

Development and validation of a scale for the tendency to exercise in response to mood, eating, and body image cues: The Reactive Exercise Scale (RES)

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Abstract

Purpose: Earlier work on engaging in physical exercise when experiencing negative affect demonstrated robust associations with eating disorder (ED) behaviors and attitudes; however, measurement of the behavior was primitive. We report on the development of a self-report measure, the Reactive Exercise Scale (RES), that disentangles the tendency to engage in exercise in response to negative mood cues from the tendency to engage in exercise in response to eating and body image cues, which themselves may be associated with negative mood. The measure also assesses exercising in response to positive mood cues.

Method: Exploratory factor analysis (FA) guided item and factor selection. Confirmatory FA in an independent sample supported a 3-factor solution – exercising in response to negative mood cues, eating and body image cues, and positive mood cues.

Results: Results supported the construct validity of the RES subscales and indicated that exercising in response to negative mood cues may not uniquely relate to most aspects of ED psychopathology when accounting for eating and body image cues, which themselves are associated with negative mood.

Conclusion: The RES allows for testing the unique relation of exercise to regulate negative emotion with ED constructs independent from the appearance-related motives for which exercise may also be used.

What Is Already Known On This Subject?

Exercise behavior is often disrupted in individuals with EDs and itself may be an important ED behavior. The aspects of exercise that explain its relation to ED features, and what differentiates exercise as it occurs within and outside EDs, remains an important topic of study.

What This Study Adds?

This study contributes a novel measure of the tendency to engage in exercise in response to specific cues: negative emotion, eating/body image, and positive emotion. Together, these subscales may aid in identifying the specific components of exercise that relate to ED features from those that may occur both within and outside of EDs.

Introduction

Exercise has mood-regulating and stress-reducing effects (Cash et al., 1994; Thayer et al., 1994; Taranis et al., 2011). Specifically, exercise is associated with increases in positive affect and decreases in negative affect (Giacobbi et al., 2006; Bodin & Martinsen, 2004), including reducing anxiety (Asmundson et al., 2013; Schuch et al., 2016). Generally speaking, exercise interventions have beneficial physical and psychological effects in individuals with psychiatric disorders (Szuhany et al., 2015; Sachs & Buffone, 1984). Among individuals with eating disorders (EDs), although the primary motive of compulsive exercise is to control shape and weight (Dalle Grave et al., 2008), individuals often report using exercise to regulate mood (Meyer et al., 2011), and evidence supports pre- to post-exercise decreases in negative emotion in individuals with

EDs (Engel et al., 2013; Noetel et al., 2016). Thus, the mood regulating effects of exercise can be understood as one of its benefits; however, exercise behavior as it occurs among individuals with EDs has been the subject of scrutiny for its possible role as a problematic behavior targeted for reduction in treatment (e.g., Martenstyn et al., 2021; see also Cook & Leininger, 2017; Mathisen et al., 2021; Quesnel et al., 2018).

In fact, exercising in response to negative affect, which may reflect using exercise to regulate emotions, is both common and robustly associated with ED psychopathology. For instance, 58% of college students reported having ever engaged in exercise because they were experiencing negative mood, and these students were much more likely to endorse current ED thoughts and behaviors (De Young & Anderson, 2010). Distinguishing participants by whether they ever exercised in response to negative mood resulted in large effects on measures of ED behaviors and psychopathology, in some cases being the only unique predictor of these outcomes when included among existing exercise dimensions known to be related to ED constructs (e.g., obligatory exercise). Importantly, in the cited study, exercise in response to negative mood was assessed with the use of a single dichotomous item, which precluded thorough analysis of the relations between ED constructs and the dimension possibly underlying this dichotomous item. The goal of the studies we report on here was to develop a measure of this dimension in addition to other similar dimensions that might be important for clarifying the relations between the tendency to exercise in response to negative mood cues and ED constructs. This work has the potential to support research on the emotion regulatory aspects of exercise and the associations of such exercise with ED psychopathology, clarifying the extent to which exercise itself may be a treatment target and how it might best be altered to support adaptive behavior.

To date, most concepts of exercise in association with ED psychopathology have focused on the extent to which individuals feel compelled or obligated to engage in the exercise, and a variety of terms have been used to describe these aspects of exercise (Meyer & Taranis, 2011). For instance, obligatory exercise involves experiencing negative emotion, such as feelings of guilt, depression, and anxiety, as a consequence of *not* exercising (Meyer et al., 2011). Exercising is understood to alleviate or prevent such negative emotional consequences among individuals who engage in obligatory exercise, indicating that it may also function to regulate emotion (Stice, 1994; Whiteside et al., 2007). Obligatory exercise demonstrates a number of associations with ED variables that illustrate its importance as a way of conceptualizing problematic exercise in the context of EDs. Obligatory exercise is undertaken more frequently and intensely than non-obligatory exercise, and individuals who engage in obligatory exercise spend more time thinking about exercise (Steffen & Brehm, 1999). A systematic review concluded that obligatory exercise is associated with heightened eating and weight psychopathology (Meyer et al., 2011). In fact, obligatory exercise was reported by 20-80% of individuals with EDs (Shroff et al., 2006) and associated with poorer treatment outcome, illness chronicity, and severity of psychopathology (Dalle Grave et al., 2008; El Ghoch et al., 2013). Importantly, *why* individuals' emotions are related to their exercise behavior has not been central to investigations of exercise in the context of ED psychopathology.

Individuals may feel compelled to exercise, and feel guilty if they do not exercise, for a variety of reasons, including reasons related to their eating behaviors and body shape and weight, as well as reasons unrelated to eating, shape, and weight (e.g., athletic performance; Karr et al., 2013). However, because ED behaviors

and body shape and weight concerns are themselves associated with negative emotion (e.g., Heron et al., 2014; Leahey et al., 2011), investigations of the relations between negative emotion, exercise, and ED psychopathology should account for eating behavior- and body image-driven exercise. In the absence of parsing these effects, evidence might indicate relations between negative emotion, exercise, and ED psychopathology that are better explained by the eating and body image exercise motives held by individuals with ED psychopathology who exercise, which themselves are associated with negative mood. Thus, the goal of the following studies was to develop a measure - the Reactive Exercise Scale (RES) - for assessing the dimension of negative mood cued exercise that also assesses eating cued and body image cued exercise so that the unique relations of negative mood cued exercise and ED psychopathology can be examined. In addition, we aimed to assess positive mood cued exercise to test whether the valence of mood leading to exercise is important to consider and to aid in establishing the construct validity of the scale.

Study 1

In Study 1, we aimed to develop an initial item pool and conduct an exploratory factor analysis (EFA) to gather preliminary evidence of the convergent and discriminant validity of the RES factors in an undergraduate student sample. We wrote items intending to characterize tendencies to engage in exercise in response to certain distinct moods, thoughts, and perceptual cues. These included negative mood cued exercise, eating cued exercise, body image cued exercise, and positive mood cued exercise. Broadly, we hypothesized that: (a) negative mood cued exercise would be positively associated with measures of psychopathology and emotion regulation, but not with non-mood related aspects of exercise; (b) eating cued and body image cued exercise would be positively associated with ED psychopathology, but not with aspects of emotion regulation; and (c) positive mood cued exercise would be negatively associated with measures of psychopathology, and not associated with emotion regulation.

Method

Procedure

The local institutional review board approved this study. Undergraduate students from a Northern Plains university participated in an online study (hosted on Qualtrics) for credit toward course requirements that was advertised as a survey study of eating and exercise. After providing informed consent, participants completed a series of self-report measures.

Participants

Participants were 315 undergraduate students. Their mean (*SD*) age was 19.6 (3.0) years and 82.5% identified as female. Their mean (*SD*) body mass index (BMI) based on self-reported height and weight was 23.4 (4.0) kg/m². The majority identified as non-Hispanic, White (91.1%), with fewer identifying as Black/African American (1.0%), Asian (2.9%), Native American (1.3%), Hispanic (0.6%), or other (1.3%; 1.9% did not provide information about their race/ethnicity).

[Table 1 here]

Measures

Reactive Exercise Scale (RES). The initial version of the RES contained 42 items rated on a visual analog scale, with endpoints anchored by “*Not at all*” and “*Extremely*”. The instructions asked participants to “*Please read each of the following statements. Using the scale provided, select the point on the line to indicate how likely it is that you would exercise given the situation described in the statement.*” Items are listed in Table 1. We wrote the initial RES items using a top-down approach to capture four domains that might cue exercise behavior. They were: (a) exercising in response to negative mood cues; (b) exercising in response to eating cues; (c) exercising in response to body image cues; and (d) exercising in response to positive mood cues.

Difficulties in Emotion Regulation Scale (DERS). The DERS (Gratz & Roemer, 2004) is a 36-item self-report measure of dimensions of emotion regulation, measured on six facets: nonacceptance of emotional responses ($\alpha = .92$); difficulty engaging in goal-directed behavior ($\alpha = .89$); impulse control difficulties ($\alpha = .86$); lack of emotional awareness ($\alpha = .84$); limited access to emotion regulation strategies ($\alpha = .91$); and lack of emotional clarity ($\alpha = .77$), and a total score ($\alpha = .94$). Each item is rated on a scale of 1 (*Almost never*) to 5 (*Almost always*), with higher scores indicative of greater difficulties in emotion regulation.

Positive and Negative Affect Schedule (PANAS-X). The PANAS-X (Watson & Clark, 1999) contains measures of negative and positive affect in addition to several more specific facets. We included the two 10-item affect scales to measure positive affect ($\alpha = .89$) and negative affect ($\alpha = .89$) and used the “in general” timeframe in the instructions. We also included 13 additional items that allowed for the measurement of sadness ($\alpha = .90$), guilt ($\alpha = .91$), and fatigue ($\alpha = .88$). Each item is rated on a 5-point scale ranging from 1 (*Very slightly or not at all*) to 5 (*Extremely*). Higher scores are indicative of more intense affect.

International Personality Item Pool (IPIP). The 142 items from the IPIP (Goldberg et al., 2006) approximate Cloninger et al.’s (1994) Temperament and Character Inventory dimensions of novelty-seeking ($\alpha = .82$), harm avoidance ($\alpha = .80$), and reward dependence ($\alpha = .83$) and Carver and White’s (1994) Behavioral Inhibition and Activation Scales. The behavioral inhibition system (BIS) corresponds to motivation to avoid aversive outcomes, and the behavioral activation system (BAS) corresponds to motivation to approach goal-oriented outcomes. This measure contains four subscales, one for measuring the BIS dimension ($\alpha = .82$), and three measures of the BAS dimension (Reward Responsiveness [BAS-RR; $\alpha = .67$], Drive [BAS-D; $\alpha = .63$], and Fun-Seeking [BAS-FS; $\alpha = .79$]). IPIP items were self-assessed using a 1 (*Very inaccurate*) to 5 (*Very accurate*) rating scale. For all scales, higher scores indicate higher standing on the construct.

Obligatory Exercise Questionnaire (OEQ). The OEQ (Pasman & Thomson, 1988) is a 20-item self-report questionnaire consisting of statements about the extent to which an individual feels obligated or compelled to exercise. Statements are rated on a 4-point scale ranging from 1 (*Never*) to 4 (*Always*), with higher scores indicating more obligatory exercise. Cronbach’s alpha for the OEQ was .90.

Reasons for Exercise Inventory (REI). The REI (Silberstein et al., 1988) is a 24-item self-report questionnaire that contains statements about motivation for exercise. Participants rate their motivations to engage in exercise on a 7-point scale ranging from 1 (*Not at all important*) to 7 (*Extremely important*). The subscales

of reasons for exercise include weight control ($\alpha = .54$); fitness ($\alpha = .91$); health ($\alpha = .87$); mood ($\alpha = .84$); physical attractiveness ($\alpha = .87$); enjoyment ($\alpha = .92$); and body tone ($\alpha = .84$).

Statistical Analyses

We conducted an EFA using principal axis factoring with varimax rotation in SPSS (IBM, 2019) to maximize variance in factor loadings and aid in achieving an interpretable solution in this early stage despite the likelihood that factors would be correlated (e.g., Kim & Mueller, 1978) to identify dimensions present in the RES. Pairwise exclusion was used for missing values. We visually examined the scree plot (Figure 1) and performed a parallel analysis (Horn, 1965) to determine the optimal number of factors to extract. Items that loaded above 0.60 with cross-loadings below 0.32 were automatically retained (Costello & Osborne, 2005; Tabachnick & Fidell, 2013). We used partial correlations – controlling for RES subscales, sex, and BMI – to assess convergent and discriminant validity, using $p < .05$ as the statistical significance threshold to maximize detected relationships.

[Figure 1 here]

Results

Sample size per RES item ranged from 269-296. The Kaiser-Meyer-Olkin measure of sampling adequacy was .959, above the recommended value of .6 (Costello & Osborne, 2005), and Bartlett's test of sphericity was significant ($\chi^2 = 12359.51$; $df = 861$; $p < .001$), indicating that the data were appropriate for an EFA. Examination of the scree plot, initial eigenvalues, and results of a parallel analysis all indicated that three factors should be extracted (Figure 1). Together, these three factors explained 67.09% of the inter-item variance. We retained five items (items 4, 8, 9, 14, and 22; Table 1) despite cross-loadings greater than 0.32 (Tabachnik & Fidell, 2013), because we judged their content to be central to the construct being measured or important for covering the breadth of the construct (i.e., they were critical for content validity). In total, we retained 25 of the 42 items.

[Table 2 here]

In Table 2, we provide means, standard deviations, bivariate Pearson correlations, and internal consistencies for the three extracted factors. The first extracted factor is represented by 12 items and indicates the tendency to engage in exercise in response to negative mood cues. The second extracted factor is represented by 10 items and indicates the tendency to engage in exercise in response to eating and body image cues. The third extracted factor is represented by three items and indicates the tendency to engage in exercise in response to positive mood cues. Because the eating and body image cues resided on the same factor, we also examined a four-factor solution. However, extracting a fourth factor did not lead the eating items to separate from the body image items. Instead, there was no clearly discernible pattern to the item-factor configuration, further indicating that the three-factor solution fit better.

[Table 3 here]

In Table 3, we provide preliminary evidence of convergent and discriminant validity. The negative mood factor was positively associated with the OEQ total score and the REI mood subscale but negatively associated with the REI weight control subscale. It was also positively associated with the DERS impulse and total scores and PANAS sadness facet. The negative mood factor was not associated with behavioral activation, positive affect, novelty seeking, reward dependence, or fitness and health. The eating and body image factor was positively associated with REI weight control, BIS/BAS anxiety, PANAS negative affect and guilt facet, and IPIP novelty seeking. It was not associated with behavioral activation, positive affect, novelty seeking, reward dependence, and REI fitness and health motives. Finally, the positive mood factor was positively associated with OEQ obligatory exercise and was the only factor associated with the REI fitness and health subscales. The positive mood factor was also positively associated with PANAS positive affect and BAS drive and negatively associated with DERS impulse and total scores; PANAS negative affect, guilt, and sadness; and IPIP harm avoidance. With regard to discriminant validity, the positive mood factor was not associated with behavioral inhibition, novelty seeking, reward dependence, mood, or weight control.

Discussion

The results of Study 1 preliminarily indicate that a 25-item version of the RES is composed of three dimensions representing the tendencies to exercise in response to negative mood cues, eating and body image cues, and positive mood cues. These scales appear to have excellent internal consistency reliability, indicating low idiosyncratic error. Despite using an orthogonal rotation, factors were moderately related, which is common (Nunnally & Bernstein, 1994).

Study 2

In Study 2, we tested the fit of the 3-factor solution that resulted from Study 1 in an independent undergraduate student sample. We included measures of ED psychopathology and other clinical syndromes (i.e., depression, self-injury, anxiety, and alcohol use). We hypothesized that, when controlling for sex, BMI, and the two other RES subscales (due to their moderate inter-correlations), (a) negative mood-cued exercise would be positively associated with measures of psychopathology but not ED-specific psychopathology; (b) eating and body image-cued exercise would be positively associated with ED psychopathology; and (c) positive mood-cued exercise would be negatively associated with psychopathology.

Method

Procedure

The local institutional review board approved this study. Undergraduate students from a Northern Plains university participated in an online study (hosted on Qualtrics) for credit toward course requirements advertised as a survey study about exercise, eating behavior, and mental health.

Participants

Participants were 300 undergraduates. Their mean (*SD*) age was 19.8 (1.9) years, 73.4% reported female sex, and 72.9% reported identifying as women. Their mean (*SD*) BMI based on self-reported height and weight was 24.4 (4.6) kg/m². The majority identified as non-Hispanic, White (84.9%), with fewer identified as Hispanic (9.9%), Asian (2.3%), Black (0.7%), or other/mixed (2.3%).

Measures

RES. The 25 RES items retained from Study 1 comprised the version of the RES used in this study.

Eating Disorder Examination – Questionnaire (EDE-Q). The EDE-Q (Fairburn & Beglin, 1994) is a 28-item self-report questionnaire that assesses the frequency of eating behaviors over the prior 28-days and provides indications of eating psychopathology on four subscales (Dietary Restraint [$\alpha = .87$], Eating Concern [$\alpha = .88$], Shape Concern [$\alpha = .94$], and Weight Concern [$\alpha = .90$]), which are averaged to form a Global Score ($\alpha = .96$).

Eating Pathology Symptoms Inventory (ESPI). The EPSI (Forbush et al., 2013) is a 45-item self-report questionnaire assessing eight subscales: Body Dissatisfaction ($\alpha = .91$); Binge Eating ($\alpha = .86$); Cognitive Restraint ($\alpha = .75$); Purging ($\alpha = .86$); Restricting ($\alpha = .85$); Excessive Exercise ($\alpha = .91$); Negative Attitudes Toward Obesity ($\alpha = .88$); and Muscle Building ($\alpha = .82$). Participants respond to each item using a 5-point scale from 0 (*Never*) to 4 (*Often*) describing how much each item characterizes their experiences, with higher scores indicating higher standing on the dimensions.

Clinical Impairment Assessment (CIA). The CIA (Bohn et al., 2008) is a 16-item self-report measure assessing psychosocial impairment due to ED symptoms over the prior 28 days. Participants rate the extent to which eating problems and weight and shape concerns have caused them impairment in various aspects of their life, with higher scores indicative of greater impairment. Cronbach's alpha was .96.

Multidimensional Body-Self Relations Questionnaire (MBSRQ). The MBSRQ (Cash, 2000) is a 69-item self-report questionnaire that assesses body image disturbance on 10 subscales. Participants rate the extent to which they agree with statements about their appearance from 1 (*Definitely disagree*) to 5 (*Definitely agree*). The subscales are Appearance Evaluation ($\alpha = .91$), Appearance Orientation ($\alpha = .84$), Fitness Evaluation ($\alpha = .81$); Fitness Orientation ($\alpha = .90$); Health Evaluation ($\alpha = .70$); Health Orientation ($\alpha = .76$); Illness Orientation ($\alpha = .74$); and the Body Area Satisfaction Scale (BASS; $\alpha = .87$).

Center for Epidemiologic Studies Depression Scale-Revised (CESD-R). The CESD-R (Eaton et al., 2004) is a 20-item self-report measure of depression, based on the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (APA, 2000) criteria. Participants respond to questions asking about the frequency of symptoms of depression they have experienced over the prior week, ranging from 0 (*Not at all*) to 4 (*A lot*). Scores on the CESD-R range from 0-60, with higher scores indicating greater presence of depressive symptoms. Cronbach's alpha was .95.

Alcohol Use Disorders Identification Test (AUDIT). The AUDIT (Saunders et al., 1993) is a 10-item measure assessing alcohol consumption, drinking behaviors, and alcohol-related problems. Items measure typical

frequency, typical quantity per occasion, and heavy episodic drinking (six or more drinks per occasion) frequency. Participants respond to statements indicating the frequency that they have engaged in each statement, with response options coded from 0-4 and higher scores indicating more problems with alcohol. Cronbach's alpha was .81.

State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA). The STICSA (Ree et al., 2008) is a self-report measure assessing cognitive and somatic symptoms of anxiety as pertaining to one's current feelings of anxiety (state) and one's general, overall feelings of anxiety (trait). Participants rate each item on a 4-point scale, ranging from 1 (*Not at all*) to 4 (*Very much so*). Cronbach's alpha was .94 for the total trait measure, which is what we used here.

Brief Experiential Avoidance Questionnaire (BEAQ). The BEAQ (Gámez et al., 2014) is a brief measure of the Multidimensional Experiential Avoidance Questionnaire (MEAQ). It is a 15-item self-report questionnaire assessing experiential avoidance. Each item is scored on a 6-point scale ranging from 1 (*Strongly disagree*) to 6 (*Strongly agree*). Higher scores are indicative of greater levels of experiential avoidance. Cronbach's alpha was .87.

Inventory of Statements about Self-Injury (ISAS). The ISAS (Klonsky & Glenn, 2009) assesses lifetime frequency of non-suicidal self-injurious (NSSI) behaviors performed "intentionally (i.e., on purpose) and without suicidal intent (i.e., not for suicidal reasons)." The behaviors assessed include banging/hitting self, biting, burning, carving, cutting, wound picking, needle-sticking, pinching, hair-pulling, rubbing skin against rough surfaces, severe scratching, and swallowing chemicals. Participants were asked to estimate the number of times in their lives they have performed each behavior, which we dichotomized as ever present versus absent.

Statistical Analyses

We conducted a confirmatory factor analysis (CFA) using Mplus (Version 8.3; Muthén & Muthén, 2017) to test the fit of the 3-factor solution using the MLR estimator. We assessed fit using the root mean square error of approximation (RMSEA; < .08 is fair; Brown & Cudeck, 1993), comparative fit index (CFI; > 0.95 is excellent; Hu & Bentler, 1999), Tucker-Lewis index (TLI; > 0.90 is acceptable; Bentler & Bonett, 1980), and the standardized root mean square residual (SRMR; < 0.06 is ideal; Hu & Bentler, 1999).

We calculated partial correlations between the RES scales and other study measures while controlling for the other RES scales and participant sex and BMI. We conducted independent samples *t*-tests to examine whether scores on each subscale differed by sex. Finally, we conducted a multiple linear regression to account for EDE-Q Global Score, a broad measure of ED psychopathology, using the RES scales, sex, and BMI to examine which, if any, RES scales were uniquely associated with this important indicator of ED psychopathology while accounting for their shared variance.

Results

After freeing the covariances of similarly worded items, the solution fit well ($\chi^2(263) = 485.33, p < .001$; RMSEA = .053 [95%CI: .046, .061]; CFI = 0.95; TLI = 0.94; SRMR = 0.05). The factors indicate the tendency to exercise in response to negative mood cues, in response to eating and body image cues, and in response to positive mood cues (Figure 2).

[Figure 2 here]

Male participants scored higher on the negative mood cue subscale (44.62 ± 25.61) than female participants (34.51 ± 27.01 ; $t(294) = -2.90, p = .004, d = 0.38$), and they scored higher on the positive mood cue subscale (65.03 ± 28.43) than female participants (56.83 ± 30.02 ; $t(294) = -2.12, p = .035, d = 0.28$). In contrast, female participants scored higher on the eating and body image cued subscale (53.60 ± 26.95) than male participants (44.20 ± 25.12 ; $t(294) = 2.71, p = .007, d = -0.36$).

Results of correlations between RES scales and other measures are displayed in Tables 3 and 4. The results of the multiple linear regression on the EDE-Q Global Score using all three RES scales indicated that, while controlling for sex and BMI, only the exercising in response to eating and body image cues factor was uniquely associated with EDE-Q Global Score ($B = 0.51, t = 7.83, p < .001$).

[Table 3 here]

[Table 4 here]

The Tendency to Exercise in Response to Negative Mood Cues

Exercising in response to negative mood cues was positively associated with the EDE-Q item assessing driven exercise, the EPSI excessive exercise and muscle building subscales, and the MBSRQ fitness and health orientation subscales. It was not associated with ED psychopathology subscales that do not assess exercise (e.g., dietary restraint, shape concern, restriction, impairment). The negative mood subscale was also not associated with any non-ED psychopathology measures.

The Tendency to Exercise in Response to Eating and Body Image Cues

Exercising in response to eating and body image cues was associated with higher scores on the EDE-Q dietary restraint and eating concern subscales; EPSI restriction, cognitive restraint, and purging subscales; the presence of objectively large binge-eating episodes and purging as measured by the EDE-Q; and ED-related impairment as measured by the CIA. It was also positively associated with concerns regarding shape and weight (EDE-Q Shape Concern and Weight Concern) and negative attitudes toward obesity (EPSI Negative Attitudes toward Obesity). Higher scores on this dimension were positively associated with body dissatisfaction (EPSI Body Dissatisfaction) and appearance orientation (MBSRQ Appearance Orientation) and negatively associated with body image satisfaction (MBSRQ Appearance Evaluation, BASS) and health evaluation (MBSRQ Health Evaluation). Exercising in response to eating and body image cues was associated with greater endorsement of driven and excessive exercise (EDE-Q Driven Exercise and EPSI Excessive Exercise) and worse depression (CESD-R) and experiential avoidance (BEAQ). Finally, this dimension was not associated with binge eating measured by the EPSI, objectively large overeating

episodes as measured by the EDE-Q, muscle building, fitness evaluation and orientation, health orientation, illness orientation, or depression, presence of self-injury, anxiety, and alcohol use.

The Tendency to Exercise in Response to Positive Mood Cues

No significant correlations were found between the tendency to exercise in response to positive mood cues and ED psychopathology or measures of other psychopathology. Exercising in response to positive mood cues was negatively associated with EPSI body dissatisfaction and positively associated with MBSRQ body satisfaction and appearance evaluation. It was also positively associated with EPSI excessive exercise and MBSRQ health and fitness evaluation and orientation. Further, the positive correlation between the RES Positive Mood subscale and MBSRQ Illness Orientation subscale suggests that exercising in response to positive mood is associated with increased alertness about, or reactivity to, being sick. An additional negative association was found between RES Positive Mood and BEAQ experiential avoidance. Exercising in response to positive mood cues was not associated with anxiety, depression, alcohol use problems, self-injury, age, or BMI.

Study 2 Discussion

The results of Study 2 provided support for the three-factor structure identified in Study 1, albeit with minor modifications to address correlated errors between similarly worded items. Convergent and discriminant evidence indicates that the negative mood cue subscale measures the tendency to engage in exercise in response to negative mood cues that are not specific to ED psychopathology, but are associated with other aspects of mental health, generally involving low mood and mood regulation. However, the negative mood factor did not demonstrate many associations with psychopathology, contrary to our prediction. Conversely, the eating and body image cues subscale appears to measure the tendency to engage in exercise that is related to ED psychopathology. Finally, the positive mood cue subscale appears to measure exercise that is generally associated with favorable mental health and not associated with psychopathology, ED or otherwise. Importantly, all three subscales demonstrate unique relations with the EPSI Excessive Exercise scale, and both the negative mood cue and the eating and body image cue subscales had unique relations with the EDE-Q question assessing driven exercise. Differences by sex indicated that male participants report stronger tendencies to exercise in response to mood cues but weaker tendencies to exercise in response to eating and body image cues than female participants, the latter of which is consistent with sex differences commonly observed on dimensions of ED psychopathology.

Discussion

Earlier work on the tendency to engage in exercise when experiencing negative mood demonstrated that it was robustly associated with ED behaviors and attitudes (De Young & Anderson, 2010). However, given the benefits of exercise for mood and the common overlap in motives for exercise in EDs, the extent to which exercise in response to negative mood may be pathological is unclear. Thus, we aimed to devise a measure, the RES, to disentangle exercising in response to negative mood cues from exercising in response to eating and body image cues, which themselves may be associated with negative mood. We also included a

dimension of exercising in response to positive mood cues, in part to aid in establishing discriminative validity (i.e., that exercising in response to negative mood cues is distinct from exercising in response to positive mood cues). We utilized EFA to guide our item and factor selection and CFA in an independent sample to test the fit of our three-factor solution: exercising in response to negative mood cues, exercising in response to eating and body image cues, and exercising in response to positive mood cues. We had initially expected eating and body image cues to represent distinct dimensions, but this was not supported.

Exercising in response to negative mood cues was positively associated with difficulties with emotion regulation, sadness, and fitness and health orientations. It was also associated with driven exercise, excessive exercise, and muscle building. It was not associated with problems with alcohol, depression, self-injury, or anxiety, which was counter to our expectations. Thus, while the RES appears to capture the tendency to exercise in the presence of negative mood cues, and this tendency is stronger the more one has difficulty regulating emotion or experiences sadness, this tendency does not relate to frank psychopathology. Consistent with our hypotheses, exercising in response to eating and body image cues was positively associated with nearly every ED-related variable we included and other measures of psychopathology, and was negatively associated with health evaluation. As hypothesized, exercising in response to positive mood cues was negatively associated with measures of psychopathology and positively associated with health, fitness, and appearance evaluation. Overall, these results support the construct validity of the RES subscales and indicate that exercising in response to negative mood cues may not uniquely relate to ED psychopathology, or perhaps even other forms of psychopathology, when accounting for eating and body image cues, which themselves may be associated with negative mood.

Notably, results in both studies point to the RES subscales being uniquely related to existing measures of obligatory exercise (i.e., the OEQ, EPSI Excessive Exercise, and less so with EDE-Q driven exercise). While this could be interpreted as the RES scales demonstrating a lack of discriminant validity with obligatory exercise, we think these findings reflect a strength of the RES compared to many existing measures of exercise quality employed in the ED literature. Specifically, individuals may feel compelled to exercise, and guilty if they do not exercise, for a variety of reasons. Certainly, some of those reasons are part and parcel of ED psychopathology and rightly point to such exercise as problematic in its own right. However, individuals who adopt forms of exercise as a valued, generally health-promoting, non-professional activity may set goals for their progress and improvement to which they commit themselves. Much like any other valued activity to which one commits, individuals may prioritize the activity, look forward to engaging in it, and be disappointed in general and perhaps even with themselves (i.e., feel guilty) when they fail to meet their own expectations. That disappointment may provide future motivation to compel their continued valued engagement. In fact, guilt may be understood as an adaptive emotional experience when the opportunity for reparative actions are available (Tangney et al., 1992; Dahl et al., 2003). Thus, whether such a pattern of exercise is problematic requires a detailed understanding of individuals' values and other commitments and the extent to which their pursuit of exercise-related goals interferes with them; however, the findings of these studies with the RES seem to make clear that it is specifically exercising in response to eating and body image cues that uniquely relates to most aspects of ED psychopathology. This important

finding can help contextualize work focusing on understanding the emotion-regulation functions of exercise in EDs (Kolar & Gorrell, 2020).

The RES appears to be a promising new tool for testing relations between exercise and ED psychopathology and how exercise cued by mood is implicated in these disorders. Indeed, while the ED literature presently contains a variety of measures for exercise (Harris et al., 2020), the results of our studies appear to indicate that the RES approaches characterizing the quality of exercise behavior uniquely from existing measures, and this may be advantageous for future work in this area. For instance, as research on the emotion regulation functions of exercise in ED increases (e.g., Kolar & Gorrell, 2020), it will be important to disentangle exercise undertaken in response to negative mood from exercise undertaken in response to eating and body image cues, which itself may often be accompanied by negative mood, a task the RES appears able to accomplish.

Strengths and Limits

We tested the validity of the RES using a homogenous sample in terms of sex, age, race, and ethnicity, limiting the generalizability of our findings to more diverse samples. Our use of undergraduate students in both RES studies also limits the generalizability of our findings to other populations. We have not yet tested the properties of the RES in a sample of individuals with EDs, so caution should be exercised when generalizing to that population. Our aim in developing the RES was to first ascertain reactive exercise in an undergraduate sample with a range of ED psychopathology prior to examining them in a clinical sample, in which restriction of range on variables of interest is likely. Future research should aim to examine the RES in clinical samples of individuals with EDs as well as individuals with other forms of psychopathology (e.g., depressive disorders). We did not examine the RES' test-retest reliability or stability. Future research should examine its test-retest reliability over a multi-week (e.g., 4-week) interval, as the constructs assessed by the RES are theorized to be stable over such a period. Examining how RES subscale scores change over longer periods (e.g., from adolescence to adulthood) is an important avenue for future research. Finally, participants may not encounter visual analogue scales, such as the one used for the RES, as commonly as 4-7-point ordinal response scales; however, the ubiquitous use of online survey technology has led to the easy programming and scoring of these scales to address shortcomings of ordinal response scales (e.g., the tendency of participants to avoid extreme options on typical ordinal scales; Bishop & Herron, 2015). We encourage interested readers to contact us about how to program this scale in Qualtrics, as the use of a visual analogue scale makes paper and pencil scoring of this measure labor-intensive. Strengths of these studies include the use of two large, independent samples to establish the factor structure of the RES in separate exploratory and confirmatory steps, along with the inclusion of a large variety of variables to test convergent and discriminant relations.

Declarations

Data availability statement: The data that support the findings of this study are available from the corresponding author upon request.

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Tables

Table 1 *Exploratory factor analysis rotated factor matrix*

Initial RES Items	Factor		
	1	2	3
23. After I've let someone down	.826	.255	.199
20. When I'm feeling like I'm a bad person	.792	.292	.253
24. When I'm feeling depressed	.789	.194	.214
25. When I'm feeling sad	.787	.200	.242
13. After a friend or loved one has let me down	.778	.240	.243
21. When I feel guilty about something I've done or failed to do	.775	.288	.240
18. After I've gotten into an argument	.744	.178	.307
19. When I'm feeling like my future is uncertain	.731	.182	.283
16. When I'm having a bad day	.725	.226	.283
10. After a friend or loved one treated me badly	.696	.260	.178
After I've disappointed myself	.665	.394	.187
After not living up to my expectations	.659	.453	.239
3. When I can't make something perfect	.653	.278	.269
2. When I'm feeling like I'm at my wit's end	.642	.306	.217
When I'm feeling anxious about how something will turn out	.639	.240	.323
When I'm feeling like there's nothing I can do to make things better	.625	.340	.228
After I've been the butt of a joke	.615	.433	.128
When I'm feeling worthless	.554	.420	.242
17. After finding out that I've gained weight	.229	.800	.247
12. After noticing that my clothes are too tight	.232	.784	.177
7. After I've compared myself to someone in better shape than me	.231	.774	.141
11. After someone has made a negative comment about the way I look	.312	.746	.059
22. After realizing that I'm out of shape	.239	.738	.364
8. After eating dessert	.368	.737	.186
14. After I've eaten more than I had planned	.339	.734	.197
6. After eating a large meal	.261	.733	.140
After eating fast food	.367	.711	.174
1. After noticing that my stomach is bigger than it used to be	.122	.697	.265

After eating sweets	.406	.697	.169
When I will feel guilty if I don't exercise	.305	.679	.401
15. When I'm planning on wearing a swimsuit	.170	.670	.304
9. When I'm in a good mood	.136	.375	.804
After I've gotten some good news	.354	.133	.803
After accomplishing a goal that I set for myself	.339	.213	.777
When I'm having a good day	.076	.399	.765
After receiving a good grade in school or positive feedback at work	.394	.095	.729
After I've accomplished something that was important to me	.481	.104	.727
When I feel like I have complete control over my future	.326	.240	.693
5. When I'm feeling hopeful about the future	.172	.314	.688
4. After a good night's rest	.173	.379	.682
After having a good time with family or a friend	.383	.162	.682
When I'm in the mood to celebrate	.473	.099	.602

Note. Bolded numbers indicate highest factor loading for each item. Numbers on the left identify retained items and their order in the final measure and correspond to item numbers in Figure 2. Factor 1 = negative mood cued exercise; Factor 2 = eating and body image cued exercise; Factor 3 = positive mood cued exercise.

Table 2 Descriptive statistics, Pearson correlations and internal consistencies of the Reactive Exercise Scale factors

RES Subscale	<i>M(SD)</i>	<i>α</i>	Study 1		Study 2			
			Eating/Body Image	Positive Mood	<i>M(SD)</i>	<i>α</i>	Eating/Body Image	Positive Mood
Negative Mood	39.64 (27.97)	.961	.588	.483	37.29 (26.94)	.948	.602	.545
Eating/Body Image	56.35 (27.24)	.951		.584	51.01 (26.73)	.932		.505
Positive Mood	61.46 (27.51)	.903			58.98 (29.75)	.883		

Note. *M* = mean; *SD* = standard deviation; *α* = Cronbach's alpha; All correlations are statistically significant at $p < .001$ (two-tailed).

Table 3 *Unique relations between final Reactive Exercise Scale factors and other variables while controlling for sex and BMI in Study 1*

	Negative Mood	Eating/Body Image	Positive Mood
IPIP BIS/BAS			
Anxiety	-.060	.199***	-.060
Reward Response	-.044	.112	.093
Drive	-.025	-.004	.146*
Fun Seeking	.045	.111	.009
Goals	.038	-.058	-.058
DERS			
Goals	.038	.185**	-.058
Impulse	.166**	.052	-.141*
Non-Acceptance	.126*	.137*	-.012
Awareness	.138*	-.070	-.076
Strategies	.138*	.109	-.158*
Clarity	.223***	-.009	-.059
Total	.197**	.108	-.131*
PANAS			
Positive Affect	-.023	.065	.176**
Negative Affect	.088	.151*	-.123*
Guilt	.114	.229***	-.171**
Sadness	.122*	.075	-.150*
Fatigue	-.064	.102	-.046
IPIP Harm Avoidance			
Worry/Pessimism	.021	.203***	-.161**
Fear of Uncertainty	.165**	-.022	.036
Shyness	.006	-.041	-.112
Fatigue & Asthenia	.072	.126*	-.211***
IPIP Novelty Seeking			
Variety Seeking	-.018	.105	.075
Recklessness	.023	.142*	-.097
Extravagance	.064	.000	-.077

Rebelliousness	.000	.081	-.077
IPIP Reward Dependence			
Sentimentality	.086	.041	.014
Warm Communication	.081	.060	.044
Attachment	.100	.015	-.075
Dependence	-.007	.057	.064
OEQ Total	.217***	.132*	.196**
REI			
Weight Control	-.252***	.403***	.015
Fitness	-.038	.038	.259***
Mood	.124*	-.006	.121
Health	-.078	.070	.225***

Note. Values are partial correlations, controlling for sex, BMI, and the other RES scales themselves. BIS/BAS = Behavioral Inhibition Scale/Behavioral Activation Scale; DERS = Difficulties in Emotion Regulation Scale; PANAS = Positive and Negative Affect Scales; IPIP = International Personality Item Pool; OEQ = Obligatory Exercise Questionnaire; REI = Reasons for Exercise Inventory.

*** $p < .001$; ** $p < .01$; * $p < .05$.

Table 4 *Unique relations between final Reactive Exercise Scale factors and other variables while controlling for sex and BMI in Study 2*

	Negative Mood	Eating/Body Image	Positive Mood
Age	-.011	-.071	.056
BMI ²	-.159**	.031	.059
EDE-Q			
Dietary Restraint	.064	.341***	.030
Eating Concern	-.016	.279***	-.065
Weight Concern	-.029	.393***	-.080
Shape Concern	-.060	.438***	-.108
Driven Exercise	.134*	.185**	.084
Presence of OEs ¹	.997	.997	.185**
Presence of OBEs ¹	1.000	1.020**	.992
Presence of Purging ¹	.994	1.035**	.095
CIA Total Score	.012	.310***	-.056
EPSI			
Binge Eating	.000	.016	-.039
Cognitive Restraint	.080	.348***	.158
Purging	.041	.224***	-.082
Restriction	.029	.151*	-.071
Body Dissatisfaction	.012	.310***	-.056
Negative Attitudes Toward Obesity	-.004	.130*	.044
Excessive Exercise	.213***	.160*	.260***
Muscle Building	.127*	.064	.096
MBSRQ			
Appearance Evaluation	.077	-.224***	.158**
Appearance Orientation	-.110	.384***	-.019
Fitness Evaluation	.076	-.006	.200***
Fitness Orientation	.153*	.015	.346***
Health Evaluation	.096	-.133*	.161**
Health Orientation	.149*	.054	.238***
Illness Orientation	.048	-.039	.202***

Body Area Satisfaction Scale	-.022	-.270***	.214***
CESD-R	.051	.145*	-.079
AUDIT	.036	.067	.026
STICSA	.003	.020	-.008
BEAQ	-.052	.163**	-.118*
Presence of Self-Injury ¹	1.003	1.002	.997

Note. Values are partial correlations, except where otherwise indicated, controlling for sex, BMI, and the other RES scales themselves. BMI = Body Mass Index; EDE-Q = Eating Disorder Examination – Questionnaire; OE = Objectively large overeating episodes; OBE = Objectively large binge eating episodes; CIA = Clinical Impairment Assessment; EPSI = Eating Pathology Symptom Inventory; MBSRQ = Multidimensional Body-Self Relations Questionnaire; CESD-R = Center for Epidemiological Studies Depression scale – Revised; AUDIT = Alcohol Use Disorders Identification Test; STICSA = State Trait Inventory for Cognitive and Somatic Anxiety; BEAQ = Brief Experiential Avoidance Questionnaire.

¹Odds Ratios: Behavior coded as 1 = present and 0 = absent

²Controlling for other RES scales and sex only.

*** $p < .001$; ** $p < .01$; * $p < .05$.

Figures

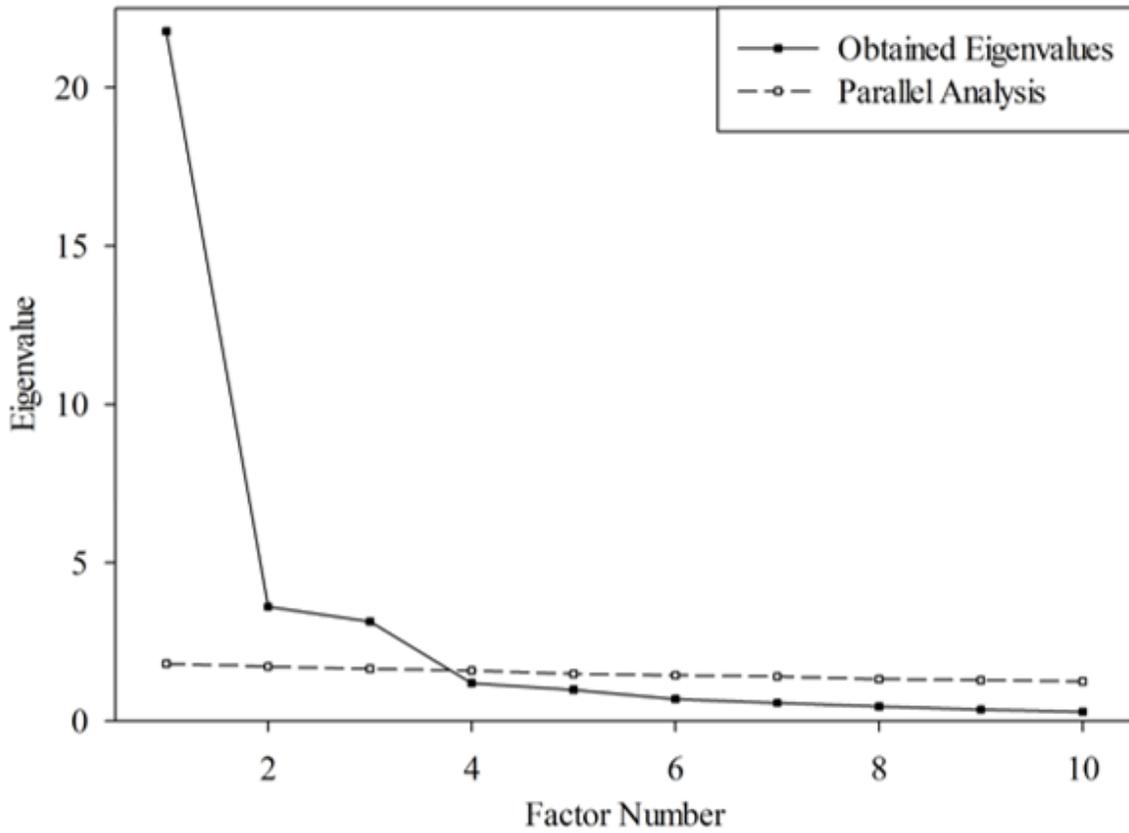


Figure 1

Scree plot of obtained Eigenvalues superimposed on the results of a parallel analysis using 1000 random datasets indicating that three factors should be extracted

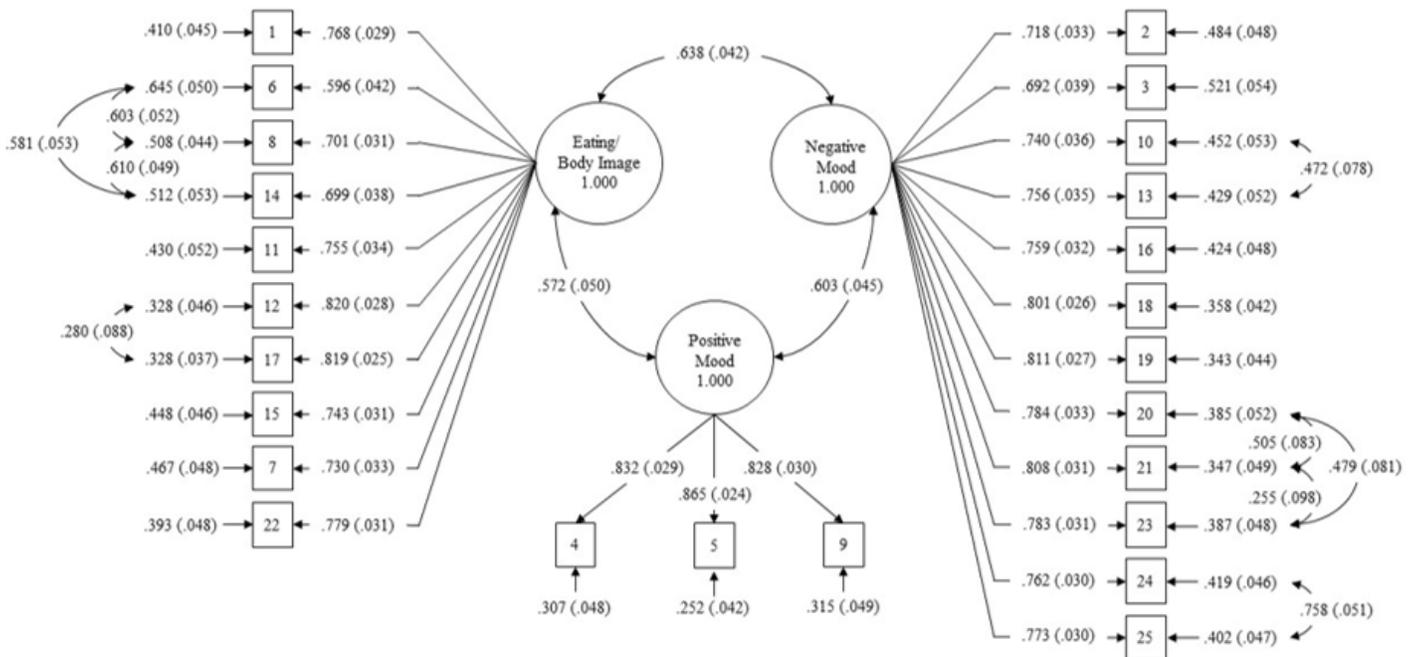


Figure 2

Results of confirmatory factor analysis indicating a three-factor solution for the Reactive Exercise Scale

Note. Numbers in boxes indicate item numbers and correspond to those in Table 1. Error covariance was freely estimated for similarly worded items.