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ORIGINAL ARTICLE

Affect and Exercise: Positive Affective Expectations Can Increase Post-Exercise Mood and Exercise Intentions

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Abstract
Background Prior research has found affect to predict exercise. Little research has examined the causal influence of exercise-related affect on exercise intentions.
Purpose The purpose of this study was to test whether expectations about post-exercise affect can be successfully manipulated to produce changes in post-exercise affect and exercise intentions. We also tested whether cognitively elaborating on the expectation would increase the duration of the expectation effect.
Methods Participants (59 men, 89 women) were exposed to an affective expectation manipulation as well as an elaboration manipulation and then completed 10 min of light-intensity exercise on a stationary bicycle in the laboratory. Participants also completed a 2-week follow-up.
Results Affective expectation participants displayed more positive post-exercise affect and exercise intentions than no-expectation participants (ps<.05). Affective expectation participants who also elaborated on that expectation reported more positive post-exercise affect during the follow-up than the no-elaboration participants (p<.05).
Conclusion Expectations about positive post-exercise affect can be experimentally manipulated to increase exercise-related feelings and intentions. The duration of this effect increases when individuals cognitively elaborate on the expectation.

Keywords Exercise · Affect · Expectations · Persuasion · Placebo effect

Epidemiological research consistently links regular physical activity to lower all-cause and cardiovascular mortality [1]. These findings, and others like them, provide a strong basis for encouraging individuals to perform regular bouts of physical activity, such as exercise. The Centers for Disease Control (CDC) recommends that healthy adults perform 150 min of moderate-intensity aerobic activity per week (http://www.cdc.gov/physicalactivity/everyone/guidelines/adults.html). As relatively few individuals meet the CDC's recommendation [2], researchers have been exploring determinants of exercising.

Feelings and Exercise

Research into the determinants of exercise behavior has historically concentrated on cognitive variables. For example, one prominent cognitive model, the Theory of Planned Behavior, focuses on subjective norms, attitudes, perceived behavioral control, and intentions to exercise [3]. Recently, studies have begun focusing on the role of affect in predicting exercise behavior and intentions [4]. For example, in a cross-sectional study, Kiviniemi et al. [5] assessed participants' current physical activity, their feelings about exercise, and the cognitive variables used to predict exercise behavior in the Theory of Planned Behavior and the Health Belief Model [3, 6]. Positive feelings regarding exercise were a better predictor of physical activity in this study than were cognitive variables. Moreover, the positive feelings statistically mediated the link between the cognitive variables and physical activity. Employing a longitudinal design, Williams et al. [7] found that a positive affect assessment at the time when participants reached 85 % of their age-predicted heart rate maximum was positively correlated with the number of minutes the participants exercised at 6- (r=.50) and 12- (r=.47) month follow-ups. More recently, Kwan and Bryan [8] also used a longitudinal design and observed that increases in positive affect while exercising on a treadmill for 30 min predicted exercise 3 months later. In addition, in a test of statistical moderation, Kwan and Bryan found that intentions to exercise were a stronger predictor of subsequent exercise

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behavior for participants who experienced positive feelings during and post-exercise compared to participants who did not experience positive feelings during and post-exercise.

The aforementioned studies, and others like them (e.g., [9–13]), suggest that feelings can play an important role in accounting for exercise behavior. These results raise the possibility that interventions could be developed to increase exercise behavior by enhancing positive feelings. Before doing so, however, it is necessary to determine if feelings about exercise can be successfully manipulated and if the resulting changes in feelings about exercise have a causal influence on exercise intentions and behavior. Complicating matters is that it is not entirely clear how individuals develop positive feelings toward exercise—making it difficult to design experimental procedures that boost exercise-related feelings [4].

One approach to changing the feelings associated with exercise is to alter the mood states individuals are in when they think about exercising. As mood states can color judgments and memory, altering moods may change exercise evaluations and judgments (e.g., [14]). To examine this possibility, Allen et al. [15] conducted a laboratory study in which mood was manipulated via clips from feature films. Participants watched either a positive, neutral, or negative clip and then answered questions assessing exercise intentions, norms, and attitudes toward exercise. Consistent with predictions, participants in the negative mood condition reported less favorable evaluations of exercise than those in the other two conditions. Unexpectedly, however, participants in the neutral condition reported greater intentions to exercise than participants in the positive or negative mood conditions, and subjective norms and behavioral control did not differ across conditions. Moreover, as participants did not engage in any exercise behavior in this study, it is unclear if these observed effects would apply to physical activity.

