93 |
| Picky Eating | 0.44 | 0.08 | 5.22 | 0.00** | 0.28 | 0.61 |

*Notes.* *se* = standard error. *LLCL* = Lower Level Confidence Interval. *ULCL* = Upper Level Confidence Interval. Avg. = Average. OCD=Obsessive Compulsive Disorder. Below interactions are conditional moderation effects discussed at 1 standard deviation below and above the mean. Data for covariates are presented in models with significant conditional moderation effects. Social Eating Anxiety Symptoms scores were adapted to reflect social anxiety in eating situations. Please see Supplemental Table 5 for models with non-significant interaction effects and covariates.

* $p < .01$.

** $p < .001$.

### 3.5. Overall eating pathology

The overall models assessing inflexible eating ($R^2 = 0.47$, $p < .001$) and anxiety ($R^2 = 0.32$, $p < .001$), depression ($R^2 = 0.33$, $p < .001$), obsessive compulsive disorder ($R^2 = 0.28$, $p < .001$), social eating anxiety ($R^2 = 0.36$, $p < .001$), and stress ($R^2 = 0.37$, $p < .001$) symptoms contributed significant variance in overall eating pathology. However, after correction ($p < .01$), no significant interaction effects, nor conditional moderation effects emerged between PE and negative psychological correlates in relation to variance in overall eating pathology (Supplemental Table 5).

## 4. Discussion

Positive relationships emerged between PE and disordered eating outcomes. Our findings build on previous research (Wildes et al., 2012; He et al., 2020) and suggest that these maladaptive eating phenotypes may not be as mutually exclusive as once thought. Positive relationships also emerged between PE and negative psychological correlates. Findings replicate previous research on negative psychological correlates in adult populations (Ellis et al., 2017; Ellis et al., 2018; Kauer et al., 2015; Wildes et al., 2012) and demonstrate that although thought of by some as an innocuous and vexing eating behavior, PE is positively associated with significant distress and impairment in psychological functioning. To this end, these negative psychological correlates were examined as moderators that may *strengthen* relationships between PE and disordered eating.

Higher anxiety and stress symptoms interacted with higher PE to strengthen relationships with eating concerns. Higher PE and these negative psychological correlates appear to be associated with worsened eating concerns, a hallmark eating disorder symptom encompassing guilt and shame around eating, fear of loss of control of eating, and concern about others observing eating (Fairburn & Beglin, 1994). In addition, higher inflexible eating and PE interacted to strengthen relationships with eating concerns. Thus, inflexible eating, or rigid adherence to rules around eating behaviors and subsequent empowerment when eating behavior is congruent with these rules (Duarte et al., 2017), may positively correlate with PE in relation to worsened eating concerns in adulthood. These data overlap with research highlighting a relationship between psychological inflexibility and PE (Ellis et al., 2017; Zickgraf & Schepps, 2016). Furthermore, findings suggest that targeting inflexible eating and anxiety and stress symptoms may be useful in mitigating disordered attitudes and cognitions around eating among people with concurrent PE. Importantly, models examining the interaction between PE and depression and obsessive compulsive disorder symptoms were no longer significantly related to variance in eating concerns after correction. Future research should consider more severe PE presentations, particularly in relation to these negative psychological correlates, as factors that may contribute to variance in disordered eating.

It is also noteworthy that social eating anxiety, which was positively related to PE and all disordered eating outcomes, did not significantly interact with PE in relation to disordered eating outcomes. It could be the case that the adaptations made to this measure to map onto social eating anxiety, and thus PE behavior (Marcontell et al., 2003),

influenced outcomes. Furthermore, none of the negative psychological correlates interacted with PE in relation to binge eating, and after correction ($p < .01$), dietary restraint and overall eating pathology. Because PE and binge eating may be functionally different (e.g., restriction versus binge eating; APA, 2013), the relationship between these maladaptive eating phenotypes may be less influenced by negative psychological correlates. That said, PE and binge eating were positively related, as was binge eating to each of the negative psychological correlates, which may provide useful information about the nature and severity of PE sampled, as well as the importance for future research to parse out specific PE dimensions (e.g., meal disengagement; Ellis et al., 2017) in relation to disordered eating outcomes. Furthermore, more severe PE presentations as evidenced in those with ARFID (APA, 2013; Zickgraf et al., 2016) may provide additional insights about the overlap between these maladaptive eating phenotypes and their relationships with negative psychological correlates.

### 4.1. Limitations and future directions

First, due to its cross-sectional nature, inferences of causality cannot be made from the present results. Experimental and longitudinal methods targeting negative psychological correlates could discern causal pathways between PE and disordered eating. Second, participants were mostly WEIRD: Western, Educated, Industrialized, Rich, and Democratic (Henrich et al., 2010). In addition to this, the present study used a non-clinical, undergraduate student population. Thus, findings should not be generalized to non-WEIRD, clinical populations, illustrating important future research directions to test constraints on generality (Simonds et al., 2017). Third, the adapted Social Phobia Scale has not been utilized as a measure of social eating anxiety and thus future research should examine this adapted measure, as well as more traditional measures of social anxiety, to assess relations between PE and disordered eating. Finally, use of self-report measures highlight potential threats to validity and opportunities for diverse research methods (e.g., experience sampling) to examine how these variables unfold in the real world.

## 5. Conclusions

Findings from the present study build on the evidence base highlighting positive relationships between PE and disordered eating. Inflexible eating and anxiety and stress symptoms interacted with adult PE to strengthen relationships with eating concerns, a hallmark eating disorder symptom encompassing guilt and shame around eating, as well as social concerns about others observing eating. Researchers and clinicians interested in the overlap between PE and disordered eating should consider these negative psychological correlates in screening, prevention, and treatment efforts given their potential to worsen disordered eating symptom presentation.

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## CRediT authorship contribution statement

**Wesley R. Barnhart:** Conceptualization, Methodology, Formal Analysis, Investigation, Data Curation, Writing - Original Draft, Project Administration. **Lindsay Hamilton:** Conceptualization, Methodology, Validation, Investigation, Data Curation, Writing - Original Draft, Project Administration. **Amy K. Jordan:** Conceptualization, Methodology, Investigation, Writing - Review & Editing, Project Administration. **Mercedes Pratt:** Conceptualization, Methodology, Investigation, Writing - Review & Editing, Project Administration. **Dara R. Musher-Eizenman:** Conceptualization, Methodology, Validation, Investigation, Writing - Review & Editing, Supervision, Project Administration.

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