MOTIVATION AND EMOTION DYSREGULATION ASSOCIATED WITH PATHOLOGICAL EXERCISE AMONG INDIVIDUALS WITH EATING DISORDER PSYCHOPATHOLOGY

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ABSTRACT OF THE THESIS

Motivation and Positive Emotion Dysregulation Associated with Pathological Exercise among Individuals with Eating Disorder Psychopathology

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Pathological exercise, or exercise that is pursued in a rigid, compulsive, or extreme fashion, is omnipresent in eating disorder psychopathology. Despite this, minimal guidance exists in current treatment manuals for shaping pathological exercise behavior, which has led clinicians to prescribe total abstinence until treatment concludes. The purpose of this study was to better characterize pathological exercise using two relevant descriptive constructs – emotion regulation and motivation – to increase the specificity with which both pathological and healthy exercise is described, to ultimately inform treatment interventions. The present study aimed to identify types of motivation associated with exercise in a sample of college women (n=200) and a sample of adult women in the community with eating disorder psychopathology (n=211). Latent profile analysis was used to characterize homogenous groups of individuals based on exercise motivation. These profiles were then compared on levels of eating and general psychopathology and emotion regulation difficulties. Three profiles emerged describing a

sedentary, athlete, and eating disordered group in the first sample, and five profiles describing a sedentary, athlete, AN-like, weight loss, and healthy group were identified in the second sample. In both samples, the athlete group exhibited intrinsic motivation for exercise and scored significantly lower than the other groups on levels of general psychopathology, while the eating disordered groups displayed identified and extrinsic motivation for exercise and scored significantly higher than the other groups on body dissatisfaction and cognitive restraint. Findings indicate that motivation style may be a salient factor in defining pathological exercise and may also therefore be a clinically useful treatment target. Future studies should investigate the dynamic nature of motivation longitudinal throughout the course of illness.

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I. Introduction

Eating disorders often involve rigid, compulsive pursuit of weight loss behaviors even when faced with negative health consequences (American Psychiatric Association, 2013), and can be notoriously challenging disorders to treat (Fairburn, 2005; Watson & Bulik, 2013). Excessive use of weight loss behaviors, which may include self-induced vomiting, laxative or diuretic abuse, or exercise, contributes to the high mortality rate associated with eating disorders. This is because weight loss behaviors are associated with a host of dangerous and potentially life-threatening medical complications, such as cardiac arrhythmias and electrolyte imbalances (Brown & Mehler, 2013; Mitchell & Crow, 2006). However, because pursuit of weight loss is a core feature of eating disorders, weight loss behaviors, including exercise, are difficult to extinguish.

Problematic exercise has been defined and classified in a number of different ways. Excessive exercise (i.e. an objectively large amount of exercise) has been defined in research settings as exceeding 6 hours of physical activity per week (Solenberger, 2001) and is associated with negative health outcomes, such as physical injury and suppressed immune function (Smith, 2003). Compensatory exercise describes exercise used as a method of purging calorie consumption to prevent weight gain (American Psychiatric Association, 2013). Different still is compulsive exercise: akin to compulsions among individuals with obsessive-compulsive disorder, compulsive exercise refers to exercise completed in a rigid, regimented way, such that individuals feel anxious and guilty if they do not accomplish it (Davis & Kaptein, 2006; Meyer, Taranis, Goodwin, & Haycraft, 2011). There has been growing sentiment that compulsive, and not

excessive, exercise is more associated with psychopathology among individuals with bulimia nervosa (BN) (Adkins & Keel, 2005), yet there is evidence that total amount of exercise activity (i.e. excessive exercise) is associated with high desire for thinness and high body dissatisfaction among individuals with anorexia nervosa (AN) and BN (Solenberger, 2001). For the purposes of this study, the distinction between these three types of exercise is essentially arbitrary, as they can occur, often in concert, in the full spectrum of eating disorders (though excessive exercise may be particularly relevant for those with AN, given that they are already underweight). Therefore, the term *pathological exercise* will be used throughout this paper in order to be as inclusive as possible of the full range of problematic exercise behavior.

Of all the weight loss methods used by individuals with eating disorders, exercise is perhaps the most enigmatic, as it can become a perversion of an otherwise healthy behavior. Nonetheless, pathological exercise may be equally as indicative of disordered eating as other methods of weight loss. A recent study found that individuals with eating disorders who used exercise alone as a method of purging calories showed similar levels of eating disorder psychopathology as individuals who use other methods of purging such as laxative abuse or self-induced vomiting (Lydecker, Shea, & Grilo, 2018). Thus, pathological exercise in the context of eating disorders is a dangerous behavior worthy of intervention.

Pathological exercise represents a particularly challenging behavior to treat, perhaps due to pathological motivational style. Individuals with eating disorders have been found to find the opportunity to exercise even more rewarding than receiving monetary rewards (Klein et al., 2010). An added challenge in treatment is that, unlike

self-induced vomiting or laxative/diuretic abuse, exercise is not objectively pathological, and thus the treatment target for exercise is not complete extinction as it is for other methods of purging. On the contrary, the 2008 Physical Activity Guidelines from the Centers for Disease Control and Prevention recommend that adults engage in moderate intensity aerobic activity for at least 150 minutes per week, and engage in muscle-strengthening activities at least twice per week (U.S. Department of Health and Human Services, 2008). Thus, encouraging complete cessation of exercise may create motivational and therapeutic barriers among eating disorder patients.

Exercise is also associated with a range of secondary benefits like improving mood, lowering anxiety, and reducing risk of chronic disease (Penedo & Dahn, 2005; Shors, Olson, Bates, Selby, & Alderman, 2014). Given that many individuals with eating disorders may already show deficits in these domains, preliminary research has even suggested that exercise may serve as a potential treatment modality (Hausenblas, Cook, & Chittester, 2008). However, the use of exercise as a treatment has not gained much traction, likely in part due to the fact that most patients are not yet ready to entertain moderation in exercise frequency or intensity. Transdiagnostic studies of individuals with eating disorders show deficits in global (vs. local) processing (Becker et al., 2017), meaning that many with eating disorders default to perfectionist, dichotomous ("all or nothing") thinking styles (Lethbridge, Watson, Egan, Street, & Nathan, 2011). This thinking style may be inconsistent with engaging in behaviors in moderation. For example, those with eating disorders might feel that if they eat a small portion of a forbidden food, they might as well binge on a much larger portion because that day of dieting is effectively ruined. The same issue may apply to moderation of exercise.

Although it is true that those who are underweight or who engage in compulsive, compensatory exercise might benefit from a hiatus, discouraging exercise for short-term treatment gains dismisses the notion that extinguishing exercise entirely is not sustainable for a healthy lifestyle. It is clear, then, that unlike other disordered weight loss behaviors (e.g., self-induced vomiting), treating exercise in the context of eating disorders may require a more nuanced approach that favors more moderate forms of exercise like gentle yoga or walking, rather than complete abstinence.

To date, most therapeutic guidelines for eating disorders include only vague recommendations for how to reduce pathological exercise and instead engage in healthy, moderate levels of exercise. Indeed, the field is still very much debating how to address exercise in disorders where exercise may be so excessive that it leads to a low body weight, such as in those with AN. For example, cognitive behavioral therapy (CBT) for eating disorders instructs patients to exercise between 150 and 240 minutes per week, and to do so out of enjoyment, rather than to lose weight (Waller et al., 2007). However, there is no distinction made between healthy and pathological exercise in terms of the type of exercise activity. Further, if following these guidelines means that someone must exercise less frequently than they prefer, then they may not at all enjoy this new truncated regimen, despite the recommendation to exercise for enjoyment. Similarly, family-based treatment (FBT) for adolescents with AN stipulates that exercise is to be banned during the initial phase of treatment, while the parents take charge of weight restoration (Lock & Le Grange, 2013; Swenne, Parling, & Salonen Ros, 2017). After this, the adolescent slowly regains independence of food intake and exercise. Yet there are no explicit instructions for the adolescent to learn how to exercise in a moderate and appropriate

way. Overall, while existing treatments acknowledge that exercise in moderation is advisable for those with eating disorders, they fall short of providing specific recommendations for how to reintroduce a once-disordered activity in a way that does not inspire the disorder to return.