Expectations and Exercise

One promising approach to increasing exercise through promoting positive feelings comes from the literatures on affective expectations and placebo effects [16]. Expectancies have been shown to shape feelings and somatic sensations such that they are experienced in an expectation-congruent fashion [17–25]. Evidence that expectations guide affective and somatic experience has been found using both subjective and neurobiological measures [26–30]. However, subjective experiences are not always shifted toward expectations. Research indicates that subjective experiences are more likely to be assimilated with an expectation when experiences are ambiguous or consistent with the expectation [31–34].

As expectations can shape feeling states, manipulating them may increase positive feelings about exercise. At least three lines of research from the exercise literature support taking this approach. First, expecting that exercise will make you feel good has been found to predict exercise behavior [35, 36]. Thus, positive affective expectations are associated with more exercising. Second, affectively framed messages can increase self-reported level of exercise more than cognitively framed messages [37], which supports the notion that affective communications can be used for affective interventions. Third, although not focused on affect, one study [38] has successfully employed an expectation manipulation to alter the perceived consequences of exercising. Prior to taking part in a 10-week exercise program, participants in an expectation condition were told that the program had been designed to increase psychological well-being as well as physical fitness. Participants in a control condition were only told that the program would alter physical fitness. At the end of the 10 weeks, the groups did not differ on aerobic fitness or enjoyment of the program, but expectation participants had significantly increased self-esteem compared to control participants. These results provide initial evidence that expectation manipulations can be used to change the perceived effects of exercising. The study, however, did not directly test whether expectations about exercise can increase positive feelings toward exercise. Further, exercise intentions and adherence were not assessed in this study.

Affective Expectations and Post-Exercise Affect

In the present research, we experimentally manipulated affective expectations to determine if they can change exercise-related affect, intentions, and behavior. We focused our manipulation on altering expectations about post-exercise feelings rather than on changing the feelings experienced during exercise. Several important considerations led us to focus on post-exercise feelings. First, research has found that, similar to feelings during exercise, positive post-exercise feelings can predict future exercise behavior and can increase the link between exercise intentions and behavior [8, 39]. Second, mood states during exercise can be quite negative—particularly for individuals who do not engage in regular physical activity [40, 41]. Post-exercise affect, by comparison, tends to be neutral to positive [42]. As noted previously, prior research indicates that experiences are more likely to be assimilated with affective expectations when the valence is neutral or consistent with the expectation. As such, post-exercise affect should be more open to affective assimilation than affect experienced during exercise. Third, individuals often report believing that exercise does make them feel better [43]. Although evidence for this post-exercise affective boost is complicated (see [44]), the fact that many individuals are familiar with this idea should facilitate the acceptance of this expectation.

Changing Beliefs over Time

The primary focus of the present work was to determine whether an affective expectation manipulation can increase post-exercise affect, exercise intentions, and exercise behavior. If found, the results would provide initial evidence that affect-focused interventions can be designed to increase exercise. Brief laboratory interventions like this, however, tend to produce only short-term change. Such limited effects make sense given the relatively small portion of the participant's overall experience with exercise that has been affected in the laboratory setting. For this reason, a secondary goal in this study was to explore a way to strengthen the out-of-laboratory consequences of our affective expectation manipulation.

As affective expectations are in essence beliefs about our future feeling states, we drew on the Elaboration Likelihood Model (ELM; [45, 46]), which makes clear predictions on how to change immediate and enduring beliefs. According to the ELM, the amount of mental processing an individual uses when evaluating a message varies along a continuum from low to high elaboration. Low levels of message elaboration refer to when individuals expend little thought and cognitive effort in reaching an assessment (e.g., making an evaluation based on a simple mental heuristic). High levels of message elaboration refer to when individuals use considerable cognitive resources to carefully consider a message (e.g., assessing the relevance and merit of different arguments). According to the ELM, high and low levels of elaborative message processing can both lead to belief change in the short-term. Critical to the current research, however, is the model's prediction that belief change occurring through high levels of elaborative processing tends to last longer than belief change occurring through low levels of elaborative processing [47, 48]. Importantly, prior research indicates that elaboration level can be altered by situational factors, such as increasing message relevance, asking individuals to generate arguments advocating a position, and by directing individuals to spend time considering the merits of a communication [48–50]. Consequently, researchers have been able to stimulate higher levels of message elaboration to generate persuasion effects that are longer in duration [48].

In the context of the present research, the ELM leads to the following two predictions. First, regardless of whether individuals process an affective expectation message with high or low levels of elaboration, the belief in positive post-exercise feelings should be similar in the short-term. Second, individuals engaging in high levels of elaborative processing of the affective expectation message should be more likely to maintain the belief in positive post-exercise feelings than individuals engaging in lower levels of elaborative processing. To test these subsidiary predictions, we included a second experimental manipulation aimed at increasing message elaboration. Further, we provided participants an opportunity to take part in a follow-up study in which we assessed their exercise behavior and affective reactions to that exercise for 2 weeks.

The Current Research

In the present study, we manipulated affective expectations and mental elaboration before participants took part in a brief bout of light-intensity exercise on a stationary bicycle in the laboratory. Exercise was purposefully light in intensity and short in duration (10 min). These design parameters for the exercise task were selected because prior research suggests that positive affective expectations are more effective at altering the perception of ambiguous experience, rather than aversive experiences [31–34]. Thus, to test whether affective expectations can change post-exercise affect, we chose a briefer and less intense exercise experience. After exercising on the stationary bicycle, we assessed post-exercise mood and intentions to engage in further exercise. Our primary prediction was that participants in the affective expectation condition would experience more positive post-exercise affect and intend to exercise more in the future than participants in the no-expectation condition. Further, all participants were also given the option to participate in a follow-up study in which they reported on their daily exercise and their feelings after exercising. Based on the ELM, we predicted that participants who were given the affective expectation and elaborated on that expectation would continue to report more positive moods post-exercise in the 2-week follow-up as compared to the other participants.

Method

Participants

Participants were 140 undergraduates (51 men and 89 women) at a large Midwestern open-enrollment university in an urban setting. Participants received partial course credit for enrolling. Participants' ages ranged from 18 to 30, and 50 % were in their first year of college. Recruitment was through Sona Systems, an online participant sign-up system. Participants signed up for a 30-min study and were asked to wear comfortable shoes but were not informed ahead of time that the study concerned exercise. Participants were healthy and free of medical conditions that would preclude 10 min of light exercise. One potential participant was excluded due to a leg injury. Assessment of habitual levels of exercise (described below) revealed that 41 % of the sample met the CDCs' recommendations for physical activity. Twenty-seven percent reported vigorous or moderate intensity exercise 1–2 days a week, and 12.1 % reported no vigorous or moderate intensity exercise. No varsity athletes participated in the study. Table 1 presents participant characteristics by condition. All procedures were approved in

Table 1 Participant characteristics by condition

		Affective expectation	No expectation
Elaboration	*n*	34	35
	Percent female	65	63
	Percent Caucasian	65	46
	Number of smokers	1	3
	M age	19.6	19.5
	Height (m)	171.4 (10.6)	168.8 (9.4)
	Weight (kg)	74.2 (17.4)	74.3 (15.3)
	Physical activity	1.6 (0.8)	1.4 (0.7)
	Pre-BMIS	45.8 (8.7)	44.7 (6.8)
No elaboration	*n*	35	36
	Percent female	63	64
	Percent Caucasian	63	67
	Number of smokers	5	5
	M age	19.8	18.8
	Height (m)	172.3 (9.6)	171.4 (11.4)
	Weight (kg)	78.6 (20.6)	68.4 (12.7)
	Physical activity	1.7 (0.7)	1.7 (0.9)
	Pre-BMIS	47.6 (6.7)	44.7 (9.8)

Physical activity was measured using the three-question physical activity assessment. Scale values range from 0 to 3, with higher numbers equating to more exercise. Pre-BMIS refers to the first measurement of the Brief Mood Introspection Scale

advance by the university's institutional review board. Participants read and signed an informed consent document prior to taking part in the study.

Design

Participants were randomly assigned to one condition in a 2 (expectation: no expectation vs. affective expectation)×2 (elaboration: no elaboration vs. elaboration) between-subjects factorial design. Specifically, prior to the exercise task, participants were either given the expectation that individuals experience positive feelings post-exercise or were instead given basic information about the exercise bicycle. Orthogonal to this affective expectation manipulation was an elaboration manipulation. For this manipulation, participants were asked to either list their thoughts about the information that the experimenter provided or not.

