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Nothing Tastes as Good as Thin Feels: Low Positive Emotion Differentiation and Weight Loss Activities in Anorexia Nervosa

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Abstract

Positive emotion (PE) has not been well studied in anorexia nervosa. Low positive emotion differentiation (PED), which involves a diminished ability to distinguish between discrete positive emotions, may contribute to positive emotion dysregulation in anorexia. Specifically, low PED may interact with elevated PE intensity to both motivate and reinforce weight loss and evaluation behaviors. Using ecological momentary assessment, we examined PE and weight loss behaviors reported over two weeks. As hypothesized, low PED predicted more vomiting, laxative-use, exercising, weighing, checking for fat, and restricting. Furthermore, those with low PED who experienced elevated average PE intensity reported even more frequent behaviors. Within-person analyses indicated that, for those with low PED, more weight loss behaviors at one recording predicted elevated PE at the subsequent recording. Similarly, for those with low PED higher momentary PE predicted more subsequent weight loss behaviors. Thus, low PED in anorexia may reinforce and motivate weight loss behavior.

Keywords

anorexia nervosa; positive emotion; emotional clarity; purging; weighing

> "[Her] demonstration of strict self-control over eating was a source of pride and accomplishment."
>
> (Oltmanns, Martin, Neale, & Davidson, 2012)

Anorexia nervosa is a disorder characterized by much mental and physical suffering, as exemplified by a high overall mortality rate (Papdopoulos, Ekborn, Brandt, & Ekselius, 2009) and elevated suicidal behavior (Selby, Smith, Bulik, et al., 2010). Accordingly, several studies have identified that eating disordered behaviors (including both binge eating, purging, and other weight loss behaviors) may reduce negative emotion (NE), and negatively

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reinforce such behavior (Berg et al., 2013; Fairburn, Cooper, & Shafran, 2003; Smyth et al., 2007). However, in focusing on negative emotion, researchers and clinicians have often overlooked the potential role of problems with positive emotion (PE) in anorexia. Empirical research indicates that positive and negative emotion may be more accurately described as bivariate rather than existing on a unipolar scale (Larsen, McGraw, & Cacioppo, 2001), suggesting that even amidst pervasive negative emotion, positive emotions can also be experienced. Along these lines, calls have been made to examine the neglected role of positive reinforcement in initiating and maintaining weight loss activities in anorexia (Walsh, 2013). Such activities include overt weight loss behaviors, such as restriction, vomiting, laxative use, and exercise, as well as self-evaluation activities, such as weighing and checking oneself for fat to gauge success with weight loss. These activities may be reinforced, especially in the early stages of anorexia, through the personal and social rewards commonly associated with successful pursuit of thinness and self-control.

Positive Emotion in Anorexia and Weight Loss Activities

The notion of weight loss behaviors involving positive reinforcement in anorexia is not a novel concept. In Slade's (1982) functional model of anorexia behaviors, it was suggested that those with anorexia may have a strong desire for control, and they may achieve this control through dieting. Dieting control is further reinforced through resultant feelings of success with weight loss at the initiation of the disorder, which results in intensified motivation to continue losing weight. Slade's (1982) model is consistent with findings that many with anorexia believe that their ability to lose weight makes them more attractive, builds self-control, makes them feel physically fit, provides feelings of confidence, makes them feel able to do at least one thing better than other people, enhances feelings of expertise, and improves their ability to push their body further (Serpell, Teasdale, Troop, & Treasure, 2004; Serpell, Treasure, Teasdale, & Sullivan, 1999).

Another source of positive reinforcement in anorexia may be through exposure to stimuli that promote extreme weight loss, such as content posted on "Pro-Ana" (Pro-Anorexia) websites, which feature images of thin/emaciated women and inspirational quotes for weight loss. One study of anorexic women suggests that women who identified themselves as "pro-anorexics" reported greater average experience of PE, less anxiety, and a greater focus on eating behaviors over other concerns (Lyons et al., 2006). Similarly, there is evidence that female undergraduates with elevated drive for thinness who viewed pictures of emaciated women tended to approach such material, as opposed to avoid it (Woud et al., 2011). In contrast, one sample of undergraduate students with high eating disorder symptoms reported greater urges to vomit following viewing of a pro-Ana website (Bardone-Cone & Cass, 2007). This reaction may have been a result of negative self-evaluations, but a complementary explanation is that these images instilled motivation to engage in weight loss behavior and to strive for extreme thinness. Finally, recent neuroimaging studies have identified that anorexic women may be more responsive to reward anticipation and reception than normal weight or overweight controls (Frank et a., 2012), demonstrating increased ventral striatal reward responsiveness (a biological index of PE) to images of underweight women (Fladung et al., 2010).

Low Positive Emotion Differentiation and Weight Loss Activities in Anorexia

We propose, based on Slade's (1982) model of positive emotion in anorexia, that positive emotion may promote weight loss behaviors in anorexia as a function of low *positive emotion differentiation* (PED). Emotion differentiation is defined as an individual's ability to successfully differentiate between discrete emotional states experienced (i.e., sad versus anxious versus angry), as compared to a tendency to experience emotion in a broad and general sense (i.e., upset; Barrett, Gross, Christensen, & Benvenuto, 2011). In our positive feedback model (Figure 1), following initiation of a weight loss goal, when those with anorexia are successful at making incremental progress toward their goal of reaching a desired body shape and weight, they experience PE, such as pride over making another step toward this difficult goal. Because of low PED, however, a positive emotion in anorexic individuals may be enhanced in a way that triggers other positive emotions, not only of pride, but also of confidence, accomplishment, attentiveness, energy, and/or happiness. This activation of other positive emotions may be a function of distorted cognitions about the positive implications of being thin, as well as implicit associations about thinness being associated with happiness or success (Henderson-King & Henderson-King, 1997). This enhanced PE may in turn motivate further weight loss behaviors, which also are positively reinforced by success toward their weight goal (e.g., lower weight, less body fat when checking). Over time, then, weight loss behaviors may become further conditioned to elicit acute positive emotion, even after weight loss goals are met and protracted (Walsh, 2013). These notions are also consistent with recent findings of increased ventral striatal responding in response to reward stimuli in anorexia (Fladung et al., 2010; Frank et al., 2012).

Anorexia, Emotional Distortion, and Emotion Differentiation

Understanding previous research on emotional distortion in anorexia further highlights the potential relevance of the low PED model of anorexia that we have proposed. Individuals with eating disorders have long been thought to experience distorted emotions, particularly in the negative realm, which may contribute to problematic eating behaviors. Relative to control participants, those with anorexia have been found to have problems identifying and describing feelings (Harrison, Tchanturia, & Treasure, 2010), difficulties recognizing facial expression of emotions (Jansch, Harmer, & Cooper, 2009), and both facial and nonverbal expression of emotion (Davies, Schmidt, Stahl, & Tchanturia, 2010; Davies et al., 2011). Those with anorexia and bulimia have also been found to have difficulties identifying and distinguishing between various emotions and bodily sensations, difficulty describing feelings, and have an externally orientated cognitive style – difficulties often conceptualized under the broad construct of *alexithymia* (Bourke, Taylor, Parker, & Bagby, 1992; de Groot, Rodin, & Olmstead, 2004; Speranza, Loas, Wallier, & Corcos, 2007). Thus, those with anorexia and bulimia may have difficulty making sense of their emotions; however, most of these studies have investigated negative and not positive emotion.

Recent research on basic emotion regulation processes has highlighted a new construct that might aid in understanding emotional distortion in anorexia, the index of *emotion*

differentiation. Emotion differentiation indices are typically generated from ecological momentary assessment (EMA) data, where participants record emotional experiences multiple times each day over a period of days, by calculating overall individual level patterns of internal consistency among emotional responses. High scores on an emotion differentiation index indicate that the individual experiences emotions in a discrete manner, with a primary emotion emphasized during each experience. Alternatively, a low score indicates that during each assessment an individual reports similar levels of multiple emotions, suggesting that either multiple emotions are experienced or the individual is unable to discretely identify emotions. Negative emotion differentiation (NED), has been found to be a protective factor against both alcohol use (Kashdan et al., 2010) and aggressive behavior (Pond et al., 2012). Importantly, difficulties distinguishing between negative emotions have also been associated with elevated binging, purging, and checking behaviors in non-clinical samples (Carano et al., 2006; De Berardis et al., 2007; Fink, Anestis, Selby, & Joiner, 2010). However, other studies have failed to find a significant association between low NED and weight loss behaviors (Becker-Stoll & Gerlinghoff, 2004; De Berardis, et al. 2007; Rastam, Gillberg, Gillberg, & Johansson, 1997). One potential explanation for these inconsistent findings is that they have all examined NED, while no studies to date have examined low positive emotion differentiation (PED), particularly in those with anorexia.

Low PED may be a particularly interesting trait to examine in those with anorexia, especially given that there is evidence that low PED may increase goal pursuit and reactivity of positive emotion responding in non-clinical samples. For example, a recent EMA study indicated that lower levels of PED were associated with increased positive emotional reactivity ($r=.48$, $p<.001$; Hill & Updegraff, 2012). Furthermore, using EMA, Tugade, Fredrickson, and Barrett (2004) found that low PED (which is also commonly referred to as low *positive emotion granularity*) was associated with decreased “behavioral disengagement,” as measured by the COPE scale (Carver, 1997). This finding indicated that those with low PED were less likely to give up or withdraw effort when stressors interfered with goals, and in the case of anorexia may contribute to the ability to persevere toward weight loss goals. In addition, Tugade and colleagues (2004) also found that low PED was associated with daydreaming. In the case of anorexia, such daydreaming about the future positive consequences of attaining an ideal body weight may also be used to generate positive emotion and motivation for weight loss behaviors. Although PED has only been examined in a few studies to date, the existing evidence suggests that it may play an important role in motivating and reinforcing weight loss activities in those with anorexia.

Current Study

The purpose of the current study was to examine the role of low PED in contributing to increased frequency of weight loss activities in anorexia. For this study we utilized Ecological Momentary Assessment (EMA) data from a sample of women with current anorexia diagnoses who completed two weeks of monitoring using digital recording devices, during which they rated their emotions and recorded weight loss and evaluation behaviors multiple times each day. Examining the role of PE in weight loss activities using EMA data allows for an examination of these behaviors with decreased recall bias, it also allows for the examination of emotions in close temporal proximity to these behaviors. From these

data we generated indices of PED and NED for each participant, as well as PE and NE intensity, and examined cross-sectionally and prospectively the role of low PED and PE in predicting elevated rates of vomiting, laxative use, exercise, weighing, checking for body fat, and calorie restriction.

Our hypotheses for this study were four-fold. *Hypothesis One:* Individuals demonstrating low PED ability scores during monitoring would exhibit more frequent weight loss and evaluation behaviors. *Hypothesis Two:* The association between average PE intensity during monitoring and the frequency of various weight loss and evaluation behaviors would be moderated by PED, such that those with lower PED will have a stronger relationship between the PE intensity and frequency of eating disordered behaviors.

We tested *Hypothesis Three* and *Hypothesis Four* using within-person momentary EMA recordings of PE intensity and weight loss behaviors. For *Hypothesis Three*, we predicted that on those occasions in which individuals reported higher PE at one momentary recording, they would be more likely to report more weight loss and evaluation behaviors at the subsequent recording, and that this association would be strongest for those with low PED ability. Finally, in *Hypothesis Four* we expected that the report of more weight loss and evaluation behaviors at one momentary recording would predict increased PE intensity at the subsequent momentary recording, especially for those with low PED ability. Importantly, although not the primary focus of the current study, because NE also promotes weight loss activities in anorexia, we also examined the role of NE intensity and NED in this study. We expected that both high NE intensity and low NED would both predict increased frequency of weight loss and evaluation behaviors reported over the monitoring period.

Methods

Participants

For this study we utilized data from 118 women who met current diagnostic or subclinical criteria for anorexia (as defined below), with designation as either restricting [N=73] or binge-purge subtype [N=45], all of whom completed an EMA protocol. A total of 601 potential participants were originally screened for eligibility via phone. Eligibility criteria for further participation in the study included: 1) female sex, 2) being at least 18 years old, and 3) endorsing at least subthreshold criteria for anorexia. Diagnoses for anorexia were modified to include the following subthreshold exceptions: 1) weight equal to 90% (rather then 85%) of ideal body weight, or 2) either amenorrhea or body image disturbance and intense fear of gaining weight. These modifications are consistent with changes to DSM-5 criteria for anorexia (Mitchell et al., 2005; APA, 2013), which has removed the amenorrhea criterion. Of the 601 potential participants phone screened, 166 were further evaluated onsite to confirm the above eligibility criteria. On the basis of these in-person assessments, 121 participants met eligibility criteria, provided verbal and written consent, and were enrolled in the study. Three participants had monitoring compliance rates of less than 50% and were excluded from analyses, resulting in a total of 118 participants. The ages of participants ranged from 18 to 58 years (M=25.3, SD=8.4 years), and the average body mass index was 17.2kg/m^2 (SD=1.0; range = 13.4-18.5 kg/m^2). The sample was almost entirely non-Hispanic Caucasian (96.6%), with some African American (2.3%) and Asian

American (1.1%) participants. The total household income for 43% of the sample was over $40,000 annually, with 26.7% of the sample having a household income of less than $10,000 annually. Over 90% of the sample had at least some college education.

Procedures

Potential participants were recruited at three coordinated sites (Fargo, ND; Minneapolis, MN; and Chicago, IL) through mailings to treatment professionals, on-line postings, advertisements in community and campus newspapers, and flyers posted in clinical, community and campus settings. The institutional review board at each site approved the study. Following the phone screening previously mentioned participants were then scheduled for two in-person clinical assessment visits, during which written consent was provided, a physical screening and laboratory tests were conducted to ensure medical stability, structured clinical interviews were conducted, and the participants completed self-report questionnaires. Following these assessments, participants were trained on the use of a digital recording device (Handspring Visor) used for EMA. The principal investigator, or a designated representative, at each site met with participants to discuss the purpose of the study, what to expect during the data collection period, and how to deal with any questions that might arise from the signaling of the digital recording device.

In order to capture a variety of mood ratings in close temporal proximity to the behaviors, signal-contingent, event-contingent, and interval contingent recording were employed (Wheeler & Reis, 1991). For each type of recording, participants were asked to complete ratings of their mood and behaviors. Signal-contingent recordings prompted participants to complete mood ratings six times throughout the day when the digital recording device signaled them. The device signaled participants at a semi-random time within 30-45 minutes of the anchor times: 8:30am, 11:10am, 1:50pm, 4:30pm, 7:10pm, and 9:50pm. In addition, event-contingent recording was employed as participants were asked to complete mood ratings whenever they engaged in certain eating disordered behaviors (e.g., vomiting, laxative use, etc.). Also, participants complete an interval contingent assessment at bedtime in which they provided both an emotion rating and an assessment of degree of caloric restriction for the day.

Participants carried the digital recording device for two practice days, at which point they returned and provided the data recorded during their practice period (these data were not used in analyses). This practice period was used both to ensure participants were familiar and comfortable with the EMA assessments and to minimize reactivity to the recording procedures (although there is little evidence of reactivity in EMA; e.g., Stein & Corte, 2003). The data from the training days were subsequently reviewed and participants were given feedback regarding their compliance rates. Participants were then given the digital recording device to complete EMA recordings over the next 2 weeks. Attempts were made to schedule 2-3 visits for each participant during this two-week interval to obtain recorded data and to minimize the amount of data lost in the event of technical problems. Participants were given feedback at each visit with respect to their compliance rates. Participants completed the study at the end of the two-week monitoring period. Participants were compensated $100 per

week for completing momentary assessments and were given a $50 bonus for a compliance rate of at least 80% to random signals.

Clinical Assessment

The *Structured Clinical Interview for DSM-IV Axis I Disorders* (SCID-I/P; First, Spitzer, Gibbon, & Williams, 1995) was used for determining anorexia diagnoses at the full and subthreshold level, as well as current and lifetime criteria for all other Axis I disorders. The SCID is a commonly used interview to diagnose anorexia (Kaye et al., 2008). A doctoral-level clinical psychologist completed the clinical interviews, which were recorded and a second, blinded independent assessor rated current eating disorder diagnoses in a random sample of 25% of the total sample (n = 30). Interrater reliability for current anorexia diagnosis was found to be very good (Kappa = .93).

Ecological Momentary Assessment

Each momentary assessment asked participants to record their current emotions, as well as if they had engaged in either weight loss activities or caloric restriction since the previous recording.

Positive and Negative Emotion Measures—At each of the momentary assessments participants answered specific questions about PE and NE, which were generated from the *Positive and Negative Affect Scale* (PANAS; Watson, Clark, & Tellegen, 1988), as well as some items from the *Profile of Mood States* (Lorr & McNair, 1971). Items from the PANAS included eight on NE (nervous, angry at self, afraid, sad, disgusted, distressed, ashamed, and dissatisfied with self) and eight on PE (strong, enthusiastic, happy, energetic, proud, attentive, confident, and cheerful). Seven items from the tension/anxiety scale of the POMS (on edge, restless, tense, anxious, uneasy, shaky, and panicky) were also used for NE, and one item – relaxed – from the POMS was included as a PE item. Items from both scales were used to assess the broadest spectrum of individual emotions, which is important for examining emotion differentiation. Participants rated their current mood for each of these items on a 5-point scale ranging from (1) *not at all* to (5) *extremely*. Alpha coefficients for NE were .94 and for PE were .92 in the current study. These items were used to generate indices of NE and PE intensity, and they were also used in the generation of the NED and PED indices.

Weight Loss and Evaluation Behaviors—At each momentary assessment all participants also completed a checklist of common weight loss activities, and this checklist has been used in previous EMA studies of weight loss behaviors in eating disorders (Smyth et al., 2007). Participants were asked to report specific weight loss and evaluation behaviors including: vomiting or laxative use for weight control, weighing-in on a scale, exercising, and checking joints and bones for fat. All participants were given clarification regarding the definitions of each activity. All activities were individually summed into total monitoring frequency variables averaged over 2 weeks for each participant because some participants completed less or more than 14 days. For a within-subjects analysis we also created a total weight loss activities variable for any momentary recording, with all activities except daily calorie restriction reported at that signal summed (below). Creating such a combined

variable was supported by a principal components factor analysis which found that these behaviors loaded well onto one primary factor (all factor loadings >.30) at the momentary report level, suggesting that more than one activity was often reported at each momentary recording.