Thus, during recovery from an eating disorder, individuals are faced with a paradoxical challenge: To exercise in a healthy way that does not facilitate a return to previous pathological exercise patterns. The lack of specificity with regards to exercise recommendations in current eating disorder treatments is a clinical problem still in need of further investigation and clarification. Research on: a) the motivation for exercise among those who engage in pathological exercise, and b) the associated clinical features of pathological exercise, including the way exercise is used to regulate emotions, can help begin to demarcate pathological from healthy exercise, which may provide much-needed direction in cultivating healthy exercise habits.

Differentiators of Pathological versus Healthy Exercise

Emotion Regulation

Emotion regulation refers to the process of controlling which emotion is experienced, when it is experienced, and how it is expressed (Gross, 1998). Most models of eating disorder psychopathology agree that behaviors (like pathological exercise) function, at least in part, to regulate emotions (Fairburn, Cooper, & Shafran, 2003; Slade, 1982). More specifically, these models propose that avoidance of negative emotion is a primary factor in the maintenance of disorder-related behaviors. For example, one might binge on palatable foods as a way to ameliorate anger or sadness brought about by an interpersonal argument or use laxatives as a way to purge calories from the binge in order

to reduce guilt from eating high calorie foods. Beyond the theoretical level, research shows that indeed negative emotion is a reliable predictor of engaging in these behaviors (Berg et al., 2013; Stice, 2001).

A burgeoning area of research suggests that, when experienced in the wrong context or to an inappropriate degree, positive emotion may influence the maintenance of a wide range of dysfunctional behaviors (Gruber, Mauss, & Tamir, 2011) – though the mechanisms are poorly understood. However, emotion dysregulation research has largely neglected the contribution of positive emotion to eating disorder behaviors, likely in part because it is counter-intuitive that a) positive emotions could predict engaging in harmful behaviors, and that b) both positive and negative emotions can co-occur in the same individual at the same time. One recent model of food restriction credited the role of positive emotion as a reinforcing factor of initial weight loss at the onset of AN (Walsh, 2013), but proposed that this operant conditioned weight loss (with positive emotion as the reward) is gradually replaced by classically conditioned weight loss, wherein food restriction becomes a habit and is maintained regardless of the presence of the reward of positive emotion. Thus, the sustained effect of positive emotion in influencing eating disorder behaviors, like pathological exercise, has yet to appear in any well-established theoretical models of eating psychopathology, despite the emerging evidence that positive emotion influences a wide range of eating disorder behaviors, especially in those with AN (Selby et al., 2014; 2015).

There is overwhelming evidence that exercise results in increased positive emotion in non-clinical populations (Reed & Ones, 2006), and that this increase can be seen at the neurobiological level (Boecker et al., 2008). Among those with eating

disorders, ecological momentary assessment studies have found that exercise is followed by an increase in mean positive emotion and a decrease in mean negative emotion, whereas other weight control behaviors exhibit the opposite trend (Engel, Wonderlich, Crosby, Mitchell, Crow, Peterson, Le Grange, et al., 2013). This is a potentially important finding that may have treatment implications but has yet to be expounded on in subsequent studies. Instead, etiological eating disorder research typically groups all emotion dysregulation together (i.e. both negative and positive) when examining the predictive value for purging behaviors (Burns, Fischer, Jackson, & Harding, 2012), of which exercise is one example. Thus, more research is needed in understanding whether trait-level positive emotion dysregulation can be used to help differentiate pathological exercisers.

Motivation

Primary motivation for exercise may provide key insight between those with eating disorders, or those at risk for developing an eating disorder, compared to healthy individuals. Self-Determination Theory (SDT; Deci & Ryan, 1985) is a prominent theoretical approach to understanding motivation, especially in the context of health behaviors like exercise. SDT posits that an activity will be pursued based on the degree to which the activity promotes and satisfies a person's need for competence, autonomy, and relatedness to others. Ultimately, when these three domains are fully satisfied, a person will be completely intrinsically motivated to pursue an activity. On the other hand, extrinsic motivation describes pursuit of an activity despite that any one or more of these needs is not satisfied. SDT acknowledges that extrinsic motivation may vary considerably, and thus Organismic Integration Theory (OIT) was developed to describe

these discreet types of extrinsic motivation (Deci & Ryan, 1985; Ryan & Connell, 1989). OIT specifically postulates that extrinsic motivation varies based on the antecedents and consequences of an activity and describes distinct types of external regulation (each type of external regulation falls under the larger umbrella of extrinsic motivation). These three types of extrinsic regulation, together with intrinsic motivation exist along a continuum (see Fig. 1). At the other extreme end of intrinsic motivation is *external regulation*, which involves pursuit of an activity due entirely to external pressure (e.g., from friends, family). One step closer to intrinsic regulation is *introjected regulation*, which refers to motivation based on avoiding negative emotions, namely guilt. Even closer to intrinsic regulation is *identified regulation*, which refers to individuals who engage in an activity because their values align with the activity, despite that they may find the activity to be less than enjoyable.

Previous research on exercise among healthy individuals without eating disorders largely agrees that intrinsic motivation reliably predicts adherence to exercise regimens (Brunet & Sabiston, 2011; Oman & McAuley, 1993; Ryan, Fredrick, Lepes, Rubio, & Sheldon, 1997). Intrinsic motivation for exercise has also been associated with increased eating self-regulation (i.e. restraint from over-eating and adherence to a weight loss diet) among women without eating disorders but who are overweight or obese (Mata et al., 2009). However, given that individuals with eating disorders may already be over-exercising and often have an excess of dietary restraint, these benefits of intrinsic exercise may actually make it easier for pathological exercise to emerge among this group.

Just as previous studies have generally agreed that intrinsic motivation for exercise is beneficial for those without eating disorders, so have studies found that introjected regulation (i.e. where motivation is primarily to avoid negative feelings) is associated with the highest risk of developing an eating disorder, compared to other types of exercise motivation (Hamer, Karageorghis, & Vlachopoulos, 2002; Thøgersen-Ntoumani & Ntoumanis, 2007). Specifically, both guilt when exercise is missed and exercising to improve body dissatisfaction have been shown to most decisively differentiate women with eating disorders and healthy women (Mond & Calogero, 2009; Vartanian, Wharton, & Green, 2012). Interestingly, much of this research has been done among individuals who already exercise frequently, such as aerobics instructors and endurance athletes, which may suggest that not only is introjected regulation associated with risk of developing an eating disorder, but also it may be partially responsible for motivating excessive levels of exercise behavior outside the context of an eating disorder. In order to better understand this phenomenon, there is a need for future research to focus on the potential role of introjected regulation on motivating exercise among individuals who engage in more moderate levels of exercise.

Given the existing research on exercise as a means to regulate emotions (Bratland-Sanda et al., 2011; Goodwin, Haycraft, & Meyer, 2012; Mata, Hogan, Joormann, Waugh, & Gotlib, 2013), it is somewhat unsurprising that introjected regulation for exercise would surface as a potential risk factor for developing an eating disorder. However, introjected regulation exclusively refers to exercise as a way to rid oneself of negative emotions (i.e. it serves as a negative reinforcement). As was discussed in the previous section, much of the research on emotion regulation and eating disorder

behaviors has focused entirely on the ways in which eating disorder behaviors (including exercise, but also other behaviors like bingeing) serve to reduce negative emotion (Engel, Wonderlich, Crosby, Mitchell, Crow, Peterson, Le Grange, et al., 2013; Haedt-Matt & Keel, 2011; Smyth et al., 2007), despite sparse but promising findings that positive emotion dysregulation may serve to maintain eating disorder behaviors like pathological exercise (Engel, et al., 2013; Selby et al., 2014).

Limitations of Current Research

Minimal research has been done to understand how defining and labeling distinct types of exercise motivation might be clinically useful in defining pathological exercise. In essence, despite that previous research has identified types of exercise motivation associated with pathological exercise, and has identified types of emotion dysregulation associated with eating disorder behaviors, there is a distinct lack of research examining how motivation and emotion regulation can be used to characterize individuals who may be engaging in pathological exercise in the context of an eating disorder. Given the vital clinical need to provide patients with clear direction to reintroduce healthy exercise, while staving off characteristics of pathological exercise, it is essential to examine the features associated with pathological versus healthy exercise, so that treatment targets can begin to be clarified.

Current Study

To date, no study has examined how both exercise motivation and positive emotion dysregulation might overlap to create clinically useful profiles of pathological exercise. To that end, the present study sought to elucidate the type of motivation and level of positive emotion dysregulation involved in pathological exercise among two

high-risk groups for eating disorder psychopathology: college undergraduate women and community adults who exhibit eating disorder psychopathology, to determine a potential profile for pathological and healthy exercise, respectively. Accordingly, the current study included two primary aims: 1) to identify latent profiles of individuals based on exercise motivation, and 2) to compare these profiles across measures of eating psychopathology, general psychopathology, and emotion regulation difficulties.

II. Method

Participants and Recruitment

Two independent samples were included in this study: 1) undergraduate women enrolled in an introductory psychology course, and 2) women (ages 18 and over) in the community who display clinically significant levels of eating psychopathology. The undergraduate college sample allowed for examining pathological exercise behavior in a heterogeneous population in which rates of disordered eating may be especially high (O'Dea & Abraham, 2002; Wharton, Adams, & Hampl, 2008) compared to the general community and may also include individuals who exercise frequently but do not have eating psychopathology. Further still, some undergraduates may instead exhibit sedentary lifestyles and increased weight gain (Fountaine, Liguori, Mozumdar, & Jr Schuna, 2011; Lloyd-Richardson, Bailey, Fava, & Wing, 2009); thus the likelihood of obtaining a sample with a wide range of exercise levels and motivation type was high. Examining exercise in a nonclinical population is important, as most studies examining pathological exercise have been conducted among individuals currently in an inpatient or residential unit (Klein et al., 2010; Solenberger, 2001). Such samples often include individuals with extremely severe psychopathology, which may obscure or offer diminished insight into how pathological exercise functioned earlier in their illness course to contribute to their eventual hospitalization. Indeed, there is a strong initiative in eating disorders research to conduct studies focusing on prospective prognostic information to better understand the development of eating disorders (Mustelin et al., 2016). Accordingly, our study included this nonclinical sample in order to assess how motivation and emotion dysregulation factors serve to maintain pathological exercise

even before a full threshold eating disorder might appear. The MTurk eating psychopathology sample allowed for examination of motivation and emotion regulation associated with pathological exercise functions in women who currently display clinically elevated levels of eating psychopathology. The recruitment target for each sample was 200.

The college undergraduate sample was recruited via the Rutgers University Human Subjects Pool (SONA). The eating psychopathology sample was recruited via Amazon.com's Mechanical Turk (MTurk). In both cases, a pre-screen survey was used to confirm eligibility. For the college undergraduate sample, those who were 18 years or older, spoke English, and do not have a history of a psychotic disorder were eligible to be included in the study. For the MTurk eating psychopathology sample, those who were 18 years or older, spoke English, and have engaged in at least one thirty-minute bout of moderate to vigorous intensity exercise in the past week were eligible to be included in the study. This is because some individuals with AN in particular describe experiences of hearing an "eating disorder voice" that pushes them toward eating disorder behaviors (Schaefer, 2003). In addition, MTurk eating psychopathology sample participants also must have scored at least a 2.3 (or above) on the Eating Disorders Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 2008) global scale, and have reported in the past four weeks either a) an objective binge episode followed by a compensatory episode, or b) an episode of exercise as a means of controlling shape or weight. This is consistent with other studies that have used online community samples to conduct eating disorder research (Farrell, Lee, & Deacon, 2015; Mond, Hay, Rodgers, Owen, & Beumont, 2004). To reduce demand characteristics, the prescreen survey for each sample included

questions worded such that the eligibility criteria are not immediately obvious, in order to ensure that potential participants will answer honestly. For example, both sample participants were asked: “When is the last time that you exercised for at least thirty minutes without stopping?” rather than “Have you engaged in at least thirty minutes of continuous exercise in the past week?”

In order to ensure a wide range of exercise patterns within the college undergraduate sample, a multistage screening and recruitment process was utilized. First, the following item was included in the SONA prescreen survey: “I engaged in strenuous exercise at least five days over the past week.” This item was taken from the Eating Pathology Symptoms Inventory (EPSI; Forbush et al., 2013). At the start of recruitment, the study was open to only those undergraduates who endorsed this item (n=100), and who had endorsed engaging in at least one thirty-minute bout of moderate to vigorous intensity exercise in the past week. This was done to ensure at least half of the participants endorsed intense exercise regimens. Then, beginning in November 2018, we lifted these two criteria for approximately 10% of the sample (n=20), in order to ensure sample heterogeneity to capture symptom picture of individuals who rarely engage in exercise. Finally, after enrolling these participants in the study, only the criterion regarding engaging in at least one thirty-minute bout of exercise in the past week was applied to study recruitment eligibility for the remainder of data collection (n=80). Thus, this recruitment strategy allowed for sample heterogeneity and reduced restriction of range on responses, allowing for more discrete profiles to be identified.

Procedure

Study participation began with informed consent. For the college undergraduate

sample, a full consent form was reviewed and signed in person, while for the MTurk eating psychopathology sample, an opt-in consenting procedure was used, such that the study and relevant risks were explained, and those who wished to participate indicated that they have read the consent and agreed to participate (i.e. no signature was obtained). For both samples, following consenting procedures, participants were directed to complete several self-report measures via REDCap (Harris et al., 2009), which is a secure online data collection site. Data collection for the college undergraduate sample was conducted on site in the Emotion and Psychopathology laboratory on the 5th floor of Tillett Hall at Rutgers University. These participants were compensated for study participation through 3 RPUs (6 RPUs are needed to pass the Rutgers introductory psychology course), and MTurk sample participants were paid $0.25 for the screening questionnaire, and $4.00 for the main study survey.

Measures

Both samples completed the following self-report questionnaires. Given that there were many questionnaires to complete, attention checks were used throughout the study to ensure that participants were paying careful attention to each of the questions asked (and were not merely clicking through in order to finish). This was consistent with previous studies using online samples for data acquisition (Tabri, Wohl, Eddy, & Thomas, 2017).

Demographics. General demographic information including age, race/ethnicity, sexual orientation, and income level (i.e. to approximate socioeconomic status), was collected. Both samples self-reported height and weight, in order to assess body mass index (BMI). Of note, previous studies have shown that individuals with eating

psychopathology (Doll & Fairburn, 1998; McCabe, McFarlane, Polivy, & Olmsted, 2001) are remarkably accurate at estimating their own height and weight.

Minnesota Leisure Time Physical Activity (MLTPA) Questionnaire (Taylor et al., 1978). The MLTPA questionnaire is used to assess energy expenditure during non-occupational physical activity (i.e. physical activity not completed as part of work-related duties). The MLTPA can be used to assess physical activity completed in the past year, but this study will assess physical activity completed only in the past week. Participants were provided with a list of types of physical activity and are queried whether they completed this activity in the past week, and (if applicable) how many minutes they spent doing the activity. A total variable assessing the total amount of time spent exercising in the past week was calculated.

Behavioral Regulation in Exercise Questionnaire (BREQ; Mullan, Markland, & Ingledew, 1997). The BREQ is a 15-item self-report assessment of motivational style for exercise. Based on motivational styles outlined in SDT, the BREQ has four subscales: external, introjected, identified, and intrinsic regulation. Participants answer the prompt "Why do you exercise?" by responding to each item on a 5-point Likert scale, ranging from 1 (not true for me) to 5 (very true for me). Previous studies have shown that the BREQ is a reliable measure of exercise motivation (Wilson, Rodgers, & Fraser, 2002).

UPPS-P Impulsive Behavior Scale (Lynam, Smith, Cyders, Fischer, & Whiteside, 2007). The UPPS is a 59-item self-report questionnaire of the five aspects of personality related to impulsivity: Negative Urgency, Positive Urgency, Lack of Premeditation, Lack of Perseverance, and Sensation Seeking. The UPPS-P also generates a total score. Individuals respond to each item using a 4-point Likert scale ranging from 1 (agree

strongly) to 4 (disagree strongly). The UPPS-P has been shown to be a valid measure of impulsivity (Cyders, 2013).

Difficulty with Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). The DERS is a 36-item self-report measure that assesses difficulties with emotion regulation in general. It includes six subscales in addition to the total score: Nonacceptance of Emotional Responses, Difficulties Engaging in Goal-Directed Behavior, Impulse Control Difficulties, Lack of Emotion Awareness, Limited Access to Emotion Regulation Strategies, and Lack of Emotion Clarity. Individuals indicate the degree to which each item pertains to them, by selecting a response on a 5-point Likert scale ranging from 1 (almost never) to 5 (almost always). These subscales have demonstrated good internal consistency and reliability (Gratz & Roemer, 2004).

Eating Pathology Symptoms Inventory (EPSI; Forbush et al., 2013). The EPSI is a 45-item self-report measure of pathological eating behaviors and beliefs over the past four weeks. Unlike other more traditional measures of eating psychopathology, the EPSI has been shown to have replicable factor structures and is more inclusive of assessing eating psychopathology in diverse populations (Coniglio et al., 2018). The EPSI includes 8 subscales: Body Dissatisfaction, Binge Eating, Cognitive Restraint, Restriction, Muscle Building, Purging, Negative Attitudes Toward Obesity, and Excessive Exercise. Individuals indicate their agreement with each item as it pertains to his or her eating behaviors and attitudes using a 5-point Likert scale, ranging from 0 (never) to 4 (very often). The EPSI has demonstrated good reliability and validity, importantly among both college men and women (Forbush, Wildes, & Hunt, 2014)

Compulsive Exercise Test (CET; Meyer et al., 2016). The CET is a 24-item self-

report measure that assesses the cognitive, behavioral, and emotional features of compulsive exercise. Individuals respond to each item using a 6-point Likert scale ranging from 0 (never true) to 6 (always true). These items generate five subscales: Avoidance and Rule-driven Behavior, Weight Control Exercise, Mood Improvement, Lack of Exercise Enjoyment, and Exercise Rigidity. The CET has demonstrated good internal consistency and reliability (Meyer et al., 2016).

Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003). The SRHI comprises 12 items that measure the habit strength of a single behavior. In this study, the behavior was defined as "exercise," and question stemmed included items like "Exercise is something that I do automatically" and "Exercise is something that would require effort not to do it." Participants rate their level of agreement with each of the 12 statements using a Likert scale that the authors of the scale recommend contain at least five response categories, anchored by "agree" and "disagree."

Center for Epidemiological Studies Depression Scale-Revised (CESD-R; Eaton, Muntaner, Smith, Tien, & Ybarra, 2004) The CESD-R is a 20-item self-report measure of depression. Individuals respond to each item by indicating how often he or she has experienced that symptom over the past two weeks using stems ranging from 0 (not at all) to 3 (nearly everyday for the 2 weeks). The clinical cutoff score for likely presence of depression is 16 (with total scores ranging from 0 to 60). The CES-D has been shown to have good reliability and validity (Eaton et al., 2004).

State-Trait Anxiety Inventory (STAI)- Trait Form (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The STAI-Trait is a 20-item measure that assesses general, stable levels of anxiety irrespective of their current state. Individuals rate their

level of agreement with statements using a 4-point scale ranging from 1 (almost never) to 4 (almost always).

Data Analytic Strategy

Aim 1: Latent Profile Analysis: We used mixture modeling techniques in order to identify homogenous groups of individuals based on a variety of similar traits. Specifically, latent profile analysis (LPA), which is a type of mixture modeling appropriate for cross-sectional data with continuous variables, was used. LPA was conducted using R, via the tidyLPA package. LPA is similar to factor analysis in that both are used to explain unobserved (i.e. latent) relationships between categorical dependent variables by creating factors or profiles based on similar qualities, except that LPA is used to classify groups of individuals in a sample, rather than traits. Ultimately, LPA can provide information about specific, homogenous groups within a sample, ranging from one group (i.e. indicating that all participants responded similarly to all measures), to a number of groups determined quantitatively. The goal of LPA is to identify the lowest number of latent profiles that accounts for variability among the individuals in the sample. The number of profiles to be extracted from the data was determined primarily by the Bayesian Information Criterion (BIC), but also by log likelihood and entropy. BIC and log likelihood measure goodness of fit with the number of profiles for each individual data set, while entropy measures the precision with which any given participant is placed into one profile (versus another). For each fit index, lower values indicate a better solution. The final LPA model indicates the proportion of the entire sample in each of the profiles, as well as the posterior probabilities that a given participant belongs in their assigned profile. In the present study, LPA was used in order

to identify latent groups of individuals based on habitual exercise behavior, compulsive exercise behavior, and motivation. Each sample underwent LPA separately in order to identify differences in profile formation between individuals with clinically relevant eating psychopathology and individuals who display no or sub-clinical psychopathology. Latent profile indicators included scores from the following measures and subscales: Behavioral Regulation in Exercise Questionnaire (4 subscales), Compulsive Exercise Test (5 subscales), and the Self-Report Habit Index adapted for exercise (1 total score). We anticipated that there would be between 2 and 6 groups based on these traits.

Aim 2: Traits Associated with Group Membership: In order to increase clinical utility of the identified profiles, profiles were compared on levels of eating psychopathology (EPSI; 7 subscales), levels of general psychopathology (CESD-R and STAI; 1 total score each), and levels of general emotion dysregulation (DERS; 1 total score), and dysregulated positive emotion (UPPS-PU; 1 score). One-way ANOVA was used to determine differences between the profiles that emerged from Aim 1. ANOVA was conducted in SPSS. To account for multiple (i.e. 11) comparisons, a Bonferroni correction was used, which set alpha at .004. Again, each sample was analyzed separately so as not to introduce additional variance and thus inadvertently create profiles based on eating disorder severity and not motivational style. Importantly, these analyses allowed for identifying not only the traits associated with pathological exercise, but also the features of those who are exhibiting healthy exercise.

III. Results

Each dataset was examined for any participants who failed attention checks. These participants were removed from analyses (n=13 in the MTurk sample and n=9 in the college sample). Because of a feature embedded into REDCap code that prevents participants from continuing on to the next survey if one or more fields is blank, no participants had any missing data.

Sample Descriptive Statistics

Within the college undergraduate sample, mean age was 18.60 (*SD*=2.0). Two (1%) individuals endorsed having a previous diagnosis of an eating disorder. Within the MTurk eating psychopathology sample, mean age was 34.75 years (*SD*=9.36). The sample reported an overall mean EDE-Q Global score of 3.69 (*SD*=0.90) out of 5.00. The cutoff score for the EDE-Q indicative of clinically significant eating psychopathology is 2.30 (Mond et al., 2004), and this was also the cutoff score for participation in our study. Fifty-six (27%) individuals endorsed having a previous diagnosis of an eating disorder. A full description of demographic information for each sample, including race, ethnicity, and income level is shown in Table 1.

Latent Profile Analysis

College Sample

In the college undergraduate sample, the three, four, and five profile solutions all yielded comparable fit indices. Both log likelihood and BIC steadily decreased from three to four to five-profile solutions, which was expected given that increasing the number of profiles invariably leads to better fit. In all three solutions, relative change in entropy value was minimal (entropy=0.93 in both the three and four profile solutions and 0.92 in

the five-profile solution). Ultimately, the three-profile solution was chosen as the best fitting solution because both the four and five profile solutions yielded at least one profile with a small number of participants (n<15). Thus, the three-profile solution was determined to provide the most parsimonious account of the variance present in the data while preserving the potential clinical utility of the findings.

Profile 1 (n=44) indicated a "sedentary" group and was characterized by a distinct lack of exercise enjoyment coupled with a strong lack of habitual exercise behavior. This group displayed marked absence of any rigid rules around exercising and denied any positive mood-altering benefits from engaging in exercise. Profile 2 (n=60) included the "subthreshold pathological exercise" group. This group was characterized by strong introjected motivation for exercise, as well as fixed, rigid rules around exercising, and endorsed that exercise was primarily used as a weight control strategy (rather than for enjoyment or other health benefits). Finally, profile 3 (n=96) included as the "healthy athlete" group. Profile 3 featured a strong enjoyment of exercise coupled with the strongest intrinsic motivation to exercise out of all three of the profiles. This group endorsed a slight tendency toward habitual exercise behavior (though not as much as Profile 2) and denied using exercise solely as a weight control strategy.

MTurk Eating Psychopathology Sample

In the MTurk eating psychopathology sample, as was the case in the college undergraduate sample, more than one solution yielded comparable fit indices (i.e. both the five and six profile solutions). In the five-profile solution, BIC was lower, but entropy was higher, whereas the converse was true for the six-profile solution. We decided to select the five-profile solution in this scenario for the sake of parsimony, as well as fewer

profiles having a higher clinical utility.

Profile 1 (n=61) consisted of a “non-athlete healthy” group, and membership in this profile was defined by a marked lack of compulsive exercise globally, as well as a slightly reduced lack of any variety of motivation to exercise. Profile 2 (n=36) included the “sedentary” group, and mirrored Profile 1 in the college sample. Membership in profile 2 was characterized primarily by the strongest absence of exercise enjoyment out of all the profiles, as well as an absence of rigid rules around exercising and the strongest lack of habitual exercise behavior. Profile 3 (n=29) was labeled as the “weight loss” group. In this group, membership was characterized by a distinct lack of exercise enjoyment, having externally regulated motivation for exercise, and exercising primarily for weight loss reasons. Profile 4 (n=20) included the “healthy athlete” group, and mirrored Profile 3 in the college sample. This group featured a unique combination of traits including strong habitual exercise behavior coupled with the strongest sense of intrinsic motivation for exercise out of all the profiles, while also showing a distinct lack of rigid rules around exercising. Finally, profile 5 (n=65) was labeled as the “pathological exercise/AN-like” profile. Profile 5 membership was primarily characterized by strong habitual exercise behavior, high intensity of rule-driven behaviors around exercise, strong reliance on exercise for mood improvement, and a tendency to enjoy exercise.

Traits Associated with Group Membership

College Sample

A one-way ANOVA was used to compare the 3 profiles on a variety of eating psychopathology-related traits. There was a significant difference between profiles on the EPSI Body Dissatisfaction subscale [$F(2,197)=30.76$, $p<.001$], the EPSI Binge Eating

subscale [$F(2,197)=8.68$, $p<.001$], the EPSI Cognitive Restraint subscale [$F(2,197)=31.95$, $p<.001$], the EPSI Purging subscale [$F(2,197)=25.97$, $p<.001$], and the EPSI Restriction subscale [$F(2,197)=13.32$, $p<.001$]. Tukey post-hoc tests indicated that profile 2 scored significantly higher ($M=15.92$, $SD=6.59$) on body dissatisfaction than profiles 1 ($M=11.73$, $SD=6.22$; $p=.002$) or 3 ($M=8.15$, $SD=5.57$; $p<.001$), on cognitive restraint ($M=7.97$, $SD=2.82$) than profiles 1 ($M=4.27$, $SD=3.14$; $p<.001$) or 3 ($M=4.75$, $SD=2.50$; $p<.001$), and on beliefs about purging efficacy ($M=2.82$, $SD=3.11$) than profiles 1 ($M=1.07$, $SD=2.33$; $p<.001$) or 3 ($M=0.32$, $SD=0.89$; $p<.001$). Profile 2 scored significantly higher ($M=11.52$, $SD=7.13$) than profile 3 ($M=7.44$, $SD=5.19$; $p<.001$) on frequency of binge eating, and profile 2 also scored higher ($M=7.90$, $SD=5.67$) than profile 3 ($M=4.01$, $SD=4.02$; $p<.001$) on restriction.

Regarding general psychopathology, a one-way ANOVA was used to compare the profiles on levels of depression, anxiety, and positive and negative emotion regulation difficulties. There was a significant difference between the profiles on the CESD-R [$F(2,197)=16.95$, $p<.001$], the STAI [$F(2,197)=27.38$, $p<.001$], and the DERS [$F(2,197)=16.55$, $p<.001$]. There was no significant difference between the profiles on the UPPS-PU, which measured dysregulated positive emotion. Tukey post-hoc tests showed that profile 3 ($M=6.94$, $SD=7.58$) scored significantly lower than profiles 1 ($M=14.61$, $SD=10.90$; $p<.001$) or 2 ($M=16.20$, $SD=13.80$; $p<.001$) on the CESD-R, and lower ($M=35.02$, $SD=9.31$) than profiles 1 ($M=45.32$, $SD=9.94$; $p<.001$) or 2 ($M=45.83$, $SD=11.41$; $p<.001$) on the STAI. Finally, profile 2 ($M=95.02$, $SD=25.81$) indicated a significantly greater difficulty regulating negative emotions than did profile 3 ($M=74.21$, $SD=19.52$; $p<.001$).

MTurk Eating Psychopathology Sample

In this sample, a one-way ANOVA was also used to compare the 5 profiles on a variety of eating psychopathology-related traits. There was a significant difference between profiles on the EPSI body dissatisfaction subscale [$F(4, 210)=9.12$, $p<.001$], the EPSI cognitive restraint subscale [$F(4, 210)=5.81$, $p<.001$], and the EPSI negative attitudes toward obesity subscale [$F(4, 210)=5.73$, $p<.001$]. Tukey post hoc tests revealed that profile 4 (M=14.50, SD=7.78) displayed significantly less body dissatisfaction compared to all the other profiles (M range=19.08 to 23.00; $p<.001$ for all), profile 3 (M=9.31, SD=1.89) displayed greater levels of cognitive restraint compared to profile 1 (M=7.08, SD=2.70; p=.001), and that profile 5 (M=12.61, SD=5.75) displayed significantly higher levels of negative attitudes toward obesity compared to profiles 1 (M=8.41, SD=5.65; p=.002) or 4 (M=7.05, SD=5.42; p=.001).

A one-way ANOVA was also used to compare the 5 profiles on levels of general psychopathology, including depression, anxiety, and positive and negative emotion regulation difficulties. There was a significant difference between the profiles on the CESD-R [$F(4, 210)=6.10$, $p<.001$], the STAI [$F(4, 210)=7.94$ $p<.001$], and the DERS total score [$F(4, 210)=7.02$, $p<.001$]. As with the college sample, there was no significant difference between the profiles on the UPPS-PU. Tukey post-hoc tests indicated that profile 4 (M=9.15, SD=9.89) was significantly less depressed than profile 5 (M=27.15, SD=18.62; p=.001), profile 3 (M=31.69, SD=19.47; $p<.001$), and profile 2 (M=27.53, SD=17.51; $p<.001$), and that profile 4 (M=36.40, SD=12.39) displayed significantly lower trait-level anxiety than all the other profiles (M range=36.40 to 55.24; $p\leq .001$ for all). Finally, profile 4 (M=77.10, SD=24.98) displayed significantly less

difficulty regulating emotions than profile 5 (M=103.43, SD=26.79; p=.001) or profile 3 (M=112.31, SD=23.52; p<.001).

IV. Discussion

The purpose of this study was to investigate the discreet types of motivation that comprise pathological exercise behavior in a non-clinical sample and in a sample of individuals with eating psychopathology. A secondary purpose of this study was to examine features of eating psychopathology, depression, anxiety, and emotion regulation difficulties associated with pathological exercise in each sample.

In the college undergraduate sample, three distinct profiles emerged: a sedentary profile (profile 1), a subthreshold pathological exercise group (profile 2), and a healthy athlete-like group (profile 3). Profile 2 (subthreshold pathological exercise group) scored significantly higher than the other two profiles on virtually all subscale measures of eating psychopathology and on a measure of emotion regulation difficulties. Profile 3 (the healthy athletic group) displayed significantly lower levels of depression and anxiety compared to the other two profiles. In the MTurk eating psychopathology sample, five profiles emerged: a non-athlete healthy group, a sedentary group, a weight loss group, an athlete group, and a pathological exercise/AN-like group. Profile 4 (the athlete group) displayed lowest levels of body dissatisfaction, whereas profile 3 (the weight loss group) showed highest cognitive restraint over eating, and profile 1 (the AN-like group) displayed highest levels of negative attitudes toward obesity. Profile 4 (the athlete group) also showed low levels of depression, anxiety, and emotion regulation difficulties compared to most groups.

Despite that the samples comprised two different populations of interest, there were notable similarities across the two LPA results. First, in both samples, a group emerged that featured high levels of intrinsic motivation for exercise coupled with low

rigidity around having rules about exercising. In both samples, this group enjoyed engaging in exercise, and did so in a relatively habitual fashion, though the habitual nature of exercise was not as strong as it was in the eating pathology group. This group was labeled the athlete group because of the relatively high exercise engagement coupled with intrinsic motivation for doing so. Intrinsic motivation for exercise has been associated with overall psychological wellbeing (Sebire, Standage, & Vansteenkiste, 2016). Recall that intrinsic motivation involves a sense of competence, autonomy, and relatedness to others with regards to the activity being performed (Deci & Ryan, 1985). Further, that this group was associated with low eating disorder psychopathology supports the notion that this type of motivation may be protective.

Conversely, a sedentary group also emerged in both samples. This group included individuals whose exercise motivation was primarily extrinsic, and who accordingly exhibited a strong dislike of exercise. Extrinsic motivation involves exercising due to outside influences (e.g., "I exercise because other people say I should"). It is clear how the sense of autonomy so prominently featured in intrinsic motivation is virtually absent here. Unsurprisingly, extrinsic motivation has been associated with the lowest levels of physical activity (Brunet & Sabiston, 2011). Although this group did not have objectively high levels of eating or general psychopathology, this group represents a non-ideal profile in terms of promoting long-term, sustainable exercise engagement.

With regards to eating psychopathology, both an AN-like and a weight loss profile emerged in the MTurk sample, whereas just one pathological exercise group emerged in the college sample. In the AN-like profile from the MTurk sample, identified regulation (i.e. engagement in an activity because one's values align with the activity)

was the primary motivation for exercise. Identified regulation is considered closer to intrinsic motivation than is introjected regulation. This is contrary to previous findings that have found that introjected regulation (i.e. exercising to avoid feelings of guilt from not exercising) is associated with eating psychopathology (Thøgersen-Ntoumani & Ntoumanis, 2007). Notably, however, SDT motivational styles have not been previously applied to examining motivation for exercise among those with AN specifically. Further, this finding makes sense within the larger framework of the ego-syntonic nature of AN. Identified regulation is closely reflective of the nature of AN psychopathology, given that these individuals have often adopted pursuit of weight loss as a central component of their identity, such that exercise is pursued more fervently than simply to avoid guilt.

In the MTurk sample, the weight loss profile demonstrated that extrinsic motivation was primary. Importantly, however, a key difference between the weight loss profile and the sedentary profile was that the former group also displayed concurrent introjected motivation (though not as strongly as extrinsic motivation), engagement in strict, rule-driven behaviors regarding exercise (though not as strongly as the AN-like group), and engagement in exercise for weight control reasons. It is clear from both this profile and the sedentary profile in the MTurk sample, that extrinsic motivation is a suboptimal motivation style for increasing lifelong physical activity while staving off eating disorder psychopathology.

The college sample pathological exercise group displayed introjected motivational style, consistent with the findings cited throughout this discussion on introjected motivation and eating disorder psychopathology. In reconciling this finding with the other motivational styles observed in the AN-like and weight loss profiles from the eating

psychopathology sample, it may be that introjected motivation is a risk factor for eating disorder development, but that throughout the illness course, this motivation either becomes more central to one's identity (and thus identified motivation becomes primary) or becomes a chore to maintain despite weight loss goals (and thus extrinsic motivation becomes primary).

These observed differences in motivation for exercise across profiles and across samples provide insight into potentially relevant features of pathological exercise that may be malleable treatment targets. Pathological exercise in the context of eating disorders lacks definitional consistency, which has hindered the development of treatment for pathological exercise in evidence-based, manualized eating disorder treatments (Fairburn, 2008; Lock & Le Grange, 2013). Findings presented in this study suggest that targeting motivation to more closely align with intrinsic style may lead to a reduction in the intensity or frequency of pathological exercise behavior.

Abstinence from exercise heretofore has been most commonly prescribed during eating disorder treatment, though this practice has recently been called into question (Davies, 2014; Quesnel et al., 2018). Accordingly, two recent pilot trials have begun to assess the effects of incorporating physical activity into eating disorder treatment in both inpatient (Dittmer et al., 2018) and outpatient (Hay et al., 2018) settings. Both of these studies included additional physical activity-based sessions featuring low-intensity physical activity in conjunction with a standard course of CBT. Surprisingly, in addition to being highly acceptable and feasible from the perspective of the patients, incorporating physical activity had positive effects on BMI and weight gain in both settings.

With the success of these trials thus far, the attitude towards exercise in the field

of eating disorders has shifted from advocating for abstinence to advocating for sustainable, flexible exercise. Accordingly, the Safe Exercise at Every Stage (SEES) guidelines are in the final stages of development, and will soon be made publicly available to help clinicians make informed decisions on how to help their patients safely re-engage with exercise during treatment (Cooper, Dobinson, & Quesnel, 2019). Briefly, the SEES guidelines provide exercise prescriptions, in the form of appropriate length and metabolic equivalents (METs), for individuals based on their cardiovascular health and hormonal profile. One drawback to the SEES guidelines is that motivation for exercise is not assessed at any stage, and thus it is definitionally possible to engage in low intensity exercise that is still compulsive and rigid. Findings from the present study suggest that motivation for exercise may be a worthwhile addition to the SEES guidelines in order to ensure that compulsive exercise is not inadvertently being allowed to continue, and instead is addressed directly and early in treatment.

Limitations

The findings from this study must be considered in light of its limitations. First, LPA by nature involves assessing relative fit to the data across model comparisons. Instead of providing absolute best model fit, it provides a framework for exploratory data analysis by which future hypotheses can be generated. Despite this, each profile was selected based on empirically-derived fit indices generated from validated measures. Further, identifying motivation associated with pathological exercise in the college undergraduate sample allowed for greater insight into etiological trajectory of eating disorder psychopathology, but was hindered by the cross-sectional nature of the study.

Several methodological limitations of exercise assessment must also be reported.

First, the method of habit assessment is limited by the self-report nature of this study. The self-report habit index is a well-validated measure of habitual behavior that has been applied to the field of eating disorders via measurement of habitual food restriction (Coniglio et al., 2017; Walsh, 2013). Exercise, however, requires effortful planning and cognitive control, both of which exist outside the confines of the construct of habit. It may instead be that the items on the habit index (e.g., "Exercise is something that would feel weird if I didn't do it") are actually measuring a less pathological dimension of compulsivity. Further, as with most other health behaviors, exercise is prone to recall bias. To counteract this bias, we used a well-validated follow back measure and asked participants only to recall the prior week (as opposed to time periods more distant than the past week, which may be difficult to remember). We also did not take exercise frequency into account when creating the profiles via LPA. This was to reduce bias in inadvertently differentiating those who may overreport exercise behavior because it was so salient (i.e. led to weight loss or extreme reduction of negative affect) versus those for whom exercise is so engrained in their daily routine that they may omit exercise they performed (i.e. as may be the case for athletes who may not count shooting baskets, for example, as a form of exercise).

Finally, that differences in positive emotion dysregulation (as measured by the UPPS-PU) were not significantly different across groups may have been affected by the self-report, cross-sectional nature of the study as well. Experience sampling would have been a superior method of assessing the positive emotion preceding, during, and directly following a bout of exercise. Instead, our study examined trait-level differences in positive emotion dysregulation, which may be less relevant. It is worth mentioning,

however, that despite the lack of differences in UPPS-PU, it is clear that lack of negative emotion (i.e. lower levels of depression and anxiety) were relevant to exercise adherence.

Future Directions

The findings from this study provide many promising avenues for additional research. First, in order for motivation to be a feasible target for intervention, longitudinal studies are essential. We must first understand the degree to which exercise motivation precedes the development of eating disorder psychopathology. It may also be that motivation is context-dependent and that some individuals may experience an array of different motivational styles depending on the type of exercise being performed (e.g., lifting weights alone versus playing an intramural soccer game).

Second, the degree to which these findings can be generalized to other relevant but understudied populations, such as males and individuals who identify as transgender, needs to be assessed. Although females have higher rates of eating disorders compared to males, epidemiological studies of eating disorders in males show that rates are increasing (Sweeting et al., 2015). Males exhibit body image concerns just as females do and may also use other harmful means to alter their physical appearance through exercise, such as anabolic steroids and other performance-enhancing drugs (Murray, Griffiths, Mond, Kean, & Blashill, 2016). For example, the muscle building scale from the EPSI may be much more relevant for males than females. With respect to transgender individuals, there is mounting evidence that body image concerns (Brewster, Velez, Breslow, & Geiger, 2019; McGuire, Doty, Catalpa, & Ola, 2016) and unhealthy weight control practices (Guss, Williams, Reisner, Austin, & Katz-Wise, 2017) are highly prevalent in this population.

Conclusions

This study adds to the literature on pathological exercise in eating disorders by introducing motivation as a new dimension that is not only descriptive of pathological exercise but also may be a useful treatment target. To date, no study has mapped the motivational styles outlined in SDT on to the motivation for pathological exercise present in AN specifically. Findings show that identified regulation may characterize exercise motivation for those with AN, while intrinsic motivation may be protective from eating disorder psychopathology. Overall, our findings support the growing sentiment that teaching healthy, sustainable exercise is preferable to advocating for abstinence from exercise during and after eating disorder treatment.

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Table 1.
Demographic information

	College Undergraduate Sample *n* = 200	MTurk Eating Psychopathology Sample *n* = 211
Age M (SD)	18.6 (2.0)	34.75 (9.4)
Hispanic Ethnicity N (%)	24 (12)	23 (11)
Race N (%)*		
White	118 (59)	158 (75)
Black/African American	10 (5)	18 (8.5)
Native Hawaiian/Pacific Islander	0 (0)	0 (0)
Native American/Native Alaskan	1 (0.5)	3 (2)
Asian	51 (25.5)	27 (12.8)
Other	23 (11.5)	13 (6.2)
More than one race	16 (8.0)	4 (1.9)
Income N (%)		
Less than $19,999	26 (13)	27 (12.8)
$20,000 to $29,999	14 (7)	33 (15.6)
$30,000 to $39,999	5 (2.5)	34 (16.1)
$40,000 to $49,999	21 (10.5)	21 (10.0)
$50,000 to $74,999	27 (13.5)	42 (19.9)
$75,000 to $99,999	27 (13.5)	31 (14.7)
$100,000 or more	80 (40)	23 (10.9)
Eating Disorder Diagnostic History N (%)		
Anorexia nervosa	0 (0)	12 (5.7)
Bulimia nervosa	1 (0.5)	16 (7.6)
Binge eating disorder	0 (0)	12 (5.7)
Other specified feeding or eating disorder	1 (0.5)	16 (7.6)
No prior history of eating disorder	198 (99)	155 (73.4)

**Individuals were permitted to select more than one race*

Table 2.
Model fit indices for latent profile analysis

College Undergraduate Sample

K	*Log Likelihood*	*BIC*	*Entropy*
2	2557.61	5279.47	0.99
3	**2471.91**	**5166.35**	**0.93**
4	2384.92	5050.64	0.93
5	2343.10	5025.29	0.92
6	2320.85	5039.08	0.90

MTurk Eating Psychopathology Sample

K	*Log Likelihood*	*BIC*	*Entropy*
2	6232.10	12630.11	0.95
3	6148.25	12521.28	0.93
4	6074.10	12431.86	0.92
5	**6029.46**	**12401.45**	**0.93**
6	6014.56	12430.50	0.91

Note. K=number of profiles, BIC=Bayesian Information Criterion

Table 3.
College undergraduate sample latent profile characteristics

	Profile 1 *Sedentary* M (SD)	**Profile 2** *Subthreshold Pathological Exercise* M (SD)	**Profile 3** *Healthy Athlete* M (SD)	F (df), p value
EPSI Body Dissatisfaction[a]	11.7 (6.2)	15.9 (6.6)	8.2 (5.6)	30.76 (2,199), <.001
EPSI Binge Eating[b]	9.1 (5.8)	11.5 (7.1)	7.4 (5.2)	8.68 (2,199), <.001
EPSI Cognitive Restraint[a]	4.3 (3.1)	8.0 (2.8)	4.8 (2.5)	31.95 (2,199), <.001
EPSI Purging[a]	1.1 (2.3)	2.8 (3.1)	0.3 (0.9)	25.97 (2,199), <.001
EPSI Restriction[b]	6.8 (5.1)	7.9 (5.7)	4.0 (4.0)	13.32 (2,199), <.001
EPSI Muscle Building	1.9 (2.6)	4.2 (3.8)	3.5 (3.8)	5.39 (2,199), .005
EPSI Neg. Attitudes toward Obesity	4.1 (4.0)	6.3 (4.8)	4.2 (3.9)	5.66 (2,199), .004
Center for Epidemiological Studies Depression Scale – Revised[c]	14.6 (10.9)	16.2 (13.8)	6.9 (7.6)	16.95 (2,199), <.001
State/Trait Anxiety Inventory (Trait)[c]	45.3 (9.9)	45.8 (11.4)	35.0 (9.3)	27.38 (2,199), <.001
Urgency, Premeditation, Perseverance, Sensation-seeking, and Positive Urgency	121.8 (21.7)	124.9 (19.5)	120.5 (20.2)	2.86 (2,199), .060
Difficulties in Emotion Regulation[b]	83.0 (21.4)	95.0 (25.8)	74.2 (19.5)	16.55 (2,199), <.001

Note. EPSI=Eating Pathology Symptoms Inventory; [a]Profile 2 scored higher than Profiles 1 and 3; [b]Profile 2 scored higher than Profile 3; [c]Profile 3 scored lower than Profiles 1 and 2

Table 4.
MTurk eating psychopathology sample latent profile characteristics

	Profile 1 *Non-athlete healthy* M (SD)	**Profile 2** *Sedentary* M (SD)	**Profile 3** *Weight loss* M (SD)	**Profile 4** *Healthy Athlete* M (SD)	**Profile 5** *Pathological exercise/ AN-like* M (SD)	F (df), p value
EPSI Body Dissatisfaction[a]	19.1 (5.3)	21.2 (5.1)	23.0 (4.9)	14.5 (7.8)	21.9 (5.8)	9.12 (4,210), <.001
EPSI Binge Eating	12.0 (7.2)	15.5 (7.7)	18.0 (9.3)	8.8 (8.1)	15.2 (9.1)	5.21 (4,210), .001
EPSI Cognitive Restraint[b]	7.1 (2.7)	7.3 (2.3)	9.3 (1.9)	7.8 (2.7)	8.6 (2.6)	5.81 (4,210), <.001
EPSI Purging	4.9 (5.4)	6.9 (5.8)	9.0 (7.7)	3.4 (4.4)	7.8 (6.5)	4.41 (4,210), .002
EPSI Restriction	8.0 (5.7)	8.3 (5.1)	7.4 (5.4)	7.5 (5.3)	9.5 (6.4)	0.98 (4,210), .420
EPSI Muscle Building	3.2 (4.0)	3.1, (3.1)	4.3 (5.1)	5.2 (4.9)	4.8 (4.5)	1.90 (4,210), .110
EPSI Neg. Attitudes toward Obesity[c]	8.41 (5.7)	10.5 (5.6)	9.8 (6.8)	7.1 (5.4)	12.6 (5.8)	5.63 (4,210), <.001
Center for Epidemiological Studies Depression Scale – Revised[d]	23.5 (15.1)	27.5 (17.5)	31.7 (19.5)	9.2 (9.9)	27.2 (18.6)	6.10 (4,210), <.001
State/Trait Anxiety Inventory (Trait)[a]	49.5 (11.2)	52.0 (11.9)	55.2 (11.4)	36.4 (12.4)	51.7 (13.9)	7.94 (4,210), <.001
Urgency, Premeditation, Perseverance, Sensation-seeking, and Positive Urgency	124.3 (24.7)	132.1 (30.8)	133.8 (29.0)	119.7 (28.6)	133.8 (31.7)	1.65 (4,210), .160
Difficulties in Emotion Regulation[e]	91.9 (24.7)	97.8 (28.7)	112.3 (23.5)	77.1 (25.0)	103.4 (26.8)	7.02 (4,210), <.001

Note. AN=anorexia nervosa; EPSI=Eating Pathology Symptoms Inventory; [a]Profile 4 scored lower than all the other profiles; [b]Profile 3 scored higher than Profile 1; [c]Profile 5 scored higher than Profiles 1 and 4; [d]Profile 4 scored lower than Profiles 2, 3, and 5; [e]Profile 4 scored lower than Profiles 3 and 5

Figure 1. Spectrum of exercise motivation from Self-Determination Theory (SDT)

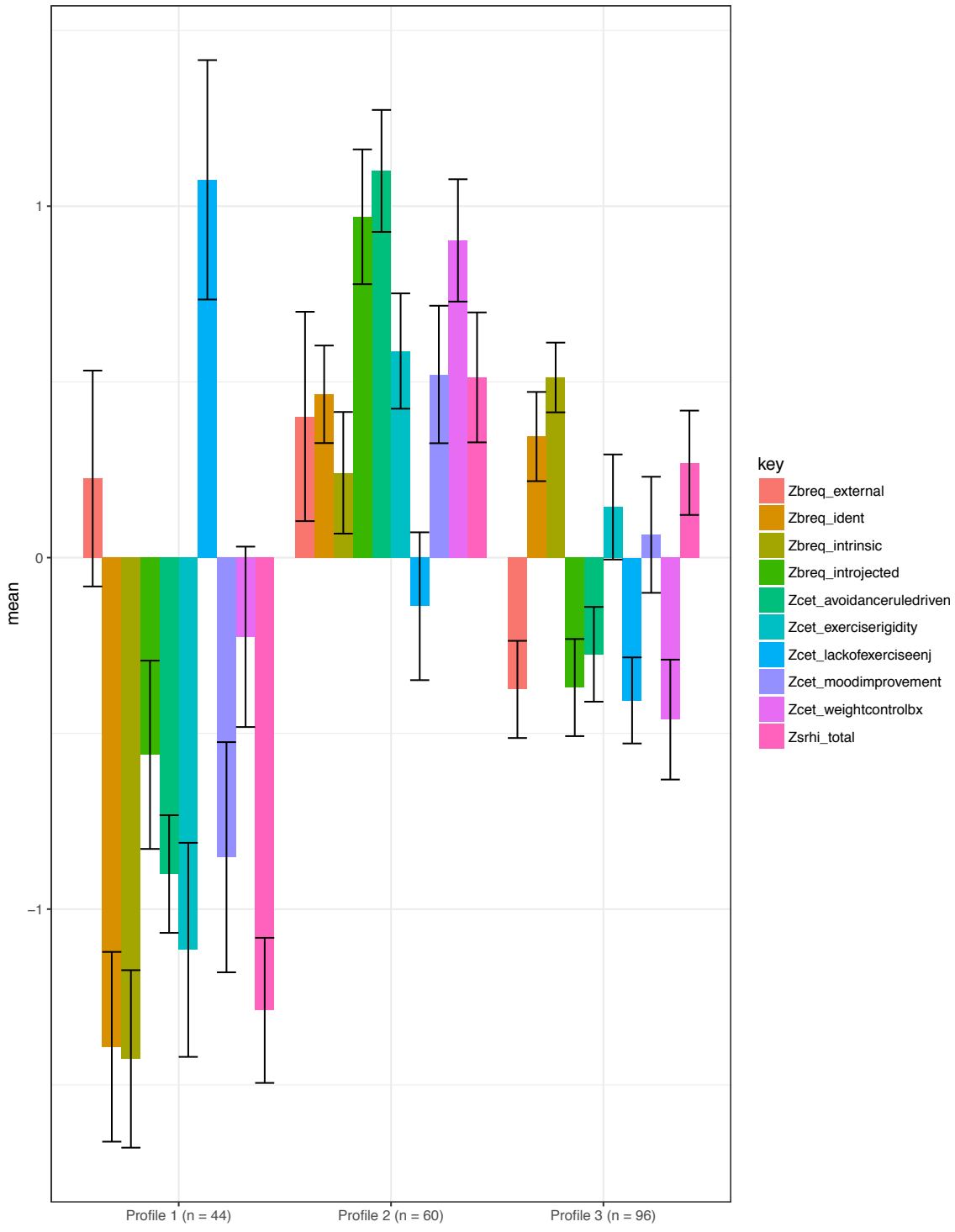

Figure 2. College undergraduate sample latent profile analysis of Z scored variables

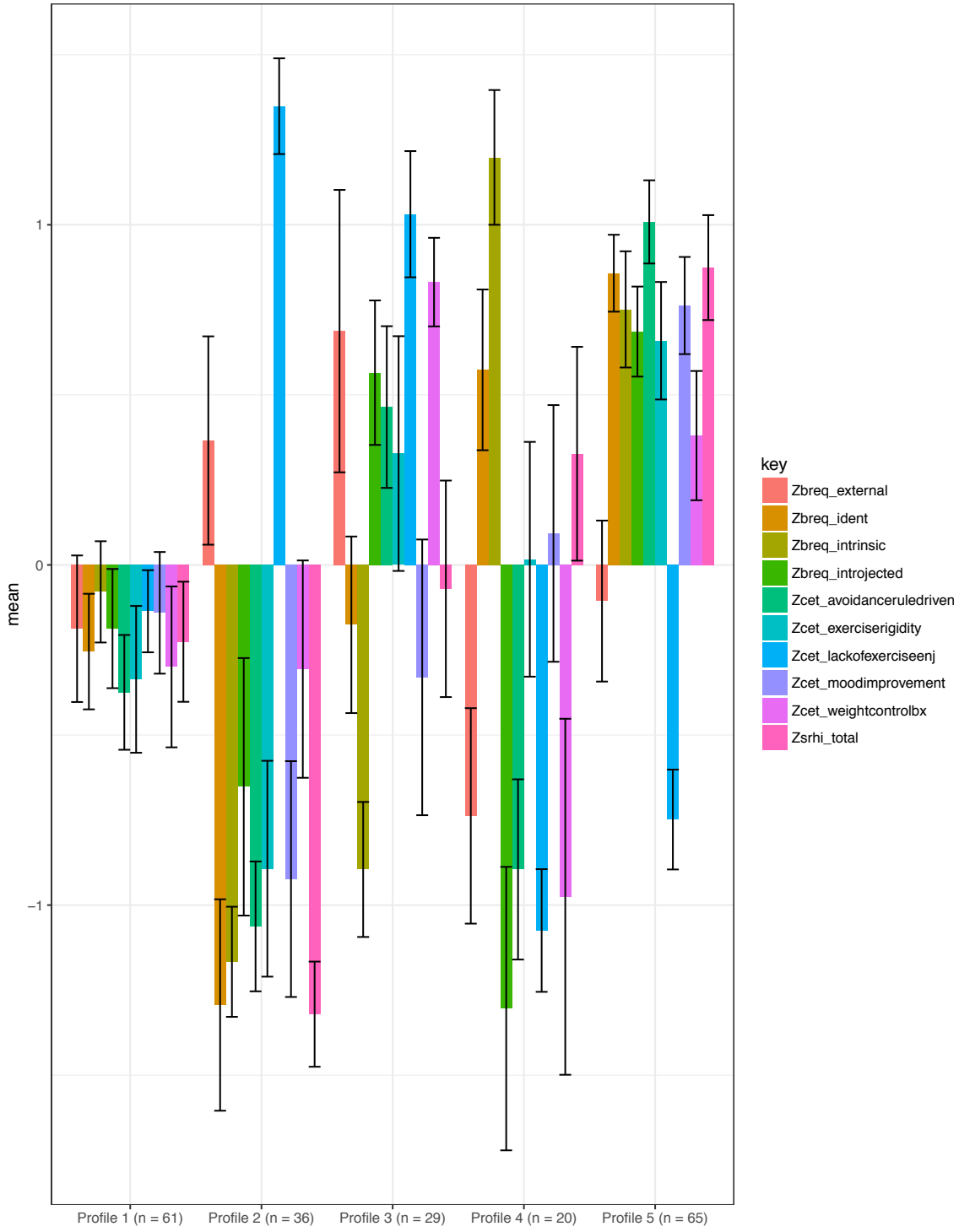

Figure 3. MTurk eating psychopathology sample latent profile analysis of Z scored variables