Materials and Apparatus

Assessment of weekly physical activity The three-question physical activity assessment is a brief and reliable measure of physical activity [51]. This measure contained one item assessing vigorous activity, one assessing moderate intensity activity, and one assessing walking. Each item was rated on a scale consisting of the following four response options: none, one to two times a week, three to four times a week, and five or more times a week. Responses to the three items (coded from 0 to 3) were averaged together to create a measure of physical activity. Cronbach's alpha reliability coefficient indicated good reliability, α=.78. Scores on this measure were used to determine if there were a priori differences in physical activity among conditions.

Mood assessment The Brief Mood Introspection Scale (BMIS; [52]) is a 16-item mood instrument consisting of positive (e.g., happy and lively) and negative (e.g., miserable and nervous) adjectives. Participants answered each item on a five-point scale from 0=*do not feel* to 4=*feel very strongly*. Negative items were reverse scored, and then, all items were summed to create a total score with higher numbers indicating a more pleasant mood. Participants completed this measure at the beginning of the study and immediately following the bout of exercise (for time 1, α=.81; for time 2, α=.82). The first measurement was used to assess whether a priori differences existed in mood states among conditions. The post-exercise BMIS scores were used as our primary mood-dependent measure.

Exercise ratings Following the bout of exercise, participants reported on how comfortable they found the exercise bicycle (1=*uncomfortable*; 7=*comfortable*) and how difficult they found the workout (1=*difficult*; 7=*easy*). As our manipulations

were focused on altering participants' post-exercise experience, these items were included to verify that participants in the different conditions had similar experiences during the exercise activity.

Exercise intention index Near the end of the study sessions, participants answered four questions about their future intentions to exercise. Each item was on a seven-point rating scale with higher scores indicating greater intentions to work out. These items were as follows: (1) How often do you intend to take part in regular physical activity, (2) I intend to exercise frequently during the remainder of the semester, (3) I want to exercise regularly, and (4) I will try to exercise at the student recreation center regularly. These items were averaged together to form an overall self-reported exercise intention index (α=.84).

Behavioral measure of exercise intentions At the conclusion of the study sessions, the experimenter offered each participant a magazine that described the campus recreation center and schedule of activities at the center. The magazine was a 36-page letter-size glossy publication. Whether or not participants took a magazine was surreptitiously recorded by the experimenter, and this dichotomous score ("yes, they took a magazine" or "no, they did not take a magazine") was used as a behavioral measure of participants' desire to engage in future exercise.

Longitudinal exercise surveys All participants in the study were offered the opportunity to participate in a 2-week exercise follow-up. Using SurveyMonkey, participants were contacted by e-mail each day at 5:00 p.m. and were given 24 h to answer. Daily surveys consisted of up to four questions. First, participants were asked if they exercised that day. If participants indicated that they did not exercise that day, they were not asked any additional questions. If participants indicated that they did exercise, they were then asked the following: (1) what type of exercise they did, (2) how long they exercised, and (3) how they felt after they completed the exercise session (on a five-point scale, ranging from 1=*not all positive*; 5=*very positive*).

Stationary exercise bicycle During the study sessions, participants exercised on a Nautilus U/R514 recumbent stationary exercise bicycle (Nautilus, Vancouver, WA). To maximize comfort, this bicycle has an adjustable seat and pedal straps. The bicycle has a chest strap containing a contact heart rate sensor that remotely transmits heart rate in beats per min to the stationary bicycle console computer. The bicycle has a heart rate control function which allows the exercise program to maintain the participants' heart rate at a specific level during an exercise session.

Procedure

Participants arrived individually to a laboratory designed to look like a small gym containing a stationary bicycle, balance ball, jump rope, mats, and dumbbells. First, participants signed an informed consent document, and then, they filled out a personal health history measure, the three-item physical activity assessment, and the BMIS.

Then, participants in the *affective expectation conditions* were told "There is recent research on the effect physical activity has on mood. It has been shown that exercise often results in good moods, happiness, contentedness, feelings of personal satisfaction, and increases in self-esteem. Currently, our research team is interested in further understanding this relationship." Participants in the *no-expectation conditions* were not given this expectation information and instead were told basic information about the stationary bicycle that they were about to use.

