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What to Expect When You're Exercising: An Experimental Test of the Anticipated Affect-Exercise Relationship

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Abstract

Objective: *Anticipated affect* may influence exercise behavior via experienced affective responses and intentions. Cognitive manipulations of anticipated affect may inform exercise intervention design. The purpose of this study was to experimentally test the effects of an expectation-based manipulation of affective responses to exercise on anticipated, experienced, and remembered affect and adherence to a 7-day exercise prescription.

Method: Participants ($N = 98$) were randomly assigned to a positive anticipated affect manipulation, a negative anticipated affect manipulation, or a no affect manipulation control. They reported anticipated, experienced, and remembered affect during and after a standardized 30-min bout of treadmill exercise at an intensity just below ventilatory threshold. Participants were asked to try to complete the prescribed exercise daily for 1 week. Differences in affect and exercise behavior were examined across conditions, as were relationships between affect measures, intentions and behavior.

Results: The manipulation influenced anticipated and experienced affective responses, but not behavior. Participants generally expected exercise to be less pleasant and more fatiguing that it actually was. Anticipated, experienced, and remembered affect were associated with intentions to exercise. Intentions and remembered affect were both directly associated with exercise behavior.

Conclusions: Moderate-to-vigorous exercise can be more pleasant than people expect it to be. Additionally, encouraging exercisers to focus on the positive affective outcomes of exercise can yield a more positive affective experience than those who focus on negative affective outcomes or do not focus on affective outcomes at all. The role of affect in both reflective and automatic motivation to exercise is discussed.

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Keywords

affective response; exercise; randomized experiment; anticipated affect

Regular aerobic exercise is an important component of a healthy lifestyle, but many Americans fall short of meeting the recommended guidelines for exercise behavior (Garber et al., 2011; Troiano et al., 2008). Recently, efforts to understand the mechanisms that support exercise motivation and adherence have increasingly focused on the role of affect. Considerable evidence shows an association between affect in anticipation of and in response to aerobic exercise and subsequent exercise motivation and behavior (Conner, McEachan, Taylor, O'Hara, & Lawton, 2015; Ekkekakis, Parfitt, & Petruzzello, 2011; Rhodes & Kates, 2015). That is, more positive affective responses experienced during exercise tend to predict increased future exercise behavior (Rhodes & Kates, 2015; Williams, Dunsiger, Jennings, & Marcus, 2012), as well as more positive intentions and greater intrinsic motivation to exercise (Kwan & Bryan, 2010a; Rose & Parfitt, 2012; Schneider & Kwan, 2013).

Prior work suggests that the now well-established affect–exercise relationship (Rhodes, Fiala, & Conner, 2009) may be at least partially mediated by social–cognitive factors such as intentions and self-efficacy (Bryan, Hutchison, Seals, & Allen, 2007; Kwan & Bryan, 2010a). According to Williams and Evans' (2014) affect and health behavior framework (AHBF), experienced affective responses influence *anticipated affective responses*, which then drive future exercise behavior via affective attitudes and intentions (Williams & Evans, 2014). Further, anticipated affective response to exercise may also directly influence experienced affect (Williams, 2008), as there is evidence that anticipated affective reactions to exercise explain variance in exercise motivation and behavior over and above the influence of other theory-driven constructs (i.e., perceived behavioral control, cognitive attitudes, social norms; Conner et al., 2015). However, the ability to draw strong causal inferences about these relationships and proposed mechanisms is precluded due to a limited number of studies using experimental designs. Thus, the purpose of this study was to experimentally test the effects of an anticipated affect manipulation on experienced affective response to exercise and subsequent exercise behavior.

According to the affective expectation model (AEM; Wilson, Lisle, Kraft, & Wetzel, 1989), experienced affect can be manipulated by providing expectations about how someone will feel upon encountering a particular stimulus (in this case, a bout of exercise). Self-reported affect in response to that stimulus then comes from two sources: (a) Information gleaned from exposure to the stimulus (e.g., physiological responses to the bout of exercise) and (b) cognitive appraisals of the stimulus (e.g., derived from expectations about whether exercise will feel good or bad). Affective evaluations are consistent with expectations when the incoming information about the stimulus is interpreted in such a way as to be consistent with the expectation (called *congruence*), or the incoming stimulus information is inconsistent with the expectation, but the observer nevertheless relies on cognitive appraisals based on the expectation (called *assimilation*). Alternatively, a "contrast effect" can occur when the stimulus information is different from what was expected and when the observer attends to the stimulus information (Geers & Lassiter, 1999). In the case of exercise, a contrast effect may occur when the stimulus information (physiological response to the exercise stimulus, such as heart rate) is interpreted in such a way that affective responses are inconsistent with expectations (e.g., I expected exercise to feel relaxing but my heart is beating really fast and it feels unpleasant).

The affect manipulation and exercise stimulus used in this study were designed to promote differences in anticipated and experienced affect via congruence or assimilation effects (i.e., affective response consistent with manipulated expectations, either positive or negative). According to the dual mode model, nearly universal negative affective response to exercise as a result of strong and unignorable physiological cues are more common when exercise intensity exceeds the ventilatory threshold (VT; Ekkekakis, Hall, & Petruzzello, 2004; Ekkekakis et al., 2011), whereas exercise at intensities proximal to or just below VT yields variability in affective responses and potentially greater sensitivity to cognitive expectations (Lind, Welch, & Ekkekakis, 2009). Exercise above VT would likely induce unignorable, negative physiological cues, leading participants to reject positive expectations (via a contrast effect). In this study, therefore, the exercise stimulus was standardized at a level just below VT to maximize the probability that experienced affect in response to the stimulus (via either congruence or assimilation) would be consistent with manipulated expectations.

Recently, Helfer, Elhai, and Geers (2015) demonstrated that *postexercise mood states* can be experimentally manipulated by providing participants with the expectation, prior to engaging in a brief bout of light exercise, that the exercise they were about to perform would result in "improved mood, happiness, satisfaction, and self-esteem." Compared to participants who did not receive this information about the exercise, participants in the positive expectation condition reported significantly more positive postexercise mood and stronger intentions to engage in subsequent exercise. However, there was no effect of condition on follow-up exercise behavior (measured as the number of days of exercise and average exercise bout duration over a 2-week period). While these findings are informative, two key questions remain. First, to what extent does an expectation-based affect manipulation influence anticipated and experienced core affective response (rather than mood states) to a standardized bout of exercise? Second, to what extent does manipulated affective response during, rather than after, exercise influence future objectively measured exercise behavior?

Important distinctions exist between the constructs of mood and affect, and in particular, core affect. Often *affect* is used as a superordinate term to refer to a vast array of feeling states (emotions, moods, etc.). *Core affect* represents the most basic, consciously accessible feeling states that are always present (e.g., pleasure, displeasure, tension, calmness, energy, and tiredness), and are triggered by an internal or external stimulus (Russell & Barrett, 1999). In comparison, moods are affective states of long duration that occur in response to diffuse contextual factors rather than a particular stimulus (Frijda, 2009). It has been argued that core affect is a more theoretically appropriate construct to measure in response to a specific stimulus such as exercise (Ekkekakis, 2013). Furthermore, a systematic review showed a null relationship between postexercise affect and future exercise, supporting the study of affect during rather than postexercise (Rhodes & Kates, 2015).

Therefore, the present study was designed to test the effects of an expectation-based manipulation on anticipated and experienced core affective responses to a standardized bout of aerobic exercise in the laboratory, and on objectively measured adherence to a week-long exercise prescription outside the laboratory. Compared to a negative anticipated affect (NAA) manipulation and a control condition, it was hypothesized that a positive anticipated affect (PAA) manipulation would lead to (a) more positive anticipated and experienced core affect during and after exercise, and (b) increased adherence to a 7-day exercise prescription to be followed outside the laboratory. Postexercise affect was included to allow for comparison with prior research (Helfer et al., 2015). Additional, exploratory aims for this analysis were to examine the extent to which experienced affect during the laboratory exercise session as well as remembered affect for laboratory exercise and anticipated affect for nonlaboratory exercise were associated with nonlaboratory exercise intentions and adherence.

Method

Participants

A total of 101 participants (41 men and 60 women, M_{age} = 24.91, age range: 18–45 years) were recruited from the local community to participate in an "exercise prescription study" via campus e-mail blasts, Craigslist.com postings, fliers posted in local establishments, and word of mouth. Eligible participants were over age 18, generally healthy, with no conditions or prescribed medications for which exercise is contraindicated, and did not self-identify as elite or professional athletes. To reduce the risk of adverse cardiac events during exercise, age limits were 45 for women and 39 for men, consistent with the American College of Sports Medicine (ACSM) guidelines at the time (Thompson, Gordon, & Pescatello, 2010). Analyses are based on the 98 participants who completed the experimental session, as three did not complete the study due to an unrelated injury, determination of ineligibility, or lack of time.

Materials and Measures

Exercise testing measures and materials.—Exercise testing was done on Trackmaster 425 treadmills (Full Vision, Newton, KS). VO_2 was assessed by exercise physiologists using an Ultima CardiO2/CP with 12 lead ECG system (MedGraphics, St. Paul, MN) and software from BreezeSuite (version 6.2.055). VT, the point during exercise where CO_2 production rises disproportionately to O_2, was calculated using the V-slope method (Beaver, Wasserman, & Whipp, 1986). Measures of VO_2max (in kg/ml/ min) and HR at VT (in beats per minute) were obtained as output from the BreezeSuite software. This informed each individual's exercise prescription (see below).

Exercise prescription.—Each participant was prescribed 30 min of aerobic exercise each day for 7 consecutive days: A 5-min warm-up building up to target HR (90–100% of HR at VT), 20 min at target HR, and a 5-min cool-down. The decision to have participants exercise at an intensity equivalent to 90–100% of HR at VT is consistent with empirical data demonstrating that affect at this intensity may be both subject to variability and manipulation (such as via cognitive appraisals), and less universally unpleasant than exercise above VT

(Lind et al., 2009). Due to its susceptibility to manipulation via cognitive appraisals, affective response to exercise below VT may be more likely to demonstrate assimilation or congruence effects. The decision to prescribe 30 min of exercise per day was based on this common public health recommendation (Garber et al., 2011). Here, the rationale for a 7-day exercise prescription was based on (a) the expectation that this would be challenging for most people given recommendations are typically 3–5 days/week, and thus would result in variability in the primary outcome, and (b) that any effect of the manipulation would wear off after a week (i.e., that participants would experience contrast effects and experimentally manipulated expectations would no longer influence behavior). In the absence of any existing evidence or theory on this matter, this seemed a reasonable approach.

Affect measures.—Two validated scales were used to assess core affect, based on prior work demonstrating both crosssectional and longitudinal relationships with exercise behavior (Rhodes & Kates, 2015). The Feeling Scale (Hardy & Rejeski, 1989) is a single-item, 11-point dimensional measure of the valence dimension of core affect. Respondents indicated how "good" or "bad" they felt during exercise (or expected to feel) on a scale from −5 = *very bad*, to +5 = *very good*, with 0 = *neutral*. The Feeling Scale constitutes the valence dimension of the circumplex model of core affect (Russell & Barrett, 1999). The Physical Activity Affect Scale (PAAS; Lox, Jackson, Tuholski, Wasley, & Treasure, 2000) is a 12-item measure comprised of four 3-item subscales: positive affect, negative affect, tranquility, and fatigue. Respondents rate their agreement with each item on this scale from 0 = *definitely do not feel*, to 4 = *definitely feel.* The PAAS subscales map on to a rotated circumplex model of core affect (Watson & Tellegen, 1985), capturing the four quadrants of the valence and arousal dimensions: Positive and negative activated affect, and positive (tranquility) and negative deactivated affect (fatigue). It is worth noting that the positive and negative ends of the FS measure are not equivalent to the positive and negative activated affect constructs from the PAAS. Rather, the FS is a bipolar dimension (good–bad), whereas the four PAAS constructs represent affective information accounting for both valence (positive or negative) and arousal (activated or deactivated) dimensions of affect (cf., Ekkekakis, 2003, 2013).

These measures were administered at multiple time points (see Figure 1), and instructions varied by time point. Immediately preexercise, participants responded to the prompt, "How do you expect to feel while exercising today?" During exercise, the prompt for experienced affect was, "How do you feel right now?" Immediately postexercise, the prompt for remembered affect was, "Think back to how you felt while exercising today. How do you remember feeling while exercising today?" and finally the prompt for anticipated affect during nonlaboratory exercise was,

> Thinking only about your aerobic activity prescription, please tell us how you expect to feel while you are doing aerobic exercise in the next week. Please keep in mind the types of aerobic exercise we have asked you to do, how long we have asked you to exercise, and the intensity at which we have asked you to exercise.

Objective exercise measures.—HR monitors (Polar S610, Polar Electro Inc., Woodbury, NY) were used to assess adherence to prescribed exercise intensity, duration, and frequency. HR monitors were programmed to beep when HR was outside the prescribed range. Upon return to the CTRC at the end of the follow-up period, HR monitors were synced with accompanying computer software and data from each minute during recorded exercise were downloaded. Polar software produced output with unique bouts of exercise, duration, and average HR of each bout. According to the HR monitor data, on days during which participants exercised, they exercised in their target HR zone for 20 min precisely as prescribed. Therefore, days of exercise, rather than minutes or intensity, were analyzed as the primary behavioral outcome variable. Analysis of exercise log data is for $n = 97$, as 1 participant failed to return the log. Due to the negative skew in the counts of exercise days (indicative of a possible ceiling effect and demand characteristics), the frequency with which participants exercised was also examined according to whether they had completed all 7 days or less than 7 days of prescribed exercise.

Exercise behavior self-report measures.—To assess prior exercise behavior at baseline, participants self-reported the average number of days per week (0–7 days) that they did aerobic activity in the past month. The instructions included a definition of aerobic activity ("any activity done for at least 10 minutes continuously during which you are breathing harder, your heart is beating faster, and you are sweating"). Total days and minutes of exercise according to the exercise prescription was also collected via paper and pencil exercise log. Participants recorded the type and total duration (including warm-up and cool-down) of exercise completed each day for 7 days. All but one participant returned the completed exercise log.

Perceived exertion.—The Rating of Perceived Exertion Scale (RPE; Borg, 1998) was administered during the practice bout to assess subjective physical exertion; RPE is measured on a 15-point scale ranging from 6 *no exertion at all* to 20 *maximal exertion*.

Intentions to exercise.—Intentions to exercise according to the prescription were assessed using six items adapted from previously used measures (Kwan & Bryan, 2010a), in which participants indicated on a scale from 1 *disagree strongly* to 7 *agree strongly*, the extent to which they intended to exercise as prescribed (e.g., "I intend to do aerobic exercise according to my prescription during the next week," "I intend to participate in aerobic exercise as often as prescribed during the next week"; $\alpha = .82$). Given negative skew, the intentions measure was dichotomized into *very strong* intentions (all items reported as a 7) or *weaker intentions* (at least one item less than 7).

Anticipated affect manipulation.—Participants were randomly assigned to one of three conditions: A negative anticipated affect manipulation (NAA condition), a positive anticipated affect manipulation (PAA condition), or a no affect manipulation (control condition). Experimenters were blind to condition, and participants were unaware of the existence of experimental conditions. All participants read that their exercise prescription was a healthy level of intensity for exercise, and then, depending on condition, read that most people indicated this level of intensity led to either positive affect (for those in the PAA condition), negative affect (for those in the NAA condition), or affect was not mentioned (for those in the control condition). The scripts were based on pilot-tested scripts that were successful at manipulating anticipated affective responses to exercise, which then influenced commitment to a planned exercise bout (Kwan & Bryan, 2010b). To further encourage participants in the NAA and PAA conditions to think about how the supposed typical affective response might apply to them personally, they were also asked to describe how they thought the exercise might lead to positive (PAA condition) or negative (NAA condition) feelings.

All participants read the following in the preexercise survey:

> Your exercise prescription is going to be exercising for 20 min each day in the next week at an intensity that is just below your own ventilatory threshold, which is the point at which your body starts using energy differently during exercise. We measured this point for you at your last session. We are interested in studying how people respond emotionally during exercise. This exercise intensity is fairly vigorous, and is recommended by the Centers for Disease Control and Prevention as a healthy level of intensity for exercise.

Those randomized to the PAA condition read the following text and then typed their response in a text box below:

> Most people exercising at this intensity say that it *feels good, and that it makes them feel energized and more positive, and more relaxed afterward*. Thinking about your exercise prescription, please list the reasons or ways in which you, personally, might expect this exercise to lead to *positive* feelings, and what specifically about this exercise might make you, personally, feel *good*.

Those randomized to the NAA condition read the following text and then typed their response in a text box below:

> Most people exercising at this intensity say that it *doesn't feel very good, and that it makes them feel tired and not so positive, and not very relaxed afterward*. Thinking about your exercise prescription, please list the reasons or ways in which you, personally, might expect this exercise to lead to *negative* feelings, and what specifically about this exercise might make you, personally, feel *bad*.

Those in the control condition were not given any information about typical affective responses and did not write about expected *positive* or *negative* feelings during exercise.

Procedures

An overview of the study design is shown in Figure 1. Following assessment of eligibility using a web-based survey (Qualtrics.com, Inc.), participants were invited to complete two in-person sessions at the university's Clinical Translational Research Center (CTRC). The baseline session involved administration of informed consent, a standard medical history and physical exam (conducted by a CTRC physician to ensure participants were healthy enough for vigorous physical activity, per CTRC protocol), and maximal aerobic capacity (VO_2max) exercise testing. Maximal exercise testing was performed using standard CTRC procedures according to methods established by Christou, Gentile, DeSouza, Seals, and Gates (2005).

About 1 week later, participants returned to the CTRC for an experimental session. A research assistant presented them with a description of an exercise prescription to follow over the next 7 days. They were then told they would complete a practice bout of this prescribed exercise in the laboratory exercise facility that day. Participants were aware they would be exercising that day prior to their arrival, and were dressed accordingly and had eaten a meal as instructed by the CTRC nutritionist.

Just prior to the practice exercise bout, participants read the affect manipulation script and completed measures of anticipated affect for both during and post exercise using an electronic survey (Qualtrics, Provo, UT). Participants were randomly assigned to condition using the randomization option in the Qualtrics survey. Participants then completed their exercise, using the programmed heart rate (HR) monitor to control intensity consistent with their prescription.

Experienced affect was measured during the practice bout at four time-points: Just before exercise while still at rest (T0), halfway through the exercise bout (at 10 min into the target HR zone period, T1), just prior to starting the cool-down (at 20 min into the target HR zone period, T2), and 5 minutes after completion of exercise while at rest (T3). These time points were selected to represent affect both during and after exercise, and both the middle and end of the target HR zone.

Nonlaboratory exercise (i.e., actual exercise behavior according to the prescription in the next 7 days) was measured using both HR monitors (which recorded exercise sessions) and paper-and-pencil exercise logs. Participants used the HR monitors during exercise only. At the end of the week, participants returned to the CTRC for debriefing, payment, and to return HR monitors and exercise logs. Participants received up to $60 for their participation ($20 each for two in-person sessions, and $20 for completing a final survey). The study was approved by the CTRC advisory committee and the university Institutional Review Board (IRB), and the study was conducted in accordance with universal ethical principles.

Analyses

This paper includes findings for the affective valence measure and the fatigue and positive activated affect subscales of the PAAS only, due to floor effects for negative activated affect and no effects of condition for tranquility. Analyses were performed in SAS Version 9.4 (SAS Institute, Cary, NC). Descriptive statistics were used to characterize the sample and exercise prescription intensity. Analysis of variance (ANOVA) was used to test effects of condition on anticipated, experienced and remembered affect measures. Omnibus tests were used to examine overall effects of condition, and planned contrasts were used to examine differences between conditions (PAA vs. NAA, PAA/NAA vs. control). To examine effects of condition on changes in affect over the course of exercise, a two-way mixed ANOVA with condition as a between-subjects factor, time as a within-subjects factor (Time: Preexercise, T1, T2), and Time × Condition interactions was performed. Polynomial contrasts were specified for time. Differences in condition for counts of exercise days using maximum likelihood estimation and a Poisson distribution were tested with PROC GENMOD in SAS. Finally, logistic regression with contrast codes for condition was used to test effects of condition and of anticipated, experienced, and remembered affect on odds of exercising all 7 days as prescribed and on odds of very strong intentions. The study was designed (estimated sample size of 35 participants/condition) to detect a small-to-moderate effect (difference in exercise behavior between the three experimental conditions) at power = .80 and $\alpha = .05$.

Results

Sample Characteristics

Demographics and sample characteristics for the 98 participants who completed the experimental session are shown in Table 1. The sample was heterogeneous in terms of prior exercise and fitness level (i.e., aerobic capacity). Experimental conditions did not differ on prior exercise or any of the demographic variables, except age, such that those in the PAA condition were slightly, but significantly older than those in the NAA condition ($M_{diff} = 3.54$ years, $p = .01$). Controlling for age did not affect any of the analyses. Prior exercise did not moderate effects of condition on affective responses or exercise behavior.

Exercise Intensity Check

According to output from the exercise testing software from the experimental session, exercise prescriptions corresponded to HR within 90–100% of each participant's own HR at VT, as assessed during aerobic capacity testing at the baseline session. On average, this prescription corresponded to 74–82% of maximum HR as assessed in aerobic capacity testing. Based on assessments of oxygen volume (VO_2) and HR obtained during the first 2 minutes of exercise in the prescribed range during the experimental session, measured VO_2 on average corresponded to 70.08% ($SD = 6.34\%$) of VO_2max and 96.36% ($SD = 4.50\%$) of VO_2 at VT; measured HR on average corresponded to 95.89% ($SD = 1.67\%$) of HR at VT. Average RPE ratings at T1 and T2 were 12.26 ($SD = 1.47$) and 13.05 ($SD = 1.61$), respectively. This suggests the prescribed exercise was consistent with moderate-to-vigorous intensity exercise (Garber et al., 2011).

Effects of Condition on Anticipated and Experienced Affective Response to Exercise

Means and standard deviations for affective responses by condition are shown in Table 2. Results of omnibus tests and planned contrasts are shown in Table 3.

Anticipated affective response to laboratory exercise.—As hypothesized, there were significant effects of condition on *anticipated* affective valence ratings during, and fatigue ratings after, the practice exercise bout in the laboratory (see Table 3). Planned contrasts showed participants in the PAA manipulation condition anticipated more positive affective valence ratings during the exercise bout and less fatigue after exercise than did the participants in the NAA condition.

Experienced affect during laboratory exercise.—Overall, results were generally supportive of the hypothesis that affective expectations influence the affective experience of exercise. As hypothesized, there were significant effects of condition on *experienced* affective valence and fatigue ratings during exercise (see Table 3). Planned contrasts showed less positive activated affect and greater fatigue in the NAA condition than those in the PAA manipulation condition. Those in the control condition also reported more fatigue than those in the NAA condition.

There were also significant differences in preexercise positive activated affect across condition, such that those in the PAA condition started exercise with less positive activated affect than those in the control or NAA conditions. Given these differences in preexercise affect, *changes over time* in affect during exercise by condition were also examined (see Table 2). There was a significant effect of condition on linear changes (Linear Time × Condition interaction) in experienced in-task affective valence responses, $F(4, 190) = 4.50$, $p = .005$ (p value is Huynh-Feldt-Lecoutre, due to violation of the sphericity assumption). Specifically, experienced affective valence responses became more positive over time for those in the PAA condition as compared to those in the NAA condition, $\beta = .28$, $SE = .10$, $F(1, 193) = 8.18$, $p = .005$. There was also a significant Time × Condition interaction for experienced positive activated affect, such that positive activated affect increased to a greater extent among participants in the PAA condition than for the participants in the NAA condition, $\beta = .21$, $SE = 0.09$, $F(3, 193) = 5.48$, p .02.

Experienced affect after laboratory exercise.—Controlling for baseline affective valence responses, posttask affective valence responses were significantly more positive in the PAA condition versus the NAA condition, $\beta = .38$, $SE = .18$, $F(1, 96) = 4.49$, $p = .04$, partial $\eta^2 = .04$. Controlling for baseline positive activated affect, there were no differences between the PAA and NAA conditions for posttask positive activated affect, $\beta = .15$, $SE = .10$, $F(1, 96) = 2.19$, $p = .14$, partial $\eta^2 = .02$. Controlling for baseline fatigue, there were no differences between the PAA and NAA conditions for posttask fatigue, $\beta = .03$, $SE = .10$, $F(1, 96) = 0.62$, $p = .79$, partial $\eta^2 = .00$.

Remembered Affect and Anticipated Affect for Nonlaboratory Exercise

The control condition remembered lab exercise as more fatiguing than did the PAA condition. There were no other differences across conditions in remembered affect for lab exercise. The control condition expected nonlab exercise to be more fatiguing and less pleasant than did the PAA condition. There were no other differences across conditions in anticipated affect for nonlaboratory exercise.

Accuracy of Affective Predictions: Anticipated Versus Experienced Affect in the Lab

In post hoc analyses of the accuracy of affective predictions, experienced affect was compared against anticipated affect ratings across the full sample and by condition. Across the full sample, participants significantly underestimated experienced affective valence ratings—that is, they expected the exercise to feel worse than it did (MANOVA test of repeated measures anticipated in-task vs. T1 affective valence: Wilks' $\Lambda = .94$; $F(1, 95) = 6.12$, $p = .02$; anticipated in-task vs. T2 affective valence: Wilks' $\Lambda = .81$; $F(1, 95) = 22.03$, $p < .001$). Similarly, on average participants expected to feel less positive affect during exercise than they actually experienced (anticipated in-task vs. T2 PA: Wilks' $\Lambda = .92$; $F(1, 97) = 7.86$, $p <.001$). Participants overestimated fatigue at all time points (Anticipated in-task vs. T1 Fatigue: Wilks' $\Lambda = .59$; $F(1, 97) = 68.35$, $p < .001$; anticipated in-task vs. T2 Fatigue: Wilks' $\Lambda = .72$; $F(1, 97) = 38.62$, $p < .001$; anticipated post versus experienced post

Fatigue: Wilks' Λ = .69; $F(1, 97) = 42.68$, $p < .001$). An examination of the mean differences by condition (see Figure 2) revealed the discrepancies between anticipated and experienced in-task affect were greater for those in the NAA condition than in the PAA and control conditions (see Table 3), but generally people actually felt better during exercise than they anticipated feeling.

Effects of Condition on Exercise Behavior

The hypothesis that the anticipated affect manipulation would influence adherence to the exercise prescription was not supported. Mean days of exercise for the control, PAA, and NAA conditions were 5.72 (*SD* = 2.17; Median = 7; Range 0 to 7), 5.86 (*SD* = 1.44; Median = 6; Range 2 to 7), and 5.68 (*SD* = 1.92; Median = 6; Range 0 to 7), respectively. There was no difference in counts of exercise days for the PAA versus NAA conditions (β = .03, *SE* = .10, Wald $\chi^2 = 0.10$, $p = .75$). According to the HR monitor data, 15 out of 29 (51.72%) in the control, 11 out of 35 (31.43%) in the PAA condition, and 13 out of 34 (38.24%) in the NAA condition exercised all 7 days. These differences were also not statistically significant: Control versus PAA/NAA: *OR* = 1.25 (0.93, 1.68); PAA versus NAA: *OR* = 0.83 (0.50, 1.38). Results were similar for exercise log data.

Associations Between Affective Response, Intentions, and Behavior

As shown in Table 4, experienced and remembered affect during laboratory exercise and anticipated affect for nonlaboratory exercise were significantly associated with increased odds of "very strong intentions." This was true for both affective valence and positive activated affect ratings, but not for fatigue ratings. Those with very strong intentions were then 3 times more likely to have exercised all 7 days (*OR* = 3.01, 95% CI: 1.29, 7.04). Notably, only remembered affective valence and positive activated affect ratings (but not anticipated or experienced affect) were directly associated with adherence to exercise prescription.

Discussion

This study tested the effects of an expectation-based manipulation of affective responses to exercise on anticipated, experienced, and remembered affect and subsequent adherence to a 7-day exercise prescription. Results confirmed that the manipulation influenced anticipated affect for laboratory exercise as designed. The hypothesis that manipulating anticipated affective response would influence experienced affect was also partially supported. However, it appeared that participants generally expected exercise to be less pleasant and more fatiguing that it actually was; this effect was more pronounced in the NAA condition than in the control and PAA conditions. The overall discrepancy between anticipated and experienced affect is consistent with other evidence that affective predictions for exercise tend to be inaccurate (Ruby, Dunn, Perrino, Gillis, & Viel, 2011).

Using the AEM as a lens (Wilson et al., 1989), it appears the PAA condition experienced more assimilation and/or congruence effects (experienced affect was relatively more consistent with their expectations) while the NAA condition experienced more contrast effects (their experience was relatively more inconsistent with their expectations). These results are consistent with evidence that expectancy influences experience in other domains, such as sensory and hedonic evaluation of food flavors (Yeomans, Chambers, Blumenthal, & Blake, 2008). Two key conclusions emerge from these findings. First, healthy individuals will likely find a moderate-to-vigorous exercise stimulus to be more pleasant than they expect it to be. Additionally, it appears that encouraging exercisers to focus on the positive affective outcomes of exercise can yield an overall more positive affective experience than those who focus on negative affective outcomes or do not focus on affective outcomes at all. These findings corroborate and build upon other evidence showing that anticipated affective reactions predict health behavior intentions and action, independent of affective attitudes (Conner et al., 2015).

The results did not support the hypothesis that an experimental manipulation of the anticipated affective response to exercise would directly influence subsequent exercise behavior. This is consistent with findings from Helfer and colleagues (2015), who also found no effect of an expectations-based manipulation of postexercise mood states on future exercise behavior. Similar effects were observed in both studies despite key differences in study design, including measurement of core affect during exercise, rather than mood state after exercise, standardized intensity based on VT, and consistency between the exercise stimulus inside and outside the laboratory. There are at least two possible explanations for why expectation-based affect manipulations fail to demonstrate direct causal effects on subsequent exercise behavior. This phenomenon may be an artifact of the experimental design. While expectation-based manipulations might influence affective response to the relatively novel experience of laboratory exercise, once back in one’s typical exercise environment, affect and behavior may be driven more by experience with exercise in that setting (i.e., contrast effects may occur). Given there was very little evidence that the manipulation influenced anticipated affective responses for the nonlaboratory exercise, this is a reasonable explanation. A single expectation-based manipulation in the laboratory may not be enough to influence repeated instances of exercise behavior outside the laboratory.

The lack of a direct causal effect of expectation-based manipulations on subsequent exercise behavior may be further explained by additional insights from the AHBF regarding distinctions between implicit and explicit affective attitudes toward a health behavior (Williams & Evans, 2014). Affective attitudes represent evaluations of a particular behavior based on how one reports he or she generally feels (good/bad, pleasant/unpleasant) while performing the behavior. In the AHBF, both implicit affective attitudes, which are automatic and nonconscious, and explicit affective attitudes, which are conscious and reflective, influence health behavior motivation and action. The anticipated affective response is considered the product of reflective processing (explicit attitudes), leading to *reflective motivation* (i.e., explicitly stated behavioral intentions). Additionally, positive affective associations (implicit attitudes) lead to more *automatic motivation*, leading to increased health behavior via automatic and non-conscious processes. It is possible that both automatic and reflective processes were present in this study, as suggested by the findings regarding remembered affect. This study showed that experienced and remembered affect during exercise in the lab, and anticipated affect for the same exercise performed outside the lab were associated with *intentions* to exercise outside the lab. However, only remembered affect for the laboratory exercise was directly associated with subsequent *behavior*. The current findings are consistent with other evidence showing that remembered experiences are better predictors of future behavioral choices than are "online" (i.e., in-task reported experience) or anticipated experiences (Wirtz, Kruger, Scollon, & Diener, 2003).

The current study results showing direct effects of remembered affect on exercise behavior may be explained by automatic processes such as those stemming from affective associations. The AHBF refers to *affective associations* as the feelings associated with a particular behavior informed by previously experienced affect in response to the behavior (Williams & Evans, 2014), and may be represented by remembered affect. Related evidence suggests affective associations with health behaviors can have direct effects on those behaviors, beyond effects of explicit (self-reported) cognitive and affective attitudes. Affective associations with physical activity behavior have been shown to be positively associated with physical activity behavior, and to mediate effects of self-reported cognitive factors such as attitudes, norms, and perceived behavioral control on physical activity (Kiviniemi, Voss-Humke, & Seifert, 2007). Walsh and Kiviniemi (2014) provided experimental evidence that affective associations with fruits and vegetables induced using an implicit priming paradigm influenced snack food choices. Compared to those primed with negative or neutral associations with fruit, participants primed with positive fruit associations were more likely to choose fruit over a granola bar despite no self-reported changes in cognitive attitudes about fruit or how much they reported enjoying fruit (Walsh & Kiviniemi, 2014).

Although the analyses of correlations between remembered affect and exercise intentions and behavior were exploratory, these interesting findings point to opportunities for future interventions. For instance, encouraging exercisers to reflect upon positive aspects of in-task affective response to exercise after they have completed an exercise bout could increase the likelihood of repeated exercise. Smart phone applications for tracking exercise behavior and affect could provide opportunities to promote such a self-monitoring practice (Stevens & Bryan, 2012). According to the peak-and-end rule (Fredrickson, 2000), remembered affect tends to reflect affect experienced at the peak of an experience (whether high or low) or the end of an experience, rather than the totality of the experience. Cognitive interventions may be strategically targeted as an exercise bout is nearing its end, encouraging exercisers to focus on positive aspects of the experience (e.g., decreased anxiety, completing a goal, taking care of themselves). However, more work is needed to determine the extent to which the peak-and-end rule applies to the affective response to exercise, as research to date has been inconclusive (Hargreaves & Stych, 2013).

Limitations

Limitations included a relatively modest sample size, the convenience sample, and the relatively short 7-day exercise prescription follow-up period. As is typically the case in this type of investigation, participants were volunteers for an exercise study, and were characterized by having generally positive attitudes toward exercise. While the population was heterogeneous in terms of prior exercise behavior and fitness level, participants did on average have some experience with regular exercise behavior. It may be important to conduct this kind of work in more exercise-naive participants who do not already know how their body reacts to moderate to vigorous physical activity and how that level of physical intensity makes them feel. As discussed in the method section, the 7-day prescription was selected given the expectation that the effect of the manipulation would wear off. Future studies could examine longer follow-up periods, with more intensive or repeated cognitive affect manipulations.

Future Directions

Further work is needed to determine the circumstances under which cognitive strategies, such as affective expectation manipulations, influence both reflective and automatic processes underlying exercise behavior change. If anticipated affective response to exercise does plays a causal role in the adoption and maintenance of physical activity, another related consideration concerns whether affective responses to exercise can be trained over time. Specifically, information is needed concerning whether or not the affective response to physical activity can be improved with training, and whether this influences exercise behavior change and maintenance over time. The answer to this question may provide valuable insight concerning how to best leverage the relationship between exercise and affect in order to promote long-lasting exercise adherence and achieve optimal health benefits.

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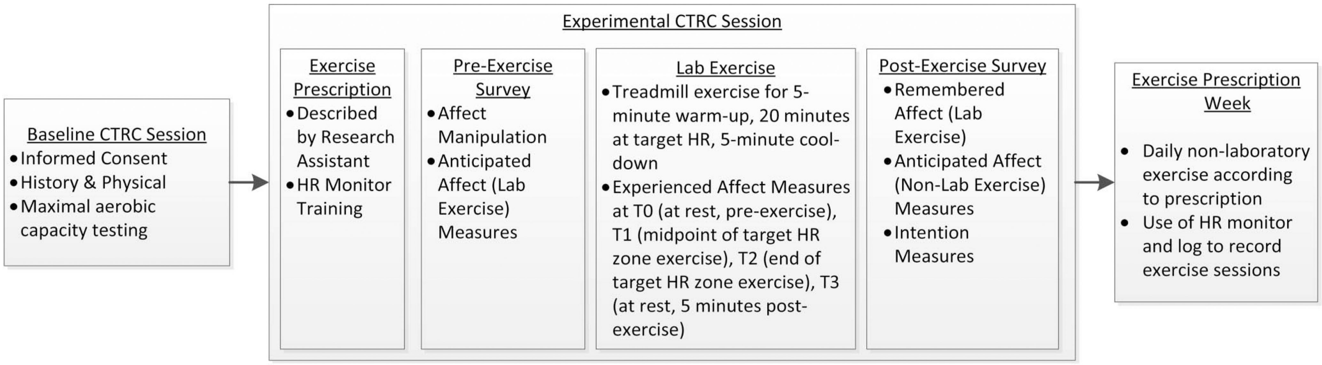

Figure 1.
Study design overview.

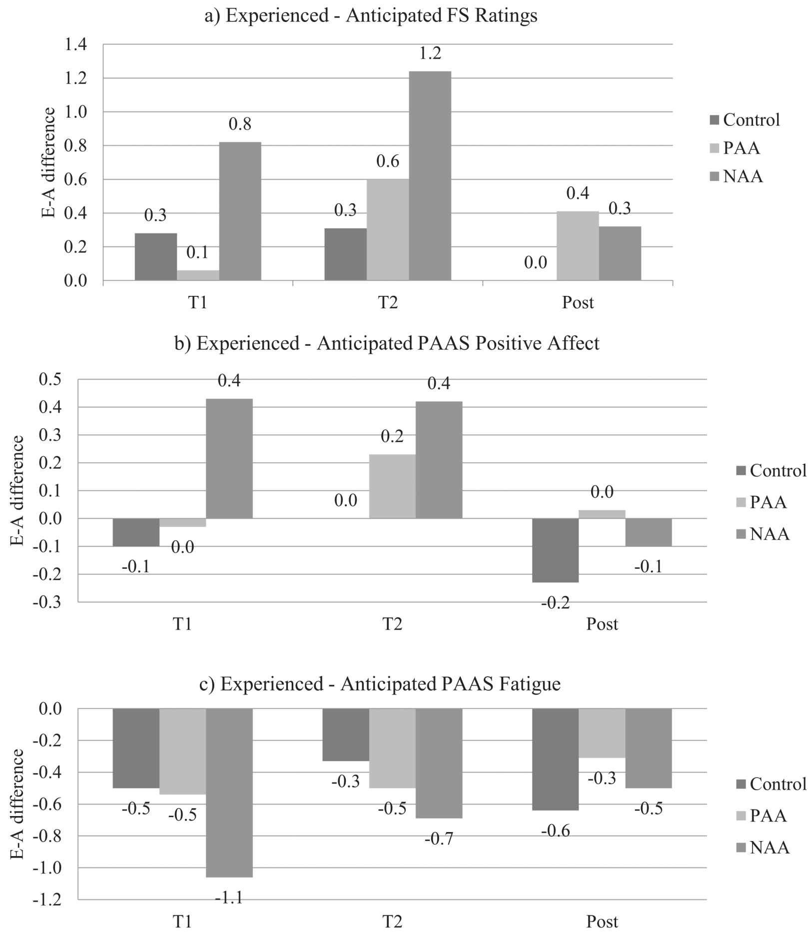

Figure 2.

Differences between anticipated and experienced affective response to laboratory exercise by condition. Affective valence is measured using the Feeling Scale (FS), range −5 (*very bad*) to +5 (*very good*); PAAS = Physical Activity Affect Scale, positive activated affect and fatigue PAAS subscales, range 0 (*definitely do not feel*) to 4 (*definitely feel*). PAA = positive anticipated affect manipulation; NAA = negative anticipated affect manipulation; T1 = 14–15 min into exercise bout (halfway), T2 = 24–25 min into exercise bout, Post = 5 minutes postexercise. (a) Experienced—anticipated affective valence ratings at T1, T2, and posttask; (b) Experienced—anticipated PAAS positive affect subscale ratings at T1, T2, and posttask; (c) Experienced—anticipated PAAS fatigue subscale ratings at T1, T2, and posttask.

Table 1

Sample Characteristics

Characteristic	Total (N = 98)*		Men (n = 39)		Women (n = 59)	
	***M* (*SD*)**	**Range**	***M* (*SD*)**	**Range**	***M* (*SD*)**	**Range**
Age	24.89 (5.98)	18–45	24.16 (5.29)	18–39	25.37 (6.40)	18–45
Race/Ethnicity: *N* (%)						
White, Non-Hispanic	82 (83.7%)		30 (76.9%)		52 (88.1%)	
Asian	6(6.1%)		4 (10.2%)		2 (3.4%)	
Mixed race	6(6.1%)		2(5.1%)		4 (6.8%)	
Black	1 (1.0%)		1 (2.6%)		0 (0%)	
Hispanic/Latino	3 (3.1%)		2(5.1%)		1 (1.7%)	
BMI	23.39 (4.03)	15.54–38.32	24.39 (3.75)	15.54–35.29	22.75 (4.10)	17.29–38.32
Past exercise: Days in last week	2.48 (1.75)	0–7	2.62 (1.79)	0–7	2.39 (1.74)	0–7
VO_2 max (ml/kg/min)	42.18 (8.87)	15.50–57.60	47.93 (7.59)	27.70–57.60	38.41 (7.56)	15.50–56.20

Note. *SD* = standard deviation; BMI = body mass index; VO_2max = maximal aerobic capacity.

* Excludes participants who did not complete the experimental session.

Table 2

Differences in Anticipated, Experienced and Remembered Affect by Condition

	Control (n = 29)	PAA (n = 35)	NAA (n = 34)	Omnibus		Control vs PAA		Control vs NAA		PAA vs NAA	
Affect ratings and time points	***M* (*SD*)**	***M* (*SD*)**	***M* (*SD*)**	***F*(2, 95)**	***p***	***F*(1, 95)**	***p***	***F*(1, 95)**	***p***	***F*(1, 95)**	***P***
Affective valence (Feeling Scale)											
Anticipated during lab	2.10 (1.45)	2.37 (1.11)	1.50 (1.56)	**3.57**	**.03**	.60	.44	2.99	.09	**6.86**	**.01**
Anticipated after lab	2.41 (1.62)	2.56 (1.11)	2.35 (1.63)	.18	.84	.15	.70	.00	.90	.34	.56
T0 (Preexercise)	1.55 (1.55)	.910 (1.15)	1.41 (1.60)	1.79	.17	3.12	.08	.15	.70	2.07	.15
T1 (During exercise)	2.38 (1.08)	2.43 (.95)	2.32(1.39)	.07	.93	.03	.87	.04	.85	.14	.71
T2 (During exercise)	2.41 (1.18)	2.97 (.86)	2.74 (1.16)	2.16	.12	**4.31**	**.04**	1.41	.24	.84	.36
T3 (Postexercise)	2.41 (1.52)	2.97 (1.20)	2.68 (1.47)	1.27	.28	2.53	.12	.55	.46	.77	.38
Remembered during lab	2.48 (1.24)	3.00 (1.19)	2.88 (1.30)	1.47	.23	2.75	.10	1.62	.21	.15	.70
Anticipated during nonlab	2.66 (1.42)	3.31 (.90)	3.09 (1.14)	2.62	.08	**5.16**	**.02**	2.20	.14	.66	.42
Positive activated affect (PAAS)											
Anticipated during lab	2.33 (.71)	2.27 (.79)	2.13 (.80)	.59	.56	.12	.73	1.11	.30	.56	.46
Anticipated after lab	2.44 (.86)	2.25 (.68)	2.40 (.87)	.52	.60	.88	.35	.00	.86	.64	.43
T0 (Preexercise)	1.85 (.80)	2.39 (.67)	1.87 (.76)	**4.54**	**.01**	**6.08**	**.02**	.01	.91	**7.26**	**.008**
T1 (During exercise)	2.23 (.65)	2.24 (.70)	2.56 (.83)	2.16	.12	.00	.96	3.13	.08	3.28	.07
T2 (During exercise)	2.33 (.84)	2.50 (.78)	2.55 (.86)	.56	.57	.60	.44	1.06	.31	.07	.79
T3 (Postexercise)	2.21 (.91)	2.28 (.82)	2.30 (.93)	.10	.91	.10	.76	.19	.67	.02	.90
Remembered during lab	2.29 (.82)	2.46 (.68)	2.56 (.89)	.91	.40	.72	.40	1.81	.18	.28	.60
Anticipated during nonlab	2.47 (.84)	2.63 (.74)	2.65 (.79)	.46	.63	.63	.43	.78	.38	.01	.92
Fatigue (PAAS)											
Anticipated during lab	1.60 (.78)	1.35 (.86)	1.75 (.91)	1.95	.15	1.31	.25	.53	.47	3.85	.05
Anticipated after lab	1.64 (.93)	1.12 (.82)	1.54 (.81)	**3.47**	**.04**	**5.90**	**.02**	.21	.64	**4.20**	**.04**
T0 (Preexercise)	1.03 (.86)	1.80 (.83)	.76 (.74)	1.00	.37	1.33	.25	1.74	.19	.03	.86
T1 (During exercise)	1.10 (.64)	.81 (.58)	.70 (.60)	**3.71**	**.03**	3.74	.06	**7.08**	**.01**	.61	.44
T2 (During exercise)	1.26 (.70)	.86 (.57)	1.07 (.79)	2.77	.07	**5.50**	**.02**	1.25	.27	1.61	.21
T3 (Postexercise)	1.00 (.73)	.81 (.54)	1.04 (.84)	1.01	.37	1.12	.29	.05	.83	1.78	.19
Remembered during lab	1.09 (.65)	.71 (.53)	1.00 (.80)	2.87	.06	**5.09**	**.03**	.30	.59	3.17	.08
Anticipated during nonlab	1.18 (.78)	.81 (.69)	.97 (.77)	2.00	.14	**4.00**	**.048**	1.28	.26	.81	.37

Note. *SD* = standard deviation; PAA = positive anticipated affect manipulation; NAA = negative anticipated affect manipulation; Affective valence is measured using the Feeling Scale (FS), range −5 (*very bad*) to +5 (*very good*); PAAS = Physical Activity Affect Scale, positive activated affect and fatigue PAAS subscales, range 0 (*definitely do not feel*) to 4 (*definitely feel*). Statistically significant effects are represented in boldface font; values in parentheses represent degrees of freedom.

Table 3

ANOVA Results for Tests of Effects of Condition on Difference Between Experienced and Anticipated Affect

Experienced-anticipated affect ratings	Omnibus		Control vs PAA		Control vs NAA		PAA vs NAA	
	***F*(2, 95)**	***p***	***F*(1, 95)**	***p***	***F*(1, 95)**	***p***	***F*(1, 95)**	***p***
E–A at T1								
Affective valence	2.25	.11	.32	.57	1.99	.16	**4.28**	**.04**
PAAS positive activated affect	**5.18**	**.007**	.17	.68	**8.43**	**.005**	**6.87**	**.01**
PAAS fatigue	**4.86**	**.01**	.06	.81	**7.50**	**.007**	**6.91**	**.01**
E–A at T2								
Affective valence	**3.81**	**.046**	.59	.44	**5.92**	**.02**	3.08	.08
PAAS positive activated affect	2.20	.12	1.31	.26	**4.40**	**.04**	1.02	.32
PAAS fatigue	1.48	.23	.63	.43	2.94	.09	.95	.33
E–A Postexercise								
Affective valence	.83	.44	1.65	.20	.42	.52	.43	.51
PAAS positive activated affect	1.70	.19	3.33	.07	.58	.45	1.21	.27
PAAS fatigue	.47	.62	.87	.35	.54	.46	.04	.84

Note. Statistically significant effects ($p < .05$) are represented in boldface font; values in parentheses represent degrees of freedom; ANOVA = analysis of variance; E–A = experienced affec-tanticipated affect; PAA = positive anticipated affect manipulation; NAA = negative anticipated affect manipