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The effect of exercise absence on affect and body dissatisfaction as moderated by obligatory exercise beliefs and eating disordered beliefs and behaviors

Marie L. LePage[a,*], **Matthew Price**[b], **Patrick O'Neil**[c], and **Janis H. Crowther**[a]
[a]Department of Psychology, Kent State University, Kent, OH 44242-0001, USA
[b]Department of Psychology, Georgia State University, Atlanta, GA 30303, USA
[c]Weight Management Center, Medical University of South Carolina, Charleston, SC 29425, USA

Abstract

Aim—Research suggests that exercise absence is frequently associated with greater guilt and negative affect, particularly when obligatory exercise beliefs and eating disordered psychopathology are considered. Two separate studies used ecological momentary assessment (EMA) to examine differences in mood on exercise and non-exercise days and the moderating impact of obligatory exercise beliefs and eating disordered beliefs and behaviors.

Method—Both studies recruited female university students who endorsed frequent exercise behavior and study two also recruited based on level of eating disordered psychopathology. Participants completed the Obligatory Exercise Questionnaire at baseline and EMA measures of affect and exercise behavior for approximately one week. Study two participants also completed measures of body dissatisfaction and cognitions.

Results—Results of study one suggest that obligation to exercise appears to have a greater impact on general level of affect than does exercise absence or the interaction of these two. In addition, in study two, eating disorder symptomatology was significantly associated with affect and cognition while exercise absence and obligatory exercise beliefs were not.

Conclusions—The present studies suggest that the absence of exercise is not associated with significant changes in affect or cognitions. However, obligation to exercise and eating disorder symptomatology do impact affect and cognitions.

Keywords

Physical activity; Obligatory; Body image; Ecological momentary assessment; Eating disorders; Affect

Exercise Absence and Obligatory Exercise Beliefs: Implications for State Levels of Affect, Body Dissatisfaction, and Body Change Related Thoughts across Two Studies.

Exercise is widely considered as one of the most effective methods to manage shape and weight (U.S. Department of Health & Human Services, 2008). In addition to positive physical effects, exercise leads to increased psychological well-being, reduced levels of depression, and increased positive affect (U.S. Department of Health & Human Services,

*Corresponding author. Tel.: +1 330 672 2166; fax: +1 330 672 3786.

2008). However, there is a growing body of research suggesting that for individuals exhibiting obligatory exercise beliefs, engagement in exercise may be the result of body dissatisfaction and eating disordered psychopathology (Davis, Fox, Cowles, Hastings, & Schwass, 1990; Krejci et al., 1992; Mond, Hay, Rodgers, Owen, & Beumont, 2004).

Obligatory exercise, or exercise dependence, is defined as a psychological attachment to exercise (Ackard, Brehm, & Steffen, 2002) or exercise of an obsessive or compulsive quality (Mond, Hay, Rodgers, & Owen, 2006). Individuals who engage in obligatory exercise place exercise above other commitments, exercise when physically unwell, and report increased guilt or negative affect when unable to exercise (Ackard et al., 2002; Mond et al., 2006). In addition, obligatory exercisers are pre-occupied with thoughts of exercise throughout the day and keep detailed records of their exercise behaviors (Krejci et al., 1992). Research suggests that obligatory exercise is the primary mediator of the relationship between exercise behaviors and eating disordered psychopathology (Cook & Hausenblas, 2008). Other findings have shown that the degree of commitment to exercise predicts eating disordered psychopathology above and beyond the frequency or duration of exercise (Lipsey, Barton, Hulley, & Hill, 2006). Moreover, guilt experienced by obligatory exercisers when they do not exercise has been identified as an important element that distinguishes exercisers with and without disordered eating behaviors (Mond, Myers, Crosby, Hay, & Mitchell, 2008).

Several studies have examined retrospective reports of mood in obligatory exercisers on naturally occurring non-exercising days. The majority of this research has been retrospective in nature and findings suggested that individuals with obligatory exercise behaviors reported worse moods on non-exercising days (Ackard et al., 2002; Mond et al., 2006). However, these studies utilized a retrospective recall approach and it is possible that individuals may over-emphasize their negative mood experiences when thinking about them retrospectively. To avoid this limitation, a number of studies have examined the impact of experimentally manipulated exercise deprivation on affect utilizing both in-vivo laboratory designs and ecological momentary assessment (Hausenblas, Gauvin, Symons-Downs, & Duley, 2008). Ecological momentary assessment (EMA; Stone & Shiffman, 1994) is an effective method for examining attitudes, emotions, and behaviors as they occur, thus reducing biases related to retrospective recall. Studies using EMA as well as studies utilizing in-vivo laboratory approaches have found significant decreases in positive affect and increases in negative affect following periods of disruption to a regular exercise schedule. However, research suggests that experimentally manipulated exercise deprivation may have different affect consequences than naturally occurring exercise absence (Hausenblas et al., 2008). Hausenblas et al. (2008) utilized EMA to examine differences in affect between days when individuals are purposefully deprived of exercise versus days when they choose not to exercise. The findings demonstrated that exercise absence was associated with more positive affect when it was experimentally deprived than when individuals chose not to exercise. However, the study had a relatively small sample size (40) and collected data over only a six day period. Furthermore, as the researchers had two different types of deprivation (researcher mandated vs. participant selected), their power was further reduced.

Only one study has utilized EMA to examine the moderating impact of exercise dependence on affect differences (Hausenblas et al., 2008). These researchers found that individuals high in exercise dependence reported more negative affect on the days when they themselves chose not to exercise versus the days when they were deprived of exercise by the researchers. This would support the hypothesis that exercise dependent people may feel more personal responsibility for exercise absence on days they themselves choose to miss exercise. Further research is needed to examine exercise absence in a naturalistic way for these individuals.

Study 1

In order to examine the relationships between exercise absence, obligatory exercise behaviors and beliefs, and affect, the present study utilized EMA to gather data on regular exercisers' reported mood and exercise experiences over ten days. In an effort to examine exercise as it naturally occurs, participants were told not to make any changes to their normal exercise routines.

It was hypothesized that exercisers would report greater negative affect (NA), guilt, and less positive affect (PA) on non-exercise than exercise days. It was also hypothesized that obligatory exercise beliefs would be associated with higher levels of baseline body dissatisfaction, eating disordered psychopathology, and thin ideal internalization. Consistent with prior work, it was hypothesized that as scores on a measure of obligation to exercise increase, participants would report higher levels of negative affect and guilt and lower levels of positive affect on days when they do not exercise (Ackard et al., 2002; Mond et al., 2006).

Participants

Participants were 53 female undergraduates who were pre-selected from a larger group of 453 students enrolled in psychology courses at a large Midwestern university during the 2006–2007 academic year. Participants were invited to participate in the study if they exercised more than 3 days per week and were included in these analyses if they did not meet criteria for an eating disorder, as assessed by the Eating Disorder Diagnostic Scale (EDD-S; Stice, Telch, & Rizvi, 2000). Eating disordered participants were excluded from this study in an attempt to look at a sample of non-eating disordered women. Participants averaged 19.06 years of age (SD = 3.10) and were almost all in their first year of college (84.3%). They were also almost entirely Caucasian (90.2%). Two of the original 53 participants were eliminated from the study after failing to complete the diary portion of the study in a compliant manner, leaving 51 participants.

Procedure

After completing informed consent, all participants completed baseline assessments of psychological functioning, including a number of measures assessing body dissatisfaction and eating disordered psychopathology. During the next ten days, they were instructed to engage in exercise at their discretion and after each exercise session to complete the Positive and Negative Affect Scale – Expanded Form (PANAS-X), described below. They were also given PDAs that were programmed to prompt the participant at four random times each day to complete the PANAS-X. Schedules were determined using a random number table, with one signal occurring randomly between 10 am and 1 pm, one between 1 pm and 4 pm, one between 4 pm and 7 pm, and one between 7 pm and 10 pm. Participants were asked to record the date and time that they completed both the exercise and random assessments. In this way, it was possible to establish on which days the individual had engaged in exercise and on which days they had not engaged in exercise.

Apparatus

The Royal Personal Digital Assistant (PDA) was given to diary participants to cue their random assessments. The device is a personal organizer that beeps at programmed times. It is approximately 4 by 6 inches and can easily be carried in a coat pocket or a backpack. Participants were also given paper diaries to carry with them, including all the questionnaires to be completed during the 10-day protocol.

Baseline measures

Obligation to exercise—The Obligatory Exercise Questionnaire (OEQ; Thompson & Pasman, 1988) is a 20 item self-report questionnaire designed to assess an individual's obligation to and compulsion for exercise. The scale was modified from Blumenthal, O'Toole, and Chang (1984) Obligatory Running Questionnaire. Respondents rate how much he or she agrees or disagrees with a statement about his/her exercise behavior on a four point scale ranging from "never" to "always." Higher scores on the scale indicate greater obligation to exercise. The OEQ has good internal consistency (0.96) and good test–retest reliability (two weeks, 0.96; Thompson & Pasman, 1988). In addition, Steffen and Brehm's (1999) analysis of the measure supports that it is related to emotional reasons for exercise as well as eating pathology. Furthermore, the measure has successfully been used to measure obligatory exercise beliefs in college aged samples by previous researchers (Ackard et al., 2002).

Eating disorder symptomatology—The EDD-S (Stice et al., 2000) is a 22-item self-report measure that assesses anorexia nervosa, bulimia nervosa, and binge eating disorder symptoms. The scale can be used to diagnose individuals with these eating disorders as well as to assess sub-clinical symptomatology. The scale also generates a continuous score of general eating disorder symptomatology, with higher scores indicating greater eating disorder patterns. It also assesses body mass index (BMI) from self-reported height and weight. The scale has been shown to demonstrate excellent content validity, temporal reliability (Kappa of 0.83), criterion validity (compared to an interview diagnosis, kappa of 0.80), and convergent validity with similar eating disorder scales (Stice et al., 2000)

Restrained eating—The Revised Restraint Scale (RRS; Herman & Polivy,1980) is a 10-item measure of chronic dieting and weight change, with higher scores indicating greater restrained eating. The RRS demonstrates good reliability with alphas around 0.82 and test–retest reliability around 0.95 (Allison, Kalinsky, & Gorman, 1992). Additionally, it has demonstrated convergent validity, with high correlations found between the RRS and the Dieting subscale of the Eating Attitudes Test (Garner & Garfinkel, 1979).

Body dissatisfaction—The Body Shape Questionnaire (BSQ; Cooper, Taylor, Cooper, & Fairburn, 1987) is comprised of 34 items designed to assess an individual's worries about his/her body shape. Higher scores indicate higher levels of body dissatisfaction. The BSQ has shown excellent reliability with a test–retest coefficient of 0.93 and excellent convergent validity with the Eating Disorder Inventory and the Eating Attitudes Test (coefficients ranging from 0.35 to 0.61; Cooper et al., 1987).

Thin ideal internalization—The Sociocultural Attitudes Toward Appearance Questionnaire (SATAQ; Heinberg, Thompson & Stormer, 1995) is a 14-item self-report questionnaire that measures how much an individual has internalized cultural ideas of body perfection (i.e. thinness). Higher scores indicate a higher level of thin ideal internalization. The SATAQ has demonstrated good internal consistency (alpha coefficients ranging from 0.71 to 0.88). Additionally, it has shown to have good convergent validity, with significant associations with related measures including the Drive for Thinness and Body Dissatisfaction subscales of the Eating Disorder Inventory (Heinberg et al., 1995), measures of dietary restraint (Griffiths et al., 2000), and general eating and weight concerns (Low et al., 2003).

EMA measures

Positive and negative affect—The Positive and Negative Affect Scale – Expanded Form (PANAS-X; Watson & Clark, 1994) is a 60-item self-report questionnaire assessing

the type and intensity of emotions a person is experiencing at the assessment time. Respondents rate how much they are feeling the emotion on a 5-point scale (1 = *very slightly or not at all* to 5 = *extremely*). Higher scores indicate greater negative affect or positive affect, respectively. For the purposes of this study, only the positive affect, negative affect, and guilt subscales of the questionnaire were included, leaving a total of 24 items. The original 10-item positive and 10-item negative affect scales have been shown to be internally consistent and have high test–retest reliability (Crawford & Henry, 2004; Watson, Clark, & Tellegan, 1988). Additionally, the PANAS-X has demonstrated good criterion validity with the positive and negative affect scales showing strong relationships to related constructs (Hensen & Chang, 1998).

Quality analyses

To assess compliance, frequencies were run on the number of assessments completed (both exercise and random). The number of random assessments completed ranged from 15 to 40 (the most that could have been completed), with a mean of 30.3 (SD = 5.93). The number of post-exercise assessments completed ranged from one to 12, with a mean of 5.5 (SD = 2.36). Additionally, upon completion of the study, investigators reviewed each diary to make sure that the random assessments were completed during the required time frames. Two participants were eliminated from the study as a result of not completing random assessments within approximately 1 h of the signal.

Results and discussion

The baseline relationships between obligatory exercise, body dissatisfaction, thin ideal internalization, restrained eating, and disordered eating are reported in Table 1. Bivariate correlations revealed strong significant positive relationships among obligatory exercise beliefs and behaviors and all of the baseline measures, suggesting that these beliefs are associated with higher levels of body dissatisfaction, thin ideal internalization, and disordered eating behaviors.

Comparison of affect on non-exercise and exercise days—Fifty-one participants completed a total of 495 PANAS-X measurements, 256 from exercise days and 239 from non-exercise days. Descriptive statistics can be found in Table 2. Differences between exercise and non-exercise days on reported positive affect, negative affect, and guilt were assessed with separate multilevel models. Multilevel Modeling (MLM) parses variance across different levels of nesting. For study 1, three levels of nesting were identified: Multiple measurements (Level 1; *i*) nested within a day (Level 2; *j*) and multiple days (Level 2; *j*) nested within a person (Level 3; *k*). Type of day was coded such that exercise day = 0 and non-exercise day = 1. Each model included fixed and random effects for exercise days (β_{000}; u_{00k}), and the dummy coded variable that accounted for the difference between exercise days and non-exercise days (β_{010ijk}; u_{10k}). Random effects were included in the level 1 model to capture residual variation within each day (e_{ijk}), the level 2 model to capture residual variation across days (r_{jk}), and the level 3 model to capture residual variation across individuals (u_k). The final model was as follows: Outcome Variable$_{ijk}$ = ($\beta_{000} + \beta_{010k}$)+ ($e_{ijk}$+ $r_{0jk} + u_{00k} + u_{10k}$) such that β_{000} is the rating on exercise days, β_{010jk} is the difference in ratings between exercise days and non-exercise days, e_{ijk} is the residual variation across measurements, r_{0jk} is the residual variation across days, u_{00k} is the residual variation across individuals on exercise days, and u_{10k} is the residual variation across individuals in the difference between exercise and non-exercise days.

The results suggested that there were no significant differences across exercise days and non-exercise days on positive affect ($\beta_{010} = -1.08$, $p = 0.12$), negative affect ($\beta_{010} = -0.15$, $p = 0.57$), and guilt ($\beta_{010} = 0.07$, $p = 0.31$). However, there was a significant individual level

random effect for exercise days for ratings of positive affect ($u_{00k} = 45.78$, $p < 0.01$), negative affect ($u_{00k} = 12.09$, $p < 0.01$), and guilt ($u_{00k} = 5.25$, $p < 0.01$). Furthermore, there was a significant random effect for the difference between exercise and non-exercise days for positive affect ($u_{10k} = 6.52$, $p = 0.02$), but not for negative affect ($u_{10k} = 0.07$, $p > 0.50$) and guilt ($u_{10k} = 0.01$, $p > 0.50$). The significant random effects suggested that there was significant individual level variation for all affect measures on exercise days and for the difference between exercise and non-exercise days for positive affect.

Association between affect and obligatory exercise—Follow up models were conducted to determine if the residual individual level variation in exercise days across all outcomes and the difference between exercise and non-exercise days for positive affect was explained by the OEQ. The OEQ was added to the level 3 model (Table 3). For positive affect, the final model included effects for is the association between OEQ and positive affect on exercise days (OEQ_{001}) and the association between the difference between exercise days and non-exercise days (OEQ_{011ijk}).

The results suggested that OEQ scores were unrelated to positive affect on exercise days ($OEQ_{001} = -0.01$, $p = 0.92$). However, OEQ scores were negatively associated with an greater difference in positive affect across exercise and non-exercise on exercise days ($OEQ_{011ijk} = -0.17$, $p = 0.03$). This finding suggests that in those with high levels of OE, there is a lower positive affect on non-exercise days than exercise days.

Similar models were used for negative affect and guilt, but did not include OEQ_{011ijk}. The results suggested that OEQ scores were significantly positively associated with negative affect on exercise days ($OEQ_{001} = 0.11$, $p = 0.02$). That is, in those with increased obligatory exercise, negative affect was stronger on exercise days. However, obligatory exercise was not associated with guilt on exercise days ($OEQ_{001} = 0.08$, $p = 0.11$).

The findings of the present study suggest differences in positive affect as a result of exercise absence are conditional upon levels of obligatory exercise. Specifically, individuals with high levels of obligatory exercise report lower levels of positive affect on days when they do not exercise. This is consistent with prior work suggesting an absence of exercise is associated with changes in affect (Hausenblas et al., 2008). It is also consistent with past research that has suggested that individuals who report high levels of obligatory exercise also endorse increased negative mood on non-exercise days (Hausenblas et al., 2008). Additionally, increased obligatory exercise was strongly correlated with baseline measures of body dissatisfaction, thin ideal internalization, restrained eating, and general eating disordered symptomatology. In contrast to prior work, the present findings did not support a relationship between exercise absence and negative affect. Increased obligatory exercise was associated with higher levels of negative affect on exercise days, but was unrelated to the difference in affect across exercise and non-exercise days. An explanation for the differences from prior work and the current study may be methodological. Previous studies used retrospective reports whereas this study used EMA. Additionally, the present study used a college aged sample rather than a community sample of women. It is possible that these methodological differences contributed to the contrasting findings.

A growing number of studies suggest that the development of obligatory exercise attitudes may play an important role in the pathogenesis or maintenance of eating disorders. One study by Ackard et al. (2002) utilized cluster analysis to examine differences among a large sample of exercisers. Two distinct groups of exercisers emerged; one with eating disorder traits and psychological attachment to exercise and one with an equivalent intensity and frequency of exercise, but no psychological attachment and no eating disordered psychopathology. It may be that eating disorder psychopathology is the link between

exercise frequency and psychological attachment to exercise. For that reason, examining obligatory exercise within a population of individuals with eating disordered symptomatology may allow us to better understand the impact of exercise absence on daily affect.

Study two

Given that obligatory exercise is often discussed in the context of eating disordered psychopathology, the researchers conducted a separate second study to examine the association between obligatory exercise and mood in a sample of individuals with disordered eating beliefs and behaviors. Additionally, several new outcome variables were added to examine the impact of exercise absence on other *state* variables in addition to affect, specifically body dissatisfaction and thoughts about changing one's eating or exercise behaviors to reduce weight. It was hypothesized that obligatory exercise would again be significantly correlated with higher levels of body dissatisfaction and eating disordered psychopathology as assessed at baseline. In addition, exercise absence was hypothesized to be associated with reductions in positive affect, increases in negative affect, guilt, state body dissatisfaction, and thoughts of changing one's eating or exercise to decrease weight or shape. The study also examined the potential moderating effects of obligatory exercise beliefs and eating disordered psychopathology on affect, body dissatisfaction, and cognitions. Given that there is significant evidence that suggests a strong relationship between obligatory exercise and eating pathology (Cook & Hausenblas, 2008; Lipsey et al., 2006), it was believed that degree of obligatory exercise beliefs would have a stronger impact on eating disordered women than non-disordered women. Additionally, given that guilt plays a large role in maintaining both eating pathology and obligatory exercise behaviors (Mond et al., 2008; Stice, 2002), it was hypothesized that when high eating disordered women do not exercise, they would report more negative affect and guilt and less positive affect than when they do. Given that no other research has examined the impact of exercise absence or obligatory exercise on state body dissatisfaction or thoughts of changing one's eating or exercise to decrease weight or shape, it was difficult to predict potential outcomes. However, it was believed that similar patterns would emerge between exercise absence and these variables when moderated by level of obligatory exercise and eating disordered behaviors.

Method

Participants—Approximately nine hundred female undergraduates completed the Eating Attitudes Test-26 (EAT-26; Garner, Olmstead, Bohr, & Garfinkel, 1982), a measure of maladaptive eating attitudes and behaviors, and provided information about their weekly frequency of exercise during mass screening sessions for psychology undergraduates enrolled in courses which require study participation in the 2009–2010 academic year. Participants were selected if they reported engaging in exercise at least three days per week and had an EAT-26 score which placed them in either the upper or lower quartile for eating disordered attitudes and behaviors. The quartile cut-off scores were approximately 4 or below for the low eating disordered group (LED) and 13 or above for the high eating disordered group (HED). Of the approximately 450 eligible participants, 76 participants agreed to participate in the study, completed the study, and supplied usable data. Most of the eligible participants chose not to participate as they had already completed their required research participation credits for the semester. The participants had an average age of 19.08 (SD = 2.86) and were mostly in their first (68.4%) or second year (18.4%) of college. The majority of participants were Caucasian (86.8%). Of the 76 participants, 28 fell into the LED group and 48 fell into the HED group. The difference in sample size between the groups reflects differences in participants who chose to participate. More HED participants agreed

to complete the study than LED participants. The average BMI for the population was 22.46 (SD = 3.64) and BMI did not significantly differ between the HED (M = 22.88, SD = 3.82) and LED (M = 21.79, SD = 3.27) groups ($t(74) = -1.27$, $p = 0.21$).

Procedure—After completing informed consent, all participants who were invited and agreed to participate completed baseline measures in the laboratory. These measures included the EAT-26, which was re-administered at this time to ensure accuracy of group distinction. Additional baseline measures included questionnaires assessing eating disordered psychopathology (EDD-S) and body dissatisfaction (BSQ).

Participants were trained on how to complete daily diaries. All participants were also provided with written instructions. Participants completed diaries at the end of each day to assess their general mood, body dissatisfaction level, and thought content over the course of the day. These measures were the State Self-Esteem Scale–Appearance Subscale (SSES; Heatherton & Polivy, 1991), the PANAS-X, and the Body Change Inventory (BCI; McCabe, Ricciardelli, & Banfield, 2001). They were also instructed to complete other measures before and after exercise.

Measures

Baseline measures: In addition to the EDD-S and the BSQ (described in study one), participants were also given the Eating Attitudes Test-26 (EAT-26; Garner et al., 1982) to assess the frequency of maladaptive eating behaviors and attitudes as described above. Higher scores indicate greater reported maladaptive eating attitudes and behaviors. The measure has been shown to be reliable (Garner et al., 1982; Raciti & Norcross, 1987) and previous studies have identified strong correlations between the Eating Attitudes Test and the Eating Disorder Inventory (Berland, Thompson, & Linton, 1986). Additionally, the measure has been shown to demonstrate correlations to other relevant variables, including dieting behaviors, body image dissatisfaction, and weight status (Koslowsky et al., 1992).

Diary measures: In addition to the PANAS-X participants were also given a measure of state body dissatisfaction (SSES) and a measure of cognitions about appearance related change strategies (BCI).

The State Self-Esteem Scale (SSES; Heatherton, & Polivy, 1991) is a 20 item self-report questionnaire designed to measure state self-esteem. The measure was designed to be sensitive to temporary shifts in self-esteem due to the experience of some environmental event or laboratory manipulation. In this study, only the appearance subscale of the SSES was used as a measure of overall state body satisfaction or body esteem, with higher scores indicating greater body dissatisfaction. The appearance subscale has robust validity (Heatherton & Polivy, 1991). The SSES was embedded in the diary with the following instruction, “answer the following questions based on how you have felt in general today”.

The Body Change Inventory (McCabe et al., 2001; Ricciardelli & McCabe, 2002) is an 18-item self-report questionnaire designed to assess thoughts about body change strategies. The questionnaire consists of three scales assessing thoughts about strategies to decrease body size, increase body size, and increase muscle size. Participants were instructed to answer the BCI based on how they generally thought that day. For data analyses, only the subscale with strategies to decrease body size was used because of its relevance for a population of eating disordered exercisers. Two smaller subscales were derived from this larger one so to separately assess the participants’ thoughts of eating and exercise as methods to decrease body size: “BCI-eat” (items 1,2 and 5) and “BCI-exercise”(items 3, 4, and 6), respectively.

Quality analyses—To assess the quality of the data provided by the participants, several analyses were performed. Frequency statistics were calculated to determine the number of useable days of data provided. Two participants (2.67%) supplied four days of usable data, two (2.67%) supplied five days, ten (13.33%) supplied six days, and the remaining 61 (81.33%) participants completed all days of data collection. With respect to exercise sessions, all but five of the 75 included participants with usable data exercised at least once during the data collection period. Eight participants exercised only one time during the measurement period and the remaining 62 participants exercised on multiple days. The average number of exercise sessions reported was 2.72 (SD = 1.54). There were no significant differences between the two groups on the number of completed days of data (HED: $M = 7.21$ [SD = 0.15], LED: $M = 7.18$ [SD = 0.27]; $t(72) = -0.10$, $p = 0.92$) or completed exercise questionnaires (HED: $M = 2.65$ [SD = 1.38], LED: $M = 2.86$ [SD = 1.86], $t(74) = 0.923$, $p = 0.36$).

Following completion of the study, participants were asked to report on a Likert scale (1(never) to 5(always)) how compliant they were in following instructions for the study. Participants who reported anything below a three (sometimes) were removed from the study (only one person). Seven participants (9.3%) reported that they were sometimes compliant, 29 (38.67%) reported that they were always compliant, and 40 (53.33%) reported that their compliance fell between sometimes and always. There were no group differences on reported compliance (HED: $M = 4.29$ [SD = 0.58], LED: $M = 4.29$ [SD = 0.71], $t(74) = 0.226$, $p = 0.82$).

Results and discussion

Table 4 displays the inter-correlations between the OEQ and the baseline measures, including, the BSQ, EAT, and the EDD-S. The results suggested that the OEQ was positively related to exercise behaviors, body dissatisfaction, and eating disordered psychopathology. Using the dates reported by participants on every questionnaire they completed, days were identified as either including an exercise session (exercise day) or not (non-exercise day). Exercise days were coded as 1 and non-exercise days were coded as 0. The data set included 521 total data points across the 76 participants. 340 of the data points were from exercise days and 181 were from non-exercise days. Descriptive statistics for the diary variables, including the negative affect, positive affect, and guilt subscales of the PANAS-X, the SSES, and the BCI-eat and BCI-exercise are presented in Table 5.

A MLM approach similar to that used in Study 1 was applied to assess the EMA data for Negative Affect, Positive Affect, and Guilt of the PANAS-X, the SSES, BCI-EAT, and BCI-Exercise. Each model included effects for non-exercise days (β_{00}), and the dummy coded variable that represented the difference between exercise days and non-exercise days (β_{10ij}). Random effects were included in the level 1 model to capture residual variation across days (e_{ij}) and the level 2 model to capture residual variation across individuals (r_j). As such, the initial model was as follows: Outcome Variable$_{ij}$ = ($\beta_{00} + \beta_{10ij}$) + ($e_{ij} + r_{0j} + r_{1j}$)

The findings indicated that positive affect was significantly higher on exercise days than non-exercise days ($\beta_{10ij} = 1.49$, $p < 0.05$) (Table 6). Negative affect was significantly lower on exercise days than non-exercise days ($\beta_{10ij} = -1.17$, $p < 0.02$). BCI-exercises scores were significantly higher on exercise days than non-exercise days ($\beta_{10ij} = 0.58$, $p < 0.01$). There was a not a significant difference in guilt ($\beta_{10ij} = -0.42$, $p = 0.20$), BCI-eat ($\beta_{10ij} = 0.05$, $p = 0.79$) or SSES ($\beta_{10ij} = -0.48$, $p = 0.08$) across exercise days and non-exercise days. Furthermore, there were significant individual level random effects for non-exercise days for positive affect ($r_0 = 39.76$, $p < 0.01$), negative affect ($r_0 = 36.76$, $p < 0.01$), guilt ($r_0 = 22.47$, $p < 0.01$), SSES ($r_0 = 17.91$, $p < 0.01$), BCI-eat ($r_0 = 10.36$, $p < 0.01$), and BCI-Exercise (r_0

= 10.79, $p < 0.01$). The random effect for the difference between exercise and non-exercise days was significant for positive affect ($r_{1j} = 10.14$, $p = 0.02$) and BCI-Exercise ($r_{1j} = 10.79$, $p = 0.03$).

Effect of OEQ and disordered eating on outcomes—OEQ scores and Disordered eating status (HED or LED) were added as level two predictors of ratings for non-exercise days (β_{01}, β_{02}) for all outcomes. These effects were also added as level two predictors of the difference between exercise and non-exercise days (β_{11}, β_{12}) for positive affect and BCI-Exercise. For non-exercise days, OEQ scores were positively associated with BCI-eat scores ($\beta_{01} = 0.17$, $p < 0.01$) and BCI-exercise scores ($\beta_{01} = 0.18$, $p < 0.01$). OEQ scores were unrelated to all other symptoms on non-exercise days. Additionally, the OEQ was unrelated to differences between exercise and non-exercise days for positive affect and BCI-exercise.

On non-exercise days, the HEDs reported significantly higher negative affect ($\beta_{02} = 3.17$, $p < 0.05$), guilt ($\beta_{02} = 3.33$, $p < 0.01$), BCI-eat ($\beta_{02} = 3.59$, $p < 0.01$), BCI-exercise ($\beta_{02} = 3.42$, $p < 0.01$), and SSES ($\beta_{02} = 4.20$, $p < 0.01$) than the LEDs (Table 6). Eating disorder status was unrelated to the difference between exercise and non-exercise days for positive affect and BCI-Exercise scores.

Interaction between disordered eating and obligatory exercise beliefs—Finally, an interaction between OEQ and disordered eating status was added to each of the models to determine if the association between obligatory exercise and outcomes on exercise days differed across HED and LED. For models in which positive affect and BCI-Exercise served as the outcomes, an interaction effect was added to the difference between exercise and non-exercise days for positive affect and BCI-Exercise. For non-exercise days, the interaction term was significant for BCI-Exercise ($b_{03} = -0.20$, $p < 0.01$). This suggested that, on non-exercise days, increased obligatory exercise was associated with more thoughts about eating on in the HED group as compared to the LED group (Fig. 1). The interaction terms for non-exercise days and the difference between exercise and non-exercise were not significant. The interaction term was not significant for the difference between exercise and non-exercise days for positive affect and thoughts about exercise.

This is the first study utilizing EMA to examine the impact of exercise absence and obligatory exercise beliefs on affect and cognitions in individuals with eating disordered psychopathology. The findings suggested that high levels of eating psychopathology are associated with poorer state affect and cognitions. This association occurred independent of the presence of exercise and obligatory exercise beliefs.

Eating disorder classification moderated the association between obligatory exercise and thoughts of eating. Participants with low levels of eating disordered psychopathology reported relatively stable disordered thoughts about eating, regardless of obligatory exercise beliefs or the presence of exercise. For participants with high levels of eating disordered psychopathology, increased obligatory exercise beliefs were associated with more dysfunctional thoughts about eating, regardless of whether exercise occurred.

Summary and concluding discussion

Obligatory exercise moderated the relationship between exercise absence and positive affect in study one, but did not moderate the relationship between affect variables exercise absence in study two. This conflicts with past EMA and retrospective research showing greater negative affect with exercise absence for obligatory exercisers (Hausenblas et al., 2008; Mond et al., 2006, 2008). It should be noted that participants in the present study were not explicitly told to exercise, in contrast to prior EMA studies (Hausenblas et al., 2008). The

impact of obligatory exercise on maladaptive affect and disordered cognitions may be mitigated when the individual can independently choose to exercise. Moreover, the present findings suggest that level of eating disordered psychopathology has consistent impact on affect state and disordered eating cognitions. Still, exercise dependence may moderate the pathogenesis of exercise behaviors to eating disordered psychopathology. Additional work should examine this association over markedly longer periods as opposed to a single week.

The findings also suggested that after accounting for obligatory exercise beliefs and eating disordered psychopathology, positive affect was significantly lower on non-exercise days than on exercise days. This finding is consistent with previous EMA research (Hausenblas et al., 2008). Further, negative affect was higher on non-exercise days. This is consistent with past research which has found that individuals report increases in negative affect on non-exercise days (Hausenblas et al., 2008).

The current studies had several limitations. First, all measures of affect and eating pathology were obtained with self-report measures, which are prone to error. Related, the use of paper diaries does not allow researchers to collect time stamps for each questionnaire. This can be problematic if participants choose to complete questionnaires at times other than those requested. However, in both study one and study two steps were taken to reduce issues of compliance and removing participants with questionable data from the analyses. Additionally, although the second study sought to examine differences between high and low eating disordered individuals, the groups were defined based on a self-report eating disorder assessment measure, not a clinical interview or diagnostic scale. Furthermore, the high eating disorder group included individuals with symptoms of a number of different eating disorders, including anorexia nervosa, bulimia nervosa, and binge eating disorder. It is possible that obligatory exercise may impact individuals with different types of eating disordered psychopathology in disparate ways. Additionally, the present study utilized a sample of undergraduate females thus the generalizability of the results is limited. Future research could examine these relationships in clinical populations as well as subgroups within clinical populations. However, studying eating disordered behaviors like exercise within a college aged female sample is still useful for researchers and clinicians alike due to the high levels of these body dissatisfaction and relatively frequent practice of compensatory strategies, particularly exercise, by that population (Crowther, Armey, Luce, Dalton, & Leahey, 2008; LePage, Crowther, Harrington, & Engler, 2008). On a related note, while the present studies contained participants with a wide range of obligatory exercise beliefs and behaviors, they did not specifically recruit for individuals high on that measure. It may be that the negative effects of obligatory exercise are only visible when examined in those with the highest scores on that measure. Future research may want to utilize similar protocols, but recruit specifically for individuals at the highest levels on the obligatory exercise questionnaire. Finally, the limited association between obligatory exercise and thoughts about eating in those with elevated eating pathology may be attributed to a ceiling effect. Those with high levels of eating disordered psychopathology may have reported maximum levels of disordered eating thoughts. Additional work that uses alternatives to self-report measures of eating thoughts are needed to better understand this relation.

Despite these limitations, the present study suggests that eating disordered psychopathology may more significantly impact day to day affect and cognitions than do exercise or obligatory exercise beliefs. For this reason, clinicians may want to focus first on reducing eating disordered behaviors and beliefs in patients with eating pathology before tackling obligatory exercise ones. However, the results of study one suggest that in college aged populations without eating pathology, degree of obligatory exercise beliefs may have a more dramatic impact on day to day negative affect. Additionally, the strong associations between obligatory exercise levels and measures of body dissatisfaction and eating pathology within

this population suggest that college administrators and clinicians should carefully monitor female students for signs and symptoms of these behaviors. This research extends the literature on exercise absence and obligatory exercise by using novel outcome measures, specifically eating- and exercise-related cognitions and by examining differences in the experience of exercise between women with and without eating disordered psychopathology. Moreover, the present work suggests the importance of assessing the impact of exercise absence under naturalistic conditions where participants decide whether or not to exercise.

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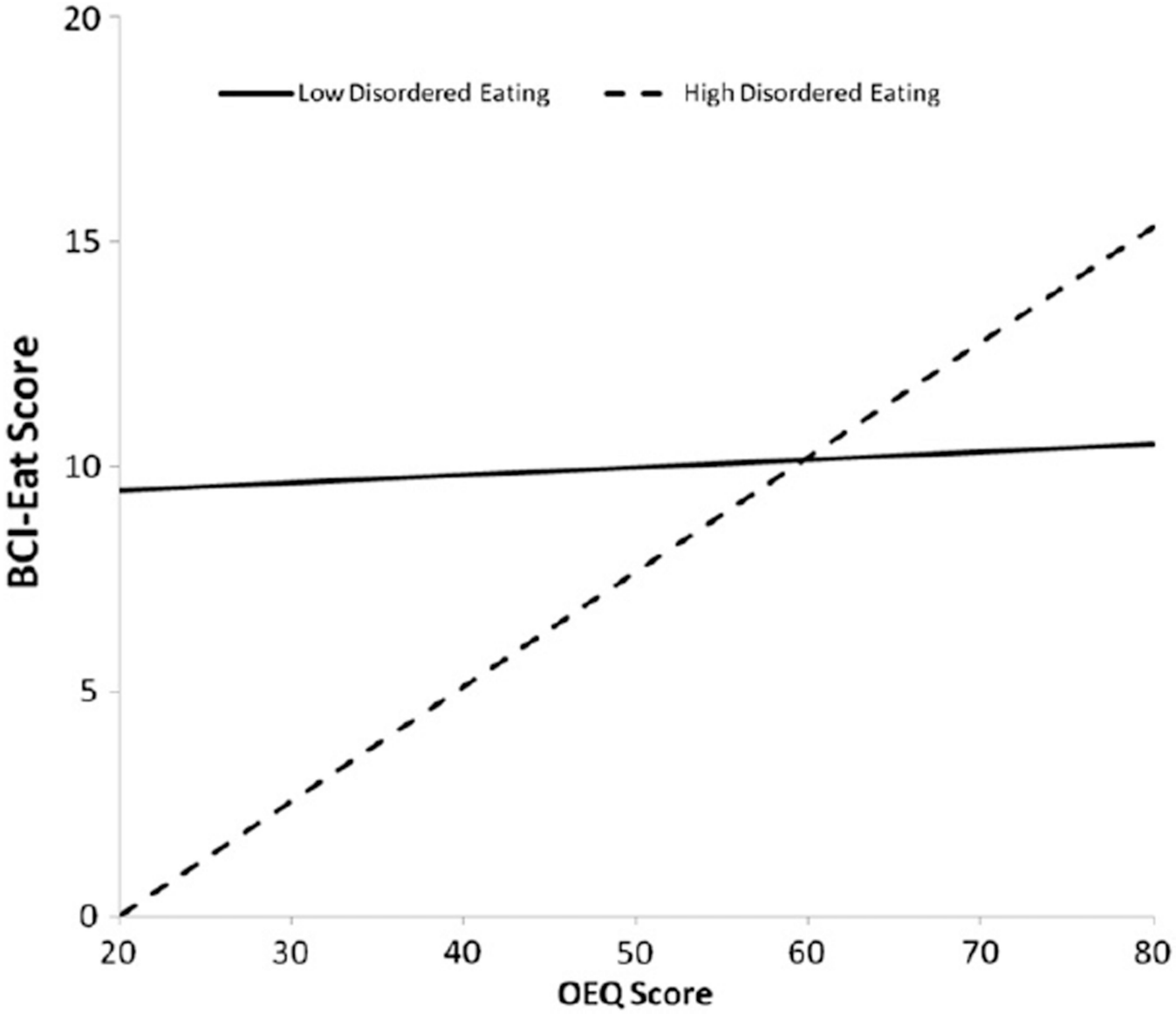

Fig. 1.
The relation between OEQ and BCI-Eat scores on non-exercise days across LED and HED conditions.

Table 1

Bivariate correlations between the OEQ and baseline measures of body dissatisfaction, internalization of the thin ideal, BMI, and disordered eating for study one.

Variables	1	2	3	4
1. OEQ	–			
2. BSQ	0.54**	–		
3. SATAQ	0.38**	0.64**	–	
4. EDD-S	0.54**	0.65**	0.43**	–
5. RRS	0.57**	0.78**	0.52**	0.67**

Note. OEQ = Obligatory Exercise Questionnaire; BSQ = Body Satisfaction Questionnaire; SATAQ = Sociocultural Attitudes Towards Appearance Questionnaire; EDD-S = Eating Disorder Diagnostic Scale; edd-s BMI = Eating Disorder Diagnostic Scale Body Mass Index; RRS = Revised Restraint Scale.

* $p < 0.05$.

** $p < 0.01$.

Table 2

Descriptive statistics for study 1.

		OEQ	PANAS-positive	PANAS-negative	PANAS-guilt
Non-exercise	Mean	45.62	25.19	14.35	7.86
	SD	8.35	7.95	4.64	2.78
Exercise day	Mean	47.31	26.67	14.01	8.07
	SD	8.54	7.50	4.81	2.91

Note. OEQ = Obligatory Exercise Questionnaire; PANAS = Positive Negative Affect Scale.

Table 3

Multilevel models comparing PANAS scales across non-exercise and exercise days and including OEQ scores as a moderator of these differences.

		PANAS-positive	PANAS-negative	PANAS-guilt
Exercise day	β_{000}	25.92**	14.25**	7.87**
Difference between days	β_{010jk}	−1.08	−0.15	0.07
Level 1 random effect	e_{ijk}	38.54**	7.82	2.77
Level 2 random effect	r_{0jk}	1.49	6.84**	2.69**
Level 3 random effect	u_{00k}	45.78**	12.09**	5.25**
	u_{10k}	6.52*	0.07	0.01
Exercise day	β_{000}	25.83**	14.24**	7.86**
OEQ	β_{001}	−0.01	0.11*	0.08
Difference between days	β_{010jk}	−1.04	−0.12	0.08
OEQ	β_{011jk}	−0.17*	–	–
Level 1 random effect	e_{ijk}	38.65**	7.90	2.89
Level 2 random effect	r_{0jk}	1.43	6.77**	2.57**
Level 3 random effect	u_{00k}	45.63**	11.14**	4.89**
	u_{10k}	4.34*	0.02	0.02

Note. OEQ = Obligatory Exercise Questionnaire; PANAS = Positive Negative Affect Scale.

* = $p < 0.05$.

** = $p < 0.01$.

Table 4

Bivariate correlations between the OEQ and baseline measures of body dissatisfaction, BMI, and disordered eating for study two.

Variables	1	2	3	4	5
1. OEQ	–				
2. BSQ	0.48**	–			
3. EAT	0.52**	0.84**	–		
4. EDD-S	0.62**	0.84**	0.81**	–	

Note. OEQ = Obligatory Exercise Questionnaire; BSQ = Body Satisfaction Questionnaire; EAT = Eating Attitudes Test; EDD-S = Eating Disorder Diagnostic Scale; edd-s BMI = Eating disorder diagnostic scale body mass index.

* $p < 0.05$.

** $p < 0.01$.

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Table 5

Descriptive statistics for study 2.

		OEQ	PANAS-positive	PANAS-negative	PANAS-guilt	BCI-eat	BCI-exercise	SSES
High eating disordered								
Non-exercise	Mean	50.02	25.38	19.60	11.93	10.24	10.57	17.92
	SD	9.22	9.11	8.48	6.48	2.87	3.01	4.75
Exercise day	Mean	52.33	26.51	16.74	10.25	10.53	11.17	16.95
	SD	9.72	7.96	6.78	5.71	3.11	2.95	4.73
Low eating disordered								
Non-exercise	Mean	41.59	28.18	15.16	7.29	5.43	5.81	12.70
	SD	7.68	8.14	5.00	2.65	3.51	3.03	3.81
Exercise day	Mean	45.43	30.68	13.13	6.87	5.74	6.88	12.81
	SD	6.55	9.77	4.32	1.92	2.93	3.40	3.03

Note. OEQ = Obligatory Exercise Questionnaire; PANAS = Positive Negative Affect Scale.

Table 6

Multilevel modeling examining the moderating effects of disordered eating status and OEQ.

		PANAS-positive	PANAS-negative	PANAS-guilt	BCI-eat	BCI-exercise	SSES
Non-exercise day	β_{00}	26.50**	17.40**	9.96**	8.58**	8.94**	16.04**
Difference between days	$\beta_{10\,ij}$	1.49*	−1.17*	−0.42	0.05	0.58**	−0.48
Random effects							
Level 1	e_{ijk}	36.39**	19.72**	9.96**	3.72	2.81	7.06*
Level 2	r_{0jk}	39.76**	36.76**	22.47**	10.36**	10.79**	17.91**
	r_{1jk}	10.14*	2.14	0.31	0.08	0.61*	0.16
Non-exercise day	β_{00}	27.93**	15.42**	7.87**	6.32**	6.78**	13.38**
OEQ	β_{01}	0.02	0.08	0.10	0.10*	0.11**	0.06
Disordered eating status	β_{02}	−2.24	3.17*	3.33**	3.59**	3.42**	4.20**
Difference between days	$\beta_{10\,ij}$	2.88**	−1.68**	−0.56	−0.64*	0.16	−0.50
OEQ	$\beta_{11\,ij}$	−0.03	−0.05	−0.01	−0.02	<0.01	−0.02
Disordered eating status	$\beta_{12\,ij}$	−2.21	0.74	0.14	1.07**	0.64	0.03
Random effects							
Level 1	e_{ijk}	36.48**	19.66**	9.93*	3.68	2.81	7.06*
Level 2	r_{0jk}	38.50**	33.01**	17.79**	5.15**	5.62**	12.58**
	R_{1jk}	7.89*	2.03	0.42	0.01	0.48*	0.14

Note. OEQ = Obligatory Exercise Questionnaire; PANAS = Positive Negative Affect Scale.

* = $p < 0.05$.

** = $p < 0.01$.