Calorie Restriction—Participants were asked to report the occurrence of specific eating-related behaviors and rituals drawn from the *Yale-Brown-Cornell Eating Disorder Scale* (YBC-EDS; Sunday, Halmi & Einhorn, 1995). As a part of this assessment, at the end of day assessment all participants were asked if they had limited their food intake to less than 1200 calories (<1200 calories); participants were given examples of objective amounts of food consumed to help them improve accuracy of calorie intake estimation. This dichotomous variable was later summed across all daily observations for the study to generate a count variable for number of days out of 14 with calorie restriction.

Emotion Differentiation and Intensity Indices

Multiple observations of emotions and behavior occurred each day over 14 days of monitoring, and using these assessments allows for the derivation of daily emotion differentiation indices. In addition, aggregated indices were also generated to establish average levels of emotional intensity.

Positive and Negative Emotion Differentiation Indices—In order to generate indices measuring individual levels of emotion differentiation ability for PE and NE during monitoring, the intraclass correlation coefficient with absolute agreement for either PE or NE items at each assessment for each participant was generated and averaged across all assessments, resulting in an average coefficient for each participant. Doing so allows for an empirical index of the consistency between multiple emotion ratings for each participant. This coefficient was then subtracted from 1.0 to reverse the score so that higher scores indicated better ability at differentiating between discrete emotions (e.g., pride OR excitement), while lower scores indicated that emotions were reported in a broad, undifferentiated manner (e.g., pride AND excitement AND energetic). This well validated method has been used in multiple studies to generate emotion differentiation indices from EMA data (Hill & Updegraff, 2012; Kashdan et al., 2010; Pond et al., 2012; Shrout & Fleiss, 1979; Tugade, Fredrickson, & Barrett, 2004).

Average Positive and Negative Emotion Intensity—In order to establish negative and positive emotion intensity levels, the ratings for positive and negative emotion items were respectively summed for each within-person momentary assessment. These momentary levels of PE and NE were then averaged across all observations for each participant, resulting in average emotional intensity ratings. For within-person analyses, momentary levels of PE and NE intensity were used.

Data Analytic Strategy

In order to examine Hypotheses One and Two for the study we utilized generalized linear modeling. This is an extension of traditional regression modeling, with the exception that the outcome variable used is not normally distributed. Rather, in this study the total number

of each weight loss or evaluation activity reported during monitoring was a count variable. To account for this non-normal distribution, generalized linear modeling uses a log link to transform the regression coefficient and standard error to be consistent with a Poisson distribution. The result is a more powerful and analytically appropriate approach to data analysis for number of behaviors reported (Dobson & Barnett, 2008).

For each analysis the following variables were first examined individually in relation to each activity: PED, NED, average PE intensity, and average NE intensity. We also further examined each model by including the PED by average PE intensity interaction. NED and NE intensity were included in the model because we expected that these factors would be related to weight loss behaviors and PED, and to demonstrate that even when accounting for level of NE low PED predicting weight loss and evaluation behaviors would maintain significance. In the next step of the analysis, the interaction between PED and PE intensity was included and examined. Finally, in each model anorexia subtype was also included as a subsequent covariate in each model to ensure third variable explanations were not accounting for the effects found, particularly as those with anorexia likely exhibit higher rates of some weight loss and evaluation behaviors, such as vomiting and laxative use.

For Hypotheses Three and Four we utilized generalized linear mixed model analyses, which allowed for the examination of momentary observations of the emotional context surrounding weight loss behaviors. For the first analysis (Hypothesis Three) we created a lag-PE intensity variable, which took the PE score for each person at one signal and shifted the data to allow it to predict a behavior at the subsequent signal. The lag variables were created within each person during each day of monitoring, and the missing score at the start of each day for each participant was not included in analyses. Weight loss and evaluation behaviors (i.e., vomiting, exercising, weighing, and checking for fat) were combined so that a count variable was created allowing for the engagement of multiple behaviors because there was not enough power to conduct this analysis for each weight loss behavior separately. The data were analyzed with a 2-level mixed model that accounted for observations nested within each participant; the predictor variables were entered as fixed effects and the intercept was specified as random.

The generalized mixed model analyses consisted of two levels: within-individual observations each day (Level 1), and between each individual at baseline (Level 2). The base model is displayed below:

$$\text{Response Distribution: Weight Loss Behaviors}_{jk} \left| \mu_{jk} \sim Poisson(\mu_{jk}) \right.$$

$$\text{Link Function: } \eta_{jk} = \log(\mu_{jk})$$

$$\text{Linear Predictor:}$$

$$\text{Level 1 (momentary observation): } \eta_{jk} = \beta_{0k}$$

$$\text{Level 2 (individual): } \beta_{0k} = \beta_{00} + u$$

In the above equations the *j* subscript refers to the momentary observation and the *k* subscript refers to each individual. The response distribution for behaviors was *Poisson*, which accounts for the count-nature distribution of these behaviors (μ_{jk}). The link function transforms the outcome of the identity analysis (η_{jk}) with a logarithm transformation

such that it is consistent with the *Poisson distribution*. Level 1 assesses the momentary observations of each behavior by adjusting the individual Level 2 intercept (B_{0k}), and Level 2 assesses the between-subjects variables and includes a fixed intercept (β_{00}). The resulting final base model equation is $\text{Log}(\mu_{jk}) = \eta_{jk} = \beta_{00} + u$, which indicates an individual-level intercept for momentary behavior reports plus random error. Mixed model analyses also have to account for autocorrelation within a model, which refers to the problems often caused by high correlation between variables that are measured closely in time. To account for the potential concerns regarding autocorrelation, lag-time was included as a predictor at Level 1 of the model to account for time between observations, according to the recommendation of West & Hepworth (1991).

Predictors were then added to the base model, with momentary within-subject variables being placed on Level 1, and between-subject predictors were added to Level 2:

$$\text{Level 1 (momentary observation): } \eta_{jk} = \beta_{0k} + \beta_{1k}(\text{lag - PE intensity})_{j-1k} + \beta_{2k}(\text{lag - NE intensity})_{j-1k}$$

$$\text{Level 2 (individual): } \beta_{0k} = \beta_{00} + \beta_{01}(\text{PED})_k + \beta_{02}(\text{NED})_k + \beta_{03}(\text{anorexia - type})_k + u$$

$$\beta_{1k} + \beta_{11} + \beta_{21}(\text{PED})_k$$

$$\beta_{2k} = \beta_{12}$$

Reduced Equation: $\eta_{jk} = \beta_{00} + \beta_{01}(\text{PED})_{j\text{-}1k} + \beta_{02}(\text{NED})_{j\text{-}1k} + \beta_{03}(\text{anorexia-type})_{j\text{-}1k} + \beta_{11}(\text{lag-PE intensity})_{j\text{-}1k} + \beta_{12}(\text{lag-NE intensity})_{j\text{-}1k} + \beta_{21}(\text{lag-PE intensity*PED})_{j\text{-}1k} + u$

In these equations, β_{00} refers to the individual intercept, β_{0n} subscripts refer to the Level 2 predictor weights, β_{1n} subscripts refer to the Level 1 variable predictor weights, and the β_{21} subscript refers to the cross-level interaction between PED and momentary PE intensity.

In order to test our Fourth Hypothesis we again utilized generalized linear mixed modeling to examine if weight loss activities reported at one signal would predict elevated PE at the subsequent signal, especially for those with low PED. In this model the same structure was used as in the previous analysis, however because PE was a normally distributed outcome variable a traditional linear mixed model was utilized (involving an identity link function and normal distribution). For this model we generated a lag-Weight Loss behaviors variable, which allowed us to examine previous reports of weight loss behaviors in predicting subsequent PE. Level 1 predictors included lag-weight loss behaviors and concurrent level of NE, Level 2 predictors included PED and NED, and a cross-level interaction term was included for a lag-weight loss behaviors by PED interaction. Concurrent level of NE was included in the model to account for the fact that weight loss activities are also frequently associated with NE, and because a high level of NE may influence concurrent feelings of PE. Lag-time was again included to account for autocorrelation, and the model also included a fixed intercept.

Due to the multiple comparisons conducted, we utilized a conservative alpha of .01. All analyses were completed in SPSS version 20.

Results

Preliminary Analyses

The 118 participants in this study provided a total of 15,017 momentary recordings during the monitoring period, representing 1,767 separate participant days. Recordings included 3,445 reports of eating-relevant events, with Table 1 displaying an average of 4.53 vomits (SD=9.39), .62 laxative uses (SD=1.93), 6.59 exercise sessions (SD= 8.59), 5.33 weigh-ins (SD= 7.62), 20.61 checks for body fat (SD=26.62), and 4.03 days with under 1200 calories consumed (SD= 5.22). Compliance rates to signals averaged 87% (range = 58-100%); 77% of all signals were responded to within 45 minutes. Compliance with end-of-day ratings averaged 89%.

Regarding PED scores, the sample was generally low (M=.26, SD=.16), and as was found in previous research in a general sample (Hill & Updegraff, 2012), low PED scores were associated with elevated average PE intensity (r=.28, p<.001). There was also a moderate correlation between PED and NED (r=.50, p<.001), and there was no correlation between PED and NE intensity (r=.02, p>.05), indicating that NED and PED may be related yet distinct constructs. The average PE intensity was 18.42 (SD= 5.24), while average NA intensity was 18.27 (SD= 7.47); both were systematically distributed. Regarding anorexia subtypes, those with anorexia binge purge subtype demonstrated significantly lower PED scores (M=.21, SD=.14) than those with anorexia restricting subtype (M=.29, SD=.16; t(1)=2.60, p=.011, d=.50). NED score did not differ by anorexia subtype (t(1)=1.64, p>.05, d=.30).

Hypothesis One: Main Effects of Low Positive Emotion Differentiation

Individual PED levels were significantly associated with frequency of behaviors reported over two weeks, including vomiting (*B*=-3.861, *SE*=.800, *p*<.001, RR=.02), laxative use (*B*=-4.251, *SE*=.580, *p*<.001, RR=.01), exercise sessions (*B*=-1.709, *SE*=.275, *p*<.001, RR=.18), weighing (*B*=-.423, *SE*=.084, *p*<.001, RR=.66), checking body for fat (*B*=-.735, *SE*=.140, *p*<.001, RR=.48), and number of <1200 calorie days (*B*=-.200, *SE*=.063, *p*<.01, RR=.82). All behaviors were higher in the context of low PED, supporting Hypothesis One.

Regarding NED, a less consistent pattern of association was found with weight loss activities. There was a significant negative association with exercise (*B*=-.914, *SE*=.310, *p*<.01, RR=.40), indicating less ability to differentiate negative emotions promoted exercise. On other hand, there was a significantly positive association with weighing episodes (*B*=1.169, *SE*=.290, *p*<.001, RR=3.22), indicating that strong ability to differentiate between negative emotions experienced promoted weighing. No significant relationship was found for NED and vomiting, laxative use, checking for fat, or calorie restriction.

Low average PE intensity was associated with vomiting (*B*=-.054, *SE*=.019, *p*<.01, RR=.95), laxative uses (*B*=-.064, *SE*=.029, *p*<.01, RR=.94), checking for fat (*B*=-.014, *SE*=.004, *p*<.001), and days with less than 1200 calories consumed (*B*=-.055, *SE*=.009, *p*<.001, RR=.99). On the other hand high PE intensity was associated with exercise sessions (*B*=.034, *SE*=.006, *p*<.001, RR=1.03), and no main effect was found for PE intensity on weighing. In line with previous research, a general pattern of high average NE intensity was

associated with all weight loss behaviors, with the exception of exercise sessions. As would be expected, those with binge purge subtype reported higher rates of vomiting ($M_{binge\text{-}purge}$ =10.49, SD= 12.11 vomits; $M_{restricting}$=.58, SD= 1.61; t(1)= 6.93, p<.001, d=1.12) and laxative use ($M_{binge\text{-}purge}$ =1.24, SD= 2.52 uses; $M_{restricting}$ =.30, SD=1.37; t(1)=2.64, p<.01, d=.48), but not weighing, exercising, checking for fat, or restriction. When anorexia subtype was added as a covariate to the previous models, low PED predicted weight loss behaviors above and beyond the effects of anorexia subtype.

Hypothesis Two: Low Positive Emotion Differentiation and Positive Emotion Intensity

The details of the interactions are presented in Table 2, and graphs for all interactions are displayed in Figure 2. The interactions were significant and in the hypothesized direction (with those with low PED and higher levels of PE predicting more weight loss and evaluation behaviors than those with high PED and high PE intensity) for vomiting (*B*= -.291, *SE*=.028, *p*<.001, RR=.75), laxative use (*B*= -.299, *SE*=.037, *p*<.001, RR=.74), exercise sessions (*B*= -.400, *SE*=.083, *p*<.01, RR=.67), weighing (*B*= -.419, *SE*=.075, *p*<.001, RR=.66), checking for fat (*B*= -.162, *SE*=.013, *p*<.001, RR=.85), and number of days <1200 calories (*B*= -.086, *SE*=.013, *p*<.001, RR=.92).

Simple slope analyses were conducted to clarify the nature of the interactions. For vomiting, there was a positive, although non-significant, slope for those with low PED and high PE intensity (slope = .04, p>.05, RR=1.04) reporting more vomiting relative to those with low PED and low PE intensity. On the other hand, those with high PED and high PE intensity reported significantly fewer instances of vomiting (slope= -.26, p<.01, RR=.77) than those with low PED and high PE intensity. Regarding laxative uses, there were significantly more episodes for low PED individuals at high PE intensity (slope=.02, p<.001, RR=1.02) than those with low PED and low PE intensity, and there were fewer uses for high PED individuals at high PE intensity (slope=-.13, p<.001, RR=.88) than those with low PED and high PE intensity. Regarding checking for body fat, there were significantly more checks for those with low PED and high PE intensity (slope=.67, p<.001, RR=1.95) than those with low PED and low PE intensity, and there were significantly fewer checks for those with high PED and high PE intensity (slope=-.54, p<.001, RR=.58) than those with low PED and high PE intensity. There were significantly more weigh-ins for those with low PED and high PE intensity (slope=.13, p<.001, RR=1.14) than low PED and low PE intensity, and there were significantly fewer weigh-ins for those with high PED and high PE intensity (slope= -.24, p<.001, RR=.79) than those with low PED and high PED intensity. Regarding exercise sessions, as expected there were more sessions for those with low PED and high PE intensity (slope=.05, p<.01, RR=1.05) than those with low PED and low PE intensity, and fewer sessions for those with high PED and high PE intensity (slope= -.13, p<.01, RR=.88) than low PED and high PE intensity. Finally, although the highest number of days with fewer than 1200 calories consumed was for those with low PED and low PE intensity relative to those with low PED and high PE intensity (slope= -.09, p<.001, RR=.91), those with high PED and high PE intensity reported fewer restricting days (slope= -.33, p<.001, RR=.72) than those with low PED and high PE intensity.

Hypothesis Three: Positive Emotion and Prediction of Subsequent Weight Loss Activities

We predicted that elevated PE intensity at one momentary signal would predict more total weight loss behaviors recorded at the subsequent signal, particularly for those with low PED. Regarding autocorrelation, lag-time was a significant predictor of weight loss and evaluation behaviors (lag-time = .003, *SE*= .001, *p*<.001, RR=1.003); accordingly lag-time was retained in subsequent analyses to account for autocorrelation. As expected, there was a significant interaction effect for PED and lag-PE intensity to predict an elevation in subsequent number of weight loss behaviors engaged in (β_{21}= -.085, SE=.017, p<.001, RR=.92). When graphed (see Figure 3), the interaction supported Hypothesis Three. Regarding other predictors, there were main effects for PED score (β_{01}=-1.009, SE=.105, p<.001, RR=.36), and lag-PE intensity (β_{11}= -.02, SE=.002, p<.001, RR=.98). Lag-NE intensity was also a significant predictor of weight loss behaviors (β_{12}=.018, SE=.001, p<.001, RR=1.02), indicating high NE predicted increases in these behaviors, and increased NED was also a significant positive predictor of anorexic behaviors (β_{02}=1.067, SE=.146, p<.001, RR=2.91). Furthermore, anorexia subtype was a significant predictor of increase weight loss behavior at any signal (β_{03}=.177, SE=.022, p<.001, RR=3.24), with those with binge-purge subtype experiencing more behaviors.

Hypothesis Four: Weight Loss Activities and Prediction of Subsequent Positive Emotion

For this model we expected to see that elevated weight loss activities reported at one signal would predict elevated levels of PE at the subsequent signal, with a more pronounced effect for those with low PED. Again, the lag-time variable indicated a significant autocorrelation effect (β=.002, SE=.001, t=3.20, p=.001, RR=1.002) and was retained. The results of this model indicated that the interaction between PED and previous weight loss and evaluation behaviors was a significant predictor of subsequent PE intensity (β= 2.172, SE=.739, t=2.94, p=.003, RR=8.76). When graphed (see Figure 4), the interaction indicated support for Hypothesis Four. There were significant main effects for PED (β= -8.486, SE=.379, t=22.42, p<.001, RR=.0002), lag-weight loss behaviors (β=.235, SE=.106, t=2.22, p=.027, RR=1.26), NED (β= -8.502, SE=.419, t=-20.31, p<.001, RR=1.26), and concurrent NE (β= -8.502, SE=.419, t=-62.66, p<.001, RR=.0002). The interaction maintained significance when anorexia subtype was included as a covariate, although anorexia subtype was not a significant predictor.

Discussion

Although many studies have examined the role of NE in facilitating weight loss and evaluation behaviors in anorexia, few studies have examined the potential role of PE. The goal of the current study was to examine the role of low positive emotion differentiation (PED) in weight loss activities in anorexia. We hypothesized that participants who exhibited lower levels of PED in combination with higher average levels of PE intensity would exhibit the highest frequency of weight loss and evaluation behaviors. Across all activities examined, low PED was found to be a significant and consistent predictor, and furthermore, it interacted with increased PE intensity to predict more frequent vomiting, laxative use, exercising, weighing, checking for fat, and number of days with less than 1200 calories consumed. Furthermore, we examined the interaction of momentary PE before and after

weight loss activities with a participant's PED level. We found evidence that low PED level interacted with high momentary PE intensity at one signal to predict the occurrence of more weight loss and evaluation behaviors at the subsequent signal, and we also found that for those with low PED, engaging in more weight loss behaviors predicted subsequently elevated levels of PE. Collectively, these findings suggest that although those with anorexia may experience abundant NE which influences weight loss behavior, they may also experience maladaptive PE that both motivates and reinforces weight loss behaviors in a positive feedback loop. Importantly, these findings held above and beyond the effects of NE, NED, and anorexia subtype.

How Does Low Positive Emotion Differentiation Develop in Anorexia?

The experience of low PED in anorexia likely has some biological contributions, given that there are increasing findings of biological vulnerability to anorexia (Bulik et al., 2006). As mentioned in the discussion, neuroimaging research indicates that those with anorexia display heightened reward responding in the ventral striatum in response to rewarding stimuli, such as pictures of underweight women (Fladung et al., 2010). This biologically heightened reward responding may have important implications for the phenomenological experience of PE, such that rewards result in more PE, potentially diminishing the differential effects of discrete positive emotions when experienced.

Low PED may also be driven, at least in part, by cognitive distortions. For example, Serpell et al. (2004) found that some individuals with anorexia viewed their success with weight loss as leading to elevated feelings of confidence, expertise, and being better at something than others. Although success with diet and consistent exercise are valuable for building confidence and self-esteem in many people, those with anorexia may inflate the importance of these skills. They may view their weight loss skills not only as a source of pride, but also associate them with a broader range of positive emotions, such as strength, joy, and happiness. Many of these distorted cognitions and their associations with positive emotion may occur at the implicit level for those with anorexia (Henderson-King & Henderson-King, 1997). Although not many studies have examined implicit associations between thin body image and PE, one study found that undergraduate women who placed a higher importance on thin ideals had stronger positive implicit associations with eating disorder behaviors and images of underweight fashion models (Ahern, Bennett, & Hetherington, 2008). Thus, distorted thoughts and beliefs about thin ideals may be associated with a blurring between the boundaries of discrete positive emotions.

Social, cultural, and media influences may also contribute to the development of low PED. Media often depicts thin women as flourishing in other areas of their lives beyond ideal body appearance – career, wealth, romance, and family life. As a result, media sources may strengthen cognitive and implicit associations between thinness, happiness, and success, essentially eroding the distinctions between discrete positive emotions in those with anorexia. Accordingly, those with anorexia may experience success with weight loss not only as success with a specific goal, but also as an indicator of broader success with increased attractiveness, happiness, and perceptions of success. Potential examples of this effect can be observed in Pro-Ana websites, which frequently display quotes such as, "being

thin and not eating are signs of true willpower and success," and "what the scale says is the most important thing." Thus, there are many factors that may contribute to the development of low PED, which may ultimately play a role in the development and/or maintenance of anorexia.

Low Positive Emotion Differentiation and Low Positive Emotion Intensity

Also of note, as can be seen in Figure 2, those exhibiting low PED and low PE intensity also reported frequent weight loss activities. For example, although our hypothesized interaction between low PED and high PE predicted restricting behavior, it was the low PED and low PE intensity combination that predicted the highest level of restriction. In this condition, participants indicated having primarily low or absent PE at most observations. This scenario presents an alternative perspective for the role of PED, suggesting that low PED may also contribute to diminished experience of PE in some cases, perhaps in a manner similar to anhedonia in major depression. Essentially, PED may also inhibit or diminish PE for some, resulting in the discounting of positive emotional experiences, which may fuel additional weight loss behaviors for negative reinforcement purposes. It is also likely that experiencing a dearth of PE goes hand-in-hand with experiencing elevated NE. This may be why many with anorexia and eating disorders, despite having loving and caring families (Casper & Troiani, 2001) and demonstrating academic/occupational achievement (Thompson-Brenner et al., 2008), still experience eating disorder symptoms. These findings suggest that in studying the role of PE in anorexia, it may be important to examine both maladaptive elevations in PE and maladaptive decreases in PE, especially in conjunction with NE.

Negative Emotion Differentiation and Weight Loss Behaviors

Although the primary focus of the current study was on low PED in promoting weight loss behaviors, increased average negative emotion intensity was also a consistent and prominent predictor of weight loss behavior in this study. However, unlike low PED, in the current study, low NED was an inconsistent predictor of weight loss behaviors, adding to previously mixed findings from other studies on negative emotional clarity in eating disordered behavior (De Berardis et al., 2007). In the current study, low NED predicted increased exercise sessions, while on the other hand high NED predicted more weighing. There were no NED associations with other weight loss behaviors. This differential association of NED and various weight loss behaviors is interesting, but currently difficult to explain. It also suggests that those with anorexia may not necessarily have difficulties differentiating all emotions, and that difficulties with differentiation may be more relevant to positive emotions. More work is needed to determine what role NED plays in weight loss activities, and whether or not a combination of low NED and PED promote weight loss activities.

Low Positive Emotion Differentiation and Negative Emotion Intensity in Anorexia

The current study provides evidence that some with anorexia may experience PE in a maladaptive manner, and this maladaptive PE may promote weight loss activities and reinforce them in a vicious feedback loop. Though these findings may initially seem inconsistent with the experience of NE in anorexia – how can someone experience elevated PE when NE is such a pervasive problem?-- the PED model proposed here does not construe these as conflicting forces. Although low PED may enhance PE in a way that promotes

and reinforces weight loss behaviors, the desire to lose weight and exaggerated focus on ideal body shape and image may result as a function of NE intensity. Furthermore, struggles with weight loss or weight gain may further prompt NE and motivate weight loss behaviors for negative reinforcement purposes. Negative emotions in anorexia may also be a result of interference with weight loss goals, and in some ways may be viewed as a product of the maladaptive association between weight loss and PE in these individuals.

The potential for combined and high levels of both positive and negative emotion dysregulation in anorexia may result in a “perfect storm” of motivation for weight loss activity, leading to weight loss well beyond what is healthy or attainable for most people. Interestingly, recent research has shown that the more people over-value happiness, the more likely they are to feel unhappy even when happiness seems within reach (Mauss et al., 2011). These conflicting feelings may involve disappointment with how happiness feels when goals are reached, relative to how it was expected it to feel. Such may be the case with anorexia, where progress toward goals may result in PE, but upon reaching a larger goal many things remain at issue (e.g., “I’m thinner, but still unhappy with my life”). This may result in ever increasing weight loss goals, trying to find an elusive happiness, wherein the pursuit of happiness actually results in more PE than the actual achievement of the primary goal, yet ultimately leads to more and pervasive unhappiness.

There may also be differential effects of low PED during the development and maintenance of anorexia. The PED model present in this study may be particularly relevant at the initial development of anorexia nervosa, where positive motivation and positive reinforcement may be primary. However, over time, more negative emotion may prompt increased engagement in negatively reinforcing weight loss activities, and the role of low PED and positive reinforcement may decrease in a manner consistent with previous theoretical models (Fairburn et al., 2003). However, given that many with anorexia have difficulty terminating weight loss activities, some may continue to experience dysregulated positive emotion and the rewarding effects of weight loss behaviors as the disorder increases in severity. This may result as a function of positive emotion becoming conditioned to weight loss behaviors over time, making them become inherently rewarding, even when weight loss is no longer visible. Such a process would be consistent with Walsh’s view of anorexic behaviors becoming habitual over time (Walsh, 2013).

Limitations

There were some limitations in this study that should be noted. First, although we found evidence that elevated PE and weight loss behaviors temporally predicted each other for those with low PED, these findings do not speak to the causal role of PE in motivating or reinforcing weight loss and evaluation behaviors. For example, it is possible that NE is still the primary original motivator of weight loss activities, and following weight loss activities those with anorexia may feel relieved as a function of negative reinforcement of NE resulting from the behaviors, rather than PE and reinforcement. Thus, responses to weight loss and weight loss behaviors may need to be further refined to determine if it is acute increases in PE that are reinforcing the behavior, or negative reinforcement of aversive experiences (e.g. making them a little less miserable). Second, because this was a highly

symptomatic group of women with anorexia, it is possible that there is a restriction of range for some variables. For example, because such an impaired sample was used, many may have had low NED, as demonstrated by a range of .02 to .78; this is in contrast to the range for PED, which was .01 to .94. Low variation in NED scores may partially explain the null and inconsistent findings for this variable in predicting weight loss activities in this study. Future research should compare those with anorexia to either other eating disordered participants or healthy controls to determine if there are significant group differences in PED and if those differences predict elevated weight loss behaviors. Finally, because this sample was primarily non-Hispanic Caucasian (96.6%) and was comprised only of women, these findings may not generalize to other groups (e.g., men with symptoms of anorexia). In addition to these concerns, future research should also attempt to tease apart the multiple motivations for weight loss behavior in anorexia. As was found in this study, both high NE and high PE, in the context of low PED, were highly associated with weight loss behaviors. Thus, a good day with weight goals may promote continued weight loss behaviors, but similarly a bad day may also spur such behaviors to make up for weight gain. Teasing apart the differential effects of PE and NE on weight loss behaviors may be important for enhancing our understanding of anorexia. Finally, it is important to note the role of PE in anorexia should be clarified as to whether there is actual distortion in the experience of positive emotion, or if distortion pertains to the way positive emotion is differentiated, potentially through the use of experimental and psychophysiological methods.

Future Directions

There are numerous ways that the findings of the current study can be extended to further our understanding of the role of positive emotion and low positive emotion differentiation in anorexia. One important direction is to examine the hypothesis that weight loss activities are positively reinforcing in anorexia using experimental methods, such as experimental positive emotion inductions, where participants with anorexia would complete writing tasks and/or view film clips designed to elicit positive emotion. Such inductions could aim to induce positive emotions that were anorexia-salient, or highly related to positive motivations for anorexia, versus anorexia-neutral positive emotions. For example, anorexic participants could be randomized to one of three positive writing tasks: 1) an anorexia-salient task asking the participants to write about their successful strategies for weight loss, 2) an anorexia-neutral task, such as writing about a favorite movie, and 3) a neutral writing task, such as writing about the importance of a strong math education. Positive emotions would be assessed before and after such tasks, and reactivity of positive emotion during the task could be compared across conditions. Based on the model in this study, those in the anorexia-salient condition would likely exhibit the largest increases in positive emotion. Furthermore, PED indices could be generated from positive emotion ratings both before and after the task, and low PED could be examined as a moderator of positive emotional reactivity. To compare methodological reactivity of PE, writing tasks could be compared to film-based inductions.

Further research could also examine the hypothesis that positive emotion serves as a motivator for anorexic behavior by using computer-based effort-expenditure tasks. Multiple computer tasks have been generated to examine how much effort people are willing to exert

for a specific reward, usually monetary, and the more effort they put into the task, the greater the reward (Klein et al., 2010; Treadway et al., 2009). These tasks could be modified so that rather than examining effort exerted to receive money, we could examine how much effort women with anorexia would exert in order to receive money towards anorexia-relevant rewards. For example, money could be earned toward gift-cards that were one of three types: 1) anorexia-salient (fitness-exercise related reward, such as a fitness equipment), anorexia-neutral (e.g., bookstore gift card), or anorexia-aversive (e.g., food-related gift card). Using such an experimental paradigm, it is likely that those in the anorexia-salient tasks would exert more effort, earn more rewards, and rate more positive emotion than those in anorexia-neutral or anorexia-aversive tasks.

Clinical Implications

Although more research is needed to better understand the role of PE and PED in anorexia, a richer understanding of the role of PE in motivating weight loss behaviors may enhance our understanding and treatment of anorexia. In addition to the current evidence supported practices of increasing food consumption, reducing weight loss behaviors, and reducing negative emotion (Wilson, Grilo, & Vitousek, 2007), a novel complementary approach may involve addressing dysregulated positive emotional responding. This could be done in two potential ways: 1) by attempting to improve PED, and 2) by attempting to capitalize on the effects of low PED, and encourage a shift from weight loss activities to other rewarding activities that are not primarily weight-related. Furthermore, these strategies may be enhanced when viewed from the perspective of self-determination theory (SDT; Ryan & Deci, 2000). SDT is a theoretical approach to human motivation that highlights three necessary, inter-related elements for the generation of intrinsic motivation and positive emotion: facilitating autonomy, building competence, and encouraging relatedness. Autonomy is defined as the universal urge to be the causal agent in one's own life and act consistently with one's values. Needs for competency, on the other hand, refers to seeking to control the outcome and experience of mastery through skills development. Finally, 'feelings of relatedness' refers to a universal desire to want to interact with, be connected to, and experience caring for others (Baumeister & Leary, 1995). Anorexia may partially fulfill these elements in a maladaptive way through weight loss activities, which individuals with anorexia often view as something they are in control of (autonomy), that requires extensive effort and learned skills (competency), and that may facilitate relatedness, potentially by identifying others with interests in weight loss and/or connecting through Pro-Ana communities. By finding alternative ways to enhance these elements in place of weight loss activities, we may be able to shift the motivation of those with anorexia away from weight loss and onto alternative activities.

The first approach of increasing discrimination among positive emotions may be accomplished by integrating supportive and open discussion about the rewarding aspects of weight loss and evaluation behaviors into psychotherapy for anorexia. One approach to this may involve including techniques from Acceptance and Commitment Therapy into treatment for anorexia (ACT; Hayes, Strosahl, & Wilson, 1999; Orsillo & Batten, 2002). A major focus of ACT involves addressing desires for control and focusing on life values in relation to achieving goals. ACT may help determine what values are most important

to those with anorexia, and what role weight loss activities play in enacting these values. Increasing engagement in value-directed activities rather than goal-directed activities, and cultivating awareness of the different positive emotions elicited by each, may improve the ability of those with anorexia to understand and appreciate different positive emotions. For example, they may feel pride or excitement about weight loss activities, but do they feel content or satisfied with their relationships? What other things in their lives are they grateful for, and what other areas of their lives could be improved by changing weight loss behaviors? Disentangling positive emotions may help them to realize that although they may be experiencing success in weight loss goals, such success does not necessarily generalize to fulfillment of other life values. Alternative approaches to improving emotion differentiation could also include providing the patient with psychoeducation about positive emotions and emotion regulation, as well as teaching them healthy ways to cultivate positive emotion and life satisfaction. Finally, adapting EMA protocols to clinical assessments of positive emotion may be helpful. Clinicians could use such assessments to help patients examine and identify times when he or she felt positive emotion and investigate the factors surrounded it, with the goal of promoting adaptive positive emotional understanding and responding.

The second approach focuses on harnessing the effects of low PED and increased sensitivity to rewards in anorexia (Fladung et al., 2010; Frank et al., 2012), and could be implemented while patients work on developing on emotion differentiation skills. This approach may involve channeling the motivation for weight loss activities into new activities that facilitate autonomy, competency, relatedness, and the formation of a new identity. Such activities may include reward-reinforcement oriented activities from various areas, including arts, humanities, and recreational activities, and these activities may also simultaneously improve ability to cope with negative emotion.

When selecting alternative activities, a focus on activities that are incrementally rewarding as a function of effort may be important for building competence. Allowing the patient to choose the activity may also facilitate autonomy, and activities that involve interacting with others may enhance feelings of relatedness. Possible activities may include facilitating artistic skills (Frisch, Franko, & Herzog, 2006), or recreational activities such as horseback riding, climbing, team sports, and/or balancing exercises (Duesund & Skarerud, 2003). Substantial debate continues about whether exercise activities should be allowed during treatment for anorexia; however, finding ways to balance exercise with appropriate nutritional intake has some empirical support (Moola, Gairdner, & Amara, 2013; Zunker, Mitchell, & Wonderlich, 2011). The exercise activities of those with anorexia are often heavily focused on rote aerobic exercise, with running and walking to burn calories being the primary goal (Long & Smith, 1993); such exercise should probably be discouraged during treatment. However, in cases where the patient has demonstrated progress toward weight normalization and expresses a desire to exercise, rather than strictly prohibiting exercise, there may be benefits to encouraging the patient to select exercise that is highly skill-focused and of mild to moderate intensity. Doing so would alter the focus of physical activity from burning calories to building skills. One such form of exercise may be yoga, which involves building strength and improving skills over raw energy expenditure, and which has some evidence for reducing eating disorder symptoms beyond standard care (Carei, Fyfe-Johnson, Breuner, & Brown, 2010). Another example may be encouraging

participation in martial arts training, which not only involves physical fitness, but also requires building muscle strength (versus pure leanness), stages of progression indicating competency (e.g., progressing up the belt-color hierarchy), and often involves interacting with other people, potentially facilitating relatedness. Importantly, there is clinical evidence to suggest that martial arts training can enhance self-regulation and relatedness in children and adolescents (Diamond & Lee, 2011; Lakes & Hoyt, 2004). However, physical activities should be carefully monitored to ensure that they do not interfere with weight normalization. Although many of these clinical suggestions are preliminary and require further empirical support, incorporating novel additions to our current treatments may increase both the motivation for treatment, as well as successful outcomes for those with anorexia.

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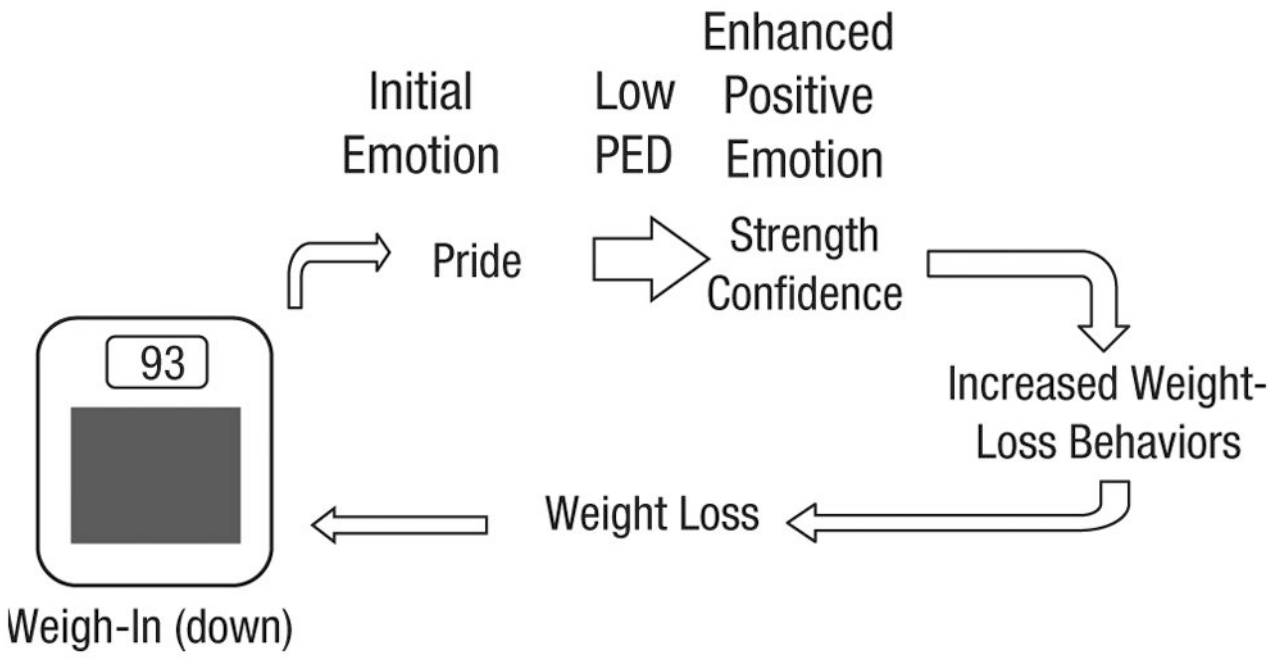

Figure 1. Low Positive Emotion Differentiation Model of Weight Loss Activities in Anorexia

Note: In the Low Positive Emotion Differentiation (PED) Model of Anorexia, a positive feedback loop exists between weight loss and weight loss behaviors for those with low PED. The experience of success with weight loss (through self-evaluation, such as weighing and observing a decrease in weight) may lead to a positive motion such as pride. However, due to low differentiation between positive emotions, other positive emotions may be experienced (such as strength or confidence) that enhance intensity of PE. This enhancement of PE may then serve to motivated additional weight loss behaviors, such as purging and exercise, which are then reinforced by further success with weight loss. It is important to note that this model exists within the context of negative emotion as well, and experiences such as failures to lose weight or gaining weight may increase negative emotion, further motivating weight loss behaviors.

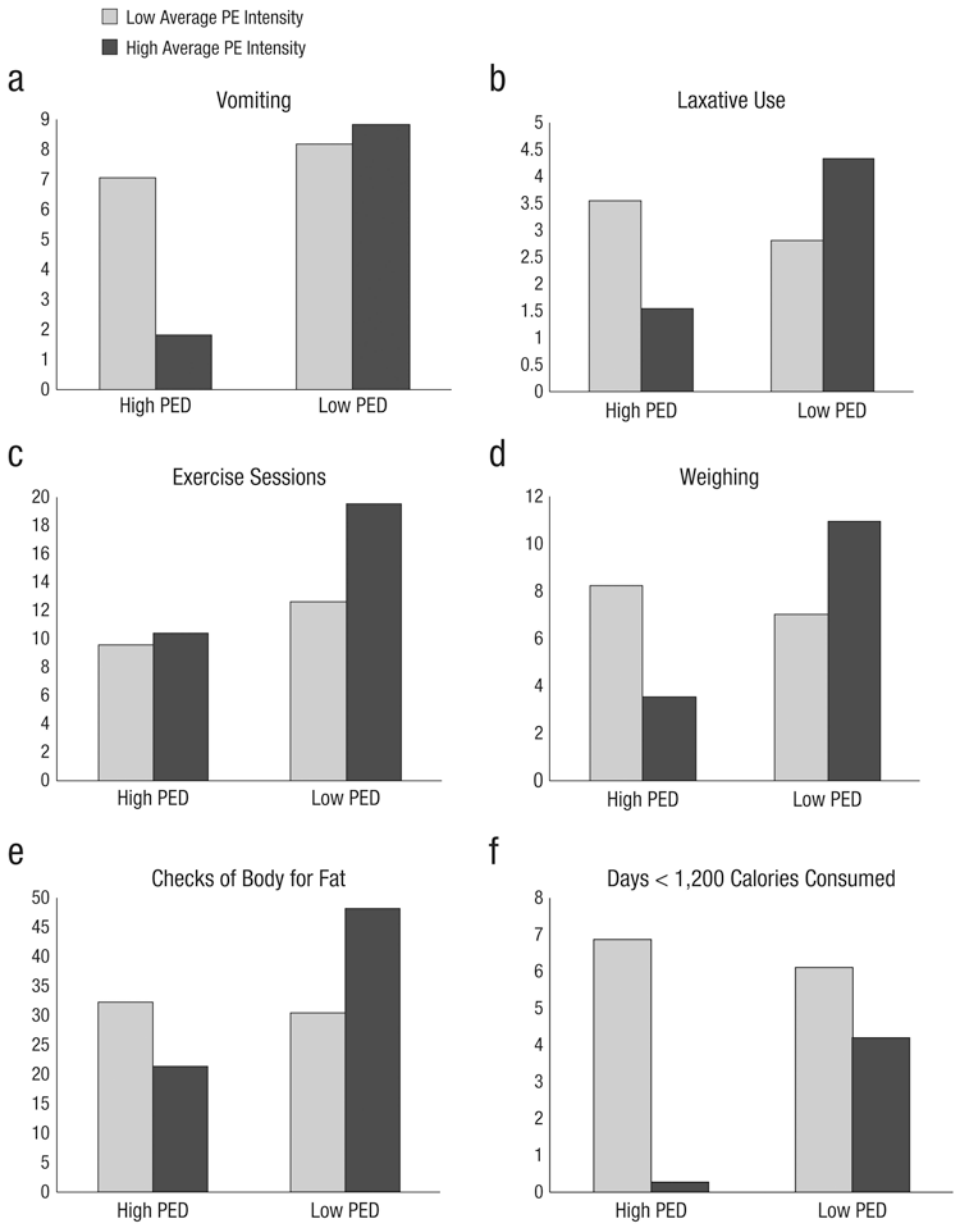

Figure 2. Positive Emotion and Positive Emotion Differentiation Predicting Weight Loss and Evaluation Behaviors in Anorexia

Note: Interactions (with high and low levels being one standard deviation from the mean) between positive emotion differentiation (PED) and positive emotion intensity (PE) predicting total number of behaviors reported during 2 weeks of monitoring. Note: High and low refer to two standard deviations above and below the mean, respectively. All variables were averaged over two weeks for each participant.

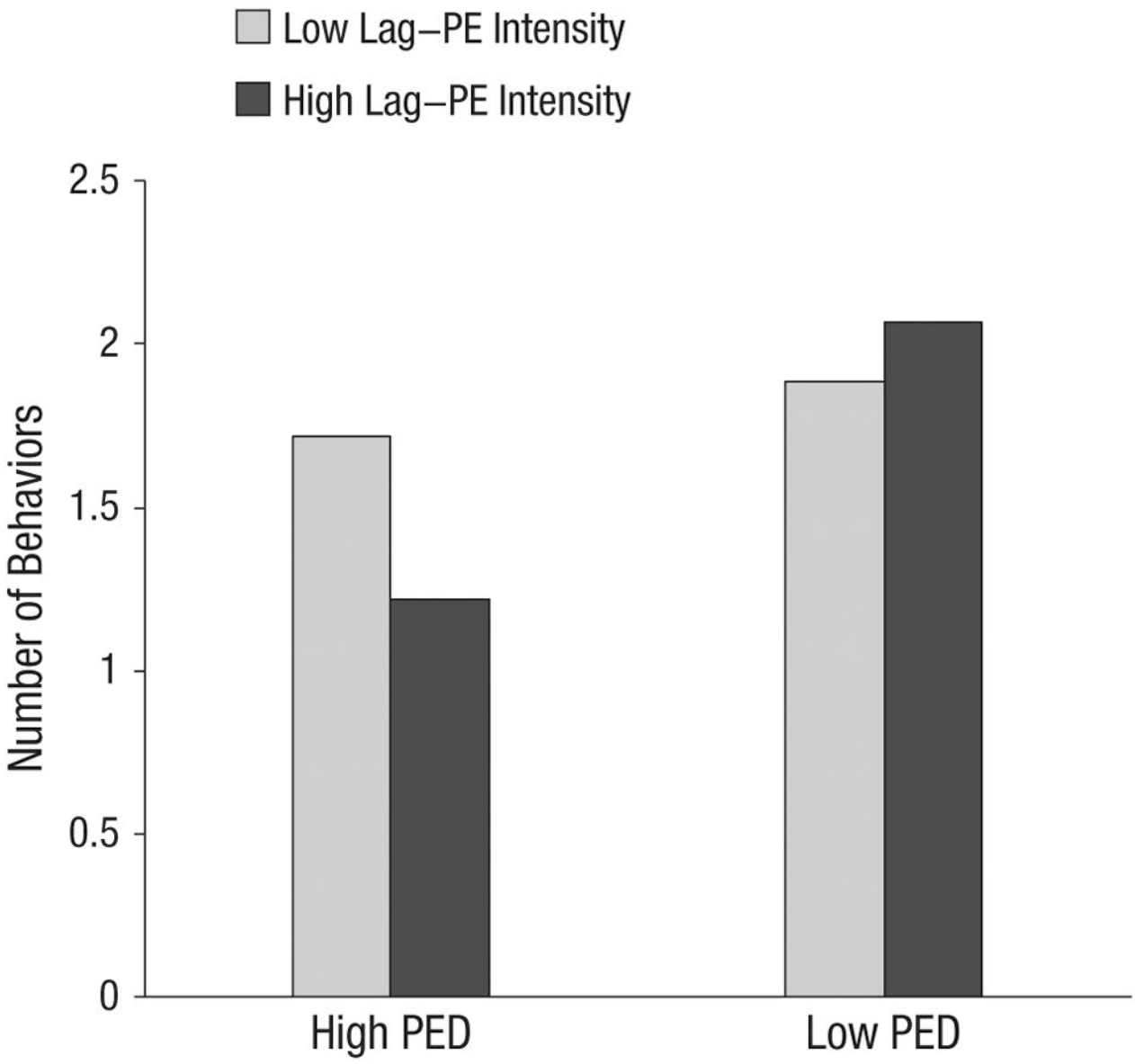

Figure 3. Previous Positive Emotion Level Predicting Subsequent Weight Loss Activities in Anorexia

Note: Interaction between PED and momentary PE intensity at one signal predicting the number of weight loss and evaluation behaviors engaged in at a subsequent signal. High and low refer to two standard deviations above and below the mean, respectively.

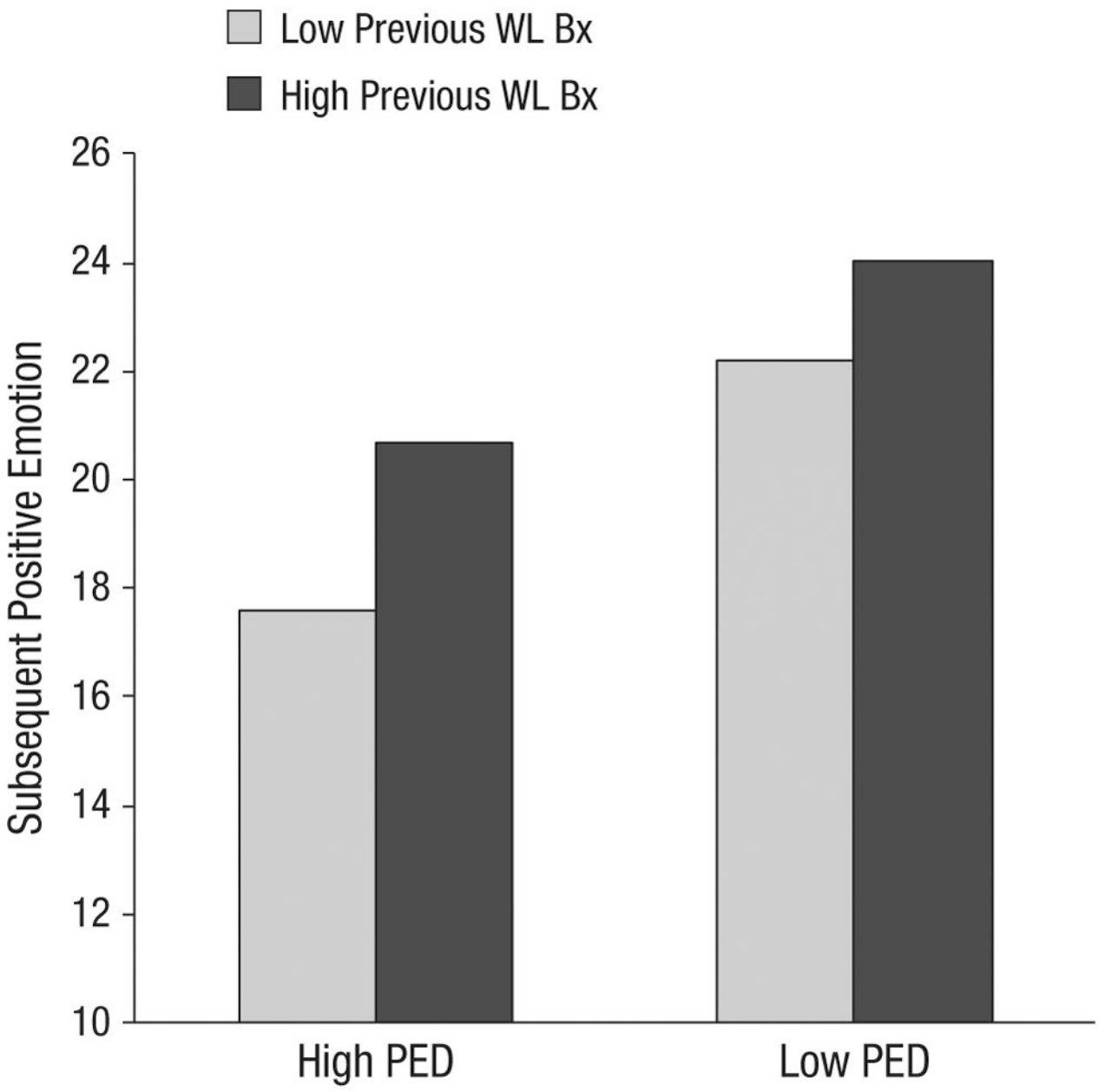

Figure 4. Previous Weight Loss and Evaluation Behaviors Predicting Subsequent Level of Positive Emotion in Anorexia

Note: Interaction between positive emotion differentiation (PED) and previous weigh loss and evaluation behaviors (WL Bx) at one signal predicting elevated positive emotion reported at the subsequent signal. High and low refer to two standard deviations above and below the mean, respectively.

Table 1

Means and Standard Deviations for, and Intercorrelations Between Key Variables

	1	2	3	4	5	6	7	8	9	10
1. PED	--									
2. Average PE Intensity	.28***	--								
3. NED	.50***	.10	--							
4. Average NE Intensity	.02	-.42***	.34***	--						
5. Vomits	.26**	-.12	.18*	.31***	--					
6. Laxative Uses	.11*	-.11*	.13*	.36***	.37***	--				
7. Exercise Sessions	.20*	.22**	.03	-.04	-.06	.07	--			
8. Weigh-ins	.06	-.05	-.11	.11	.04	.06	.06	--		
9. Body Fat Checks	.21*	-.06	.14	.37***	.29**	.25**	.01	-.02	--	
10. Days <1200 Calories	.08	.06	.02	.07	.04	.05	.01	.04	.11*	--
Mean	.26	20.79	.21	34.56	4.53	.62	6.59	5.33	20.61	4.03
SD	.16	5.71	.13	13.24	9.39	1.93	8.59	7.62	26.62	5.21
Minimum	.01	9.18	.02	15.51	0.00	0.00	0.00	0.00	0.00	0.00
Maximum	.94	38.44	.78	72.51	43.00	13.00	47.00	52.00	88.00	14.00

Note. N=118.

PED= positive emotion differentiation, PE= positive emotion, NED=negative emotion differentiation, NE=negative emotion, Days<1200 Calories = days where caloric intake was restricted to be below 1200 calories.

Table 2

Predicting Overall Frequency of Weight Loss and Evaluation Behaviors in Anorexia

Outcome	Predictor	B	SE	z	p	RR
Vomits						
	PE Differentiation	-3.861	.800	-23.31	<.001	.02
	NE Differentiation	.572	1.221	.22	>.05	--
	PE Intensity	-.054	.019	-4.22	<.01	.95
	NE Intensity	.037	.009	10.34	<.001	1.04
	PED*PE Intensity	-.291	.028	-10.23	<.001	.75
Laxative Uses						
	PE Differentiation	-4.251	.580	-7.30	<.001	.01
	NE Differentiation	1.383	1.354	1.04	>.05	--
	PE Intensity	-.064	.029	-4.81	<.01	.94
	NE Intensity	.047	.012	12.01	<.001	1.05
	PED*PE Intensity	-.299	.037	-8.02	<.001	.74
Exercise Sessions						
	PE Differentiation	-1.709	.275	-38.65	<.001	.18
	NE Differentiation	-.914	.310	-8.70	<.01	.40
	PE Intensity	.034	.006	27.35	>.001	1.03
	NE Intensity	.001	.003	1.47	>.05	--
	PED*PE Intensity	-.400	.083	-4.82	<.01	.67
Weigh-ins						
	PE Differentiation	-.423	.084	-5.06	<.001	.66
	NE Differentiation	1.169	.290	16.28	<.001	3.21
	PE Intensity	-.014	.007	-3.74	>.05	--
	NE Intensity	.013	.003	19.78	<.001	1.01
	PED*PE Intensity	-.419	.075	-5.586	<.001	.66
Checking Joints and Bones for Fat						
	PE Differentiation	-.735	.140	-27.38	<.001	.48

Outcome	Predictor	B	SE	z	p	RR
	NE Differentiation	.177	.159	1.24	>.05	--
	PE Intensity	-.014	.004	14.78	<.001	.98
	NE Intensity	.021	.001	214.61	<.001	1.02
	PED*PE Intensity	-.162	.013	-12.83	<.001	.85
<1200 Calories over 24 Hours						
	PE Differentiation	-.196	.064	-3.03	<.01	.82
	NE Differentiation	.120	.36	.11	>.05	--
	PE Intensity	-.055	.009	-41.33	<.001	.95
	NE Intensity	.017	.010	27.04	<.001	1.02
	PED*PE Intensity	-.086	.013	-6.83	<.001	.92

Note:

NE= negative emotion, PE = positive emotion, PED=positive emotion differentiation