Next, participants in the *elaboration conditions* were given 2 min to write about the information they had just been given. Specifically, affective expectation participants were provided a pen and a half sheet of paper with six lines and asked to list any thoughts they had about why exercise elevates moods. In the no-expectation condition, the elaboration participants were similarly provided a pen and paper; however, they were asked to list any thoughts they had about stationary bicycles. Finally, participants in the *no-elaboration conditions* did not engage in any thought-listing task and simply went directly to the next portion of the study. Other than the condition instructions, all other aspects of the procedure were identical for all participants.

All participants were then asked to exercise on a stationary bicycle for 10 min. Before beginning, the height of the bicycle seat was adjusted to fit the participant, and participants put on a chest strap containing a digital remote heart rate monitor that was linked to the stationary bicycle console computer. Because of evidence that post-exercise affect is related to exercise intensity [53], we attempted to control the intensity across participants. The exercise program was set to maintain the workout at 65 % of each participant's maximum heart rate (220−age), designed to be a light-intensity workout. After the workout was complete, participants were asked to complete the BMIS a second time. They also answered questions about their exercise experience and their intentions for future physical activity. Finally, participants were offered a 36-page letter-size glossy magazine describing the campus recreation center. Instead of handing the magazine to the participant, experimenters merely pointed to the publication which was placed on a table across the room. These procedures ensured that only participants who truly wanted a magazine took one and required them to initiate a new behavior to do so. The experimenter discretely recorded whether or not each participant took a magazine. Before the end of the session, participants were invited to participate in optional follow-up surveys.

Results

Preliminary Analyses

To assess if there were any pre-existing differences between the four conditions, 2 (expectation)×2 (elaboration) between-subjects analyses of variance (ANOVAs) were performed on weekly physical activity, pre-exercise BMIS, ratings of the comfort of the stationary bicycle, and difficulty of the workout. Analysis of these scores verified that there were no prior differences on these measures between experimental conditions. In addition, we counted the number of words that the elaboration participants provided to assess whether the number of words written differed across the affective expectation and control conditions. No differences were found in the number of words written between these two conditions.

Mood Assessment

To determine the influence of the expectation and elaboration manipulations on participants' mood states, BMIS scores recorded after the 10 min of exercise were submitted to a 2 (expectation)×2 (elaboration) between-subjects ANOVA. This ANOVA yielded a significant main effect of expectation condition, $F(1, 136)=9.31$, $p=.003$, $\eta^2_p=.06$ (see Table 2 for individual cell means). This main effect indicates that participants in the affective expectation conditions ($M=49.1$, SD=8.0) experienced a more positive mood state post-exercise than participants in the no-expectation conditions ($M=44.8$, SD=8.5). Mood scores did not differ based on elaboration condition, and the expectation×elaboration interaction was not significant. This ANOVA was also conducted with weekly physical activity included as a covariate, and the results were unchanged.

Exercise Intention Index

Scores on the exercise intention index were then analyzed using the same 2 (expectation)×2 (elaboration) between-subjects ANOVA (see Table 2 for individual cell means). As with the mood scores, this ANOVA resulted in only a significant effect of expectation condition, $F(1, 136)=6.87$, $p=.01$, $\eta^2_p=.05$, such that affective expectation participants reported greater intentions to exercise ($M=6.0$, SD=1.1) in the future as compared to no-expectation participants ($M=5.5$, SD=1.2). The main effect of elaboration and the expectation×elaboration interaction were non-significant. This analysis was also conducted with a weekly physical activity added as a covariate, and the results were unchanged.

Behavioral Measure of Exercise Intentions

Recall that to provide a more objective indicator of intentions to exercise, we recorded whether or not participants took a magazine describing the campus recreation center as they left their study session (No=0; Yes=1). Two participants indicated that they worked at the campus recreation center and thus did not need the magazine. These two participants were excluded from the analysis of this dependent variable. A logistic regression was used to assess whether taking the magazine (i.e., a dichotomous variable) was influenced by the expectation manipulation, the elaboration manipulation, or their interaction. In this analysis, expectation condition and elaboration condition (both dummy coded) were included on the first step of the regression model, and the interaction between these two variables was included on a second step of the model. This analysis yielded a significant main effect of expectation condition, $\beta=-1.03$, Wald χ^2 (1)=4.14, $p=.04$, with a larger percent of the affective expectation participants taking the magazine (51 %) than no-expectation participants (39 %). The elaboration main effect and the expectation×elaboration interaction were non-significant. Finally, this logistic regression was also conducted controlling for weekly physical activity, and the findings were unchanged.

Follow-Up Exercise Data

We then examined the daily follow-up exercise data. One hundred thirty-one participants (94 %) agreed to participate in the follow up. Of the 131 participants who agreed to participate in the follow-up study, 98 (75 %) completed at least one of the daily surveys. However, many of these participants failed to complete all 14 follow-up surveys, so a maximum likelihood estimation using the expectation–

Table 2 Means and standard deviations (in parentheses) on the post-exercise mood and exercise intention measures as a function of elaboration condition and expectation condition

	No elaboration		Elaboration	
Measure	No expectation	Expectation	No expectation	Expectation
Post-exercise mood	44.5 (9.9)	50.0 (7.3)	45.2 (6.8)	48.2 (8.7)
Exercise intentions	5.5 (1.3)	6.1 (0.9)	5.5 (1.0)	5.9 (1.2)

Higher scores indicate more positive moods and intentions to exercise, respectively

maximization algorithm was employed to estimate and impute missing data from the available responses. In order to avoid estimating data based on too little information, participants were excluded if they were missing more than 50 % of the follow-up surveys. The two experimental manipulations were included in the estimation algorithm as predictors of missingness, and estimates were constructed using IBM SPSS 20's Missing Value Analysis software. Whether or not participants exercised was estimated using logit regression, whereas time spent exercising and post-exercise mood were treated as continuous so that linear regression was the basis of imputing missing values within a maximum likelihood model. Notably, when we compared the sample examined in the longitudinal follow-up analyses with the remainder of the sample, we found no differences based on height, weight, age, sex, weekly physical activity, or condition assignment.

We summed the number of days that participants reported exercising and the distribution of this dependent variable did not violate the assumption of normality. We submitted scores on this summary measure to a 2 (expectation)×2 (elaboration) ANOVA (see Table 3 for individual cell means). This ANOVA yielded no significant effects. Next, we analyzed the average length of time participants reported exercising. When the data indicated that a participant did not exercise on a given day, the corresponding amount of time variable for that day was set to zero. Thus, participants indicating that they did not exercise always had "0"min for the corresponding length of time. When we averaged scores on the exercise length questions (normally distributed) and submitted them to a 2 (expectation)× 2 (elaboration) ANOVA, this ANOVA produced no significant effects (see Table 3 for individual cell means). In sum, the two manipulations did not directly alter exercise behavior in the 2-week follow-up study.

Finally, the key prediction based on the ELM was that only the affective expectation participants given the opportunity for elaboration would continue to report elevated post-exercise mood during the follow-up. To test this ELM-based hypothesis, we again used maximum likelihood estimation to estimate missing values. Because participants cannot have a post-exercise mood without first exercising, when the data indicated that a participant did not exercise on a given day, the corresponding post-exercise mood was not estimated. When we averaged scores on the post-exercise mood questions and submitted them to a 2 (expectation)×2 (elaboration) ANOVA (weighted by the number of days the participant reported exercising), this ANOVA yielded only a significant expectation×elaboration interaction, $F(1, 57)=4.58$, $p=.04$, $\eta^2_p=.07$ (see Table 3 for individual cell means). Simple effect tests revealed that, consistent with the predictions of the ELM, participants in the elaboration condition who were given the affective expectation continued to report experiencing more positive moods post-exercise than participants given no expectation, $t(57)=2.47$, $p=.02$, $d=.65$. In the no elaboration condition, the affective expectation participants and the no-expectation participants did not differ in their post-exercise mood scores.

Our analyses of the number of days exercised, length of time exercising, and post-exercise mood were also conducted with weekly physical activity included as a covariate. The results were unchanged with this covariate in the analyses.

Discussion

Prior research indicates that feelings about exercise can predict exercise intentions and behavior. Thus far, this work has largely been correlational. In the present study, we experimentally manipulated expectations about post-exercise affect to determine if we can intervene to change these exercise-related feelings. Specifically, following a positive affective expectation manipulation, participants exercised for 10 min, and then, we measured post-exercise mood, exercise intentions, and behavioral intentions. Compared to a no-expectation condition, participants who received the affective expectation manipulation reported more positive post-exercise mood, greater intentions to exercise, and displayed behavioral intentions to exercise. The results were not modified by controlling for previous physical activity. These data indicate that post-exercise feelings and intentions can be altered by an affective expectation intervention. To our knowledge, this is the first study to demonstrate that experimentally manipulated

Table 3 Means and standard deviations (in parentheses) for the number of days exercising, average amount of time exercising, and post-mood exercise during the 2-week follow-up as a function of elaboration condition and expectation condition

	No elaboration		Elaboration	
Measure	No expectation	Expectation	No expectation	Expectation
Exercise days	6.4 (3.5)	6.2 (3.2)	5.2 (3.3)	4.8 (4.2)
Time exercising	43.3 (23.6)	41.1 (19.4)	26.1 (7.6)	40.9 (16.5)
Post-exercise mood	4.2 (0.4)	4.1 (0.3)	3.8 (0.4)	4.3 (0.3)

Higher scores indicate more days of exercising, time exercising, and positive moods, respectively

affective expectations can elevate participants' post-exercise mood and increase intentions to exercise.

The current results show that exercise-related feelings can be changed by altering participants' expectations. Further, the affective expectation manipulation not only changed feelings but also changed intentions toward future exercise. These findings are consistent with prior studies, which have shown that affective expectations bias feeling states in an expectation-congruent manner and can also change behavioral intentions [54]. These results raise the prospect that inducing positive affective expectations about exercise could be used as a component of exercise adherence interventions. This will clearly require experiments that clarify the precise conditions under which affective expectations enhance positive feelings about exercise. Moreover, it may even be possible that over time, the link between affective expectations and exercise can become self-sustaining. That is, expectations that exercise enhances positive feelings could foster increased exercise, which could result in affective assimilation, which in turn could promote additional exercising. This self-sustaining chain of events is consistent with work on emotion regulation [55], although many critical factors may need to be in place for it to manifest.

In this study, we focused on post-exercise affect rather than affect during exercise. At first glance, it might seem that a more direct approach would have been to change feelings during the exercise event rather than the feelings experienced afterward. As noted at the outset, however, prior work suggests that post-exercise affect should be more open to an affective expectation intervention than feelings during exercise. Chief among these reasons is that feelings during exercise are often more negative than those felt after exercise and consequently may be less open to affective assimilation. As we did not focus on altering feelings during exercise in the current study, whether affective expectations can be used to change feelings during exercise remains an open question. At present, we should not assume that affective expectations have similar effects on feelings during and after exercising. One notable reason for this caution is that when affective expectations are clearly inconsistent with an experience, feelings can be contrasted with an affective expectation [20]. That is, individuals could actually come to feel worse during exercise if there is an obvious mismatch with the expectation to feel good.

Although the current work focused on affect and exercise, the results do not support taking only an affective approach to theoretical models of exercise. In this study, a cognitive variable—expectation—was central in increasing the feeling component of exercise. Thus, these data are consistent with a hybrid approach, one merging both cognitive and affective factors. Here, the cognitive variable was instrumental in fostering the positive affective state after exercising. This result is consistent with other work suggesting that cognitive processes—such as those involved in contextual appraisal, attributions, and re-appraising events—are key in promoting and intensifying affective states [56–58].

An important direction for future research is to examine the mechanisms by which affective expectations alter post-exercise affect. One possibility arising from the ELM [46, 50] is that affective expectations often alter experience through a heuristical style of processing. That is, in the present study, the expectation made the belief that exercise elevates mood states highly accessible, and this simple heuristic biased how participants interpreted their post-exercise experience. The ELM suggests that when participants elaborated more on the affective expectation, positive post-exercise affect came about through a more thoughtful process. Thus, positive post-exercise affect was generated by different processes for the high and low elaboration participants. Prior ELM studies are consistent with this two-process explanation [50]. One result of the present study that is somewhat inconsistent with the ELM is that we did not find differences on exercise intentions across elaboration conditions. In some ELM studies, but not all, behavioral intentions have been influenced more when participants elaborated on the message [47, 48]. Behavioral intentions may not have been altered by the elaboration manipulation in the present study because intentions were measured while participants were still in a positive mood state.

A second possible explanation can be derived from the affective association model [5]. This model suggests that affective expectations change the amount or strength of mental associations linking exercise and positive affect. An interesting implication of this affective association perspective is that affective expectations could differ in how they alter mental associations, and thus, some will produce stronger exercise interventions than others. These explanations are only two of many potential mechanisms underlying this affective expectation effect, and further research is required to test between these and other explanations.

The present data also have implications for the debate on whether exercising increases positive affect. Substantial research indicates that engaging in exercise can make individuals feel better [42]. This relationship, however, does not always hold [44]. The current studies suggest that the strength of this relationship is at least partially due to whether one expects to feel positive after exercising. That is, based on our results, it can be surmised that anticipating feeling better post-exercise contributes to this post-exercise mood effect.

We also examined the consequences of our affective intervention outside of the laboratory session. Specifically, participants were given an opportunity to report on their exercise behavior and feelings after exercising during a 2-week follow-up. On its own, the affective expectation manipulation was not associated with the number of times that participants exercised, how long they exercised, or the feelings they had post-exercise. These results indicate that the independent effect of the affective expectation manipulation diminished

considerably outside of the experimental context. One implication of these results is that on its own, an affective expectation induction like the one employed here may be limited.

Because laboratory manipulations often have such boundaries, we also tested one possible strategy to magnify the strength of a brief affective expectation manipulation. This strategy was based on the ELM [45, 46]. The ELM predicts that whereas high and low elaboration processing often leads to similar belief change in the short-term, belief change occurring through high elaborative processing is more durable over time [48]. As such, we examined whether individuals who engaged in more mental elaboration on why exercise increases post-exercise positive affect would be more likely to report positive feelings than individuals who did not engage in this additional elaboration. The results were consistent with the predictions of the ELM. First, moods and exercise intentions recorded in the laboratory sessions did not differ based on the elaboration manipulation. Second, participants who received both the expectation manipulation and the elaboration manipulation did continue to report more positive post-exercise mood during a 2-week follow-up. These findings advance the possibility that the strength of an affective expectation intervention could be enhanced by more extensive message elaboration. Although supportive, it should be noted that the follow-up portion of the study did not contain the entire study sample. As such, these findings support the ELM predictions, but they should be interpreted with some caution and merit replication.

Although the expectation and elaboration manipulations combined to determine post-exercise mood in the follow-up portion of this study, neither manipulation altered out-of-laboratory exercise behavior. We suggest that because the expectation and elaboration manipulations were aimed at changing beliefs about post-exercise mood—and were not directed at behavior—the mood variable was most likely to show effects in the follow-up portion of the study. Based on previous research linking positive affect to exercise [5], we would predict that increasing post-exercise affect can lead to more exercise. It may be that the 2-week follow-up period used here was too brief for feelings to change exercise behavior. It may also be that a stronger affective expectation manipulation or repeated affective expectation interventions are needed to lead post-exercise affect to alter exercise behavior.

The current study has a variety of important limitations. One key limitation is that, unlike other studies investigating the link between exercise and positive affect, we used a 10-min aerobic exercise event that was designed to be light in intensity. It will be essential for future studies to determine if affective expectation manipulations can be employed with longer and more intense exercise bouts—particularly ones that are more consistent with the CDC's exercise recommendations. That said, this kind of brief and accessible exercise experience may be particularly susceptible to affective expectation effects and thus useful in introducing non-exercisers to exercise. Another limitation is that our participants were young, healthy volunteers. Exercise interventions may be well suited and valuable for this sample, as physical activity habits that are developed young are easier to maintain. Additionally, controlling for previous physical activity did not alter the present results. Nevertheless, if there is a potential for producing affective expectation-based exercise interventions, it will be necessary to replicate our effects in diverse samples to determine generalizability. Finally, because we used age-predicted heart rate maximum to determine exercise intensity instead of a more objective measure, we may have underestimated the intensity of the exercise experience, and we cannot be certain that all participants exercised at an equivalent level of intensity.

In summary, this present study showed that an affective expectation manipulation can be used to increase post-exercise mood in a laboratory setting. This manipulation also increased participants' self-reported and behavioral intentions to exercise. Although independently the affective expectation manipulation did not alter exercise or post-exercise feelings during a 2-week follow-up, an elaboration manipulation coupled with the expectation manipulation resulted in participants having elevated post-exercise mood during the follow-up. Taken together, these results reveal new opportunities for enhancing positive feelings about exercise to increase exercise behavior.

Authors' Statement of Conflict of Interest and Adherence to Ethical Standards Authors Suzanne G. Helfer, Jon D. Elhai, and Andrew L. Geers declare that they have no conflict of interests. All procedures, including the informed consent process, were conducted in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000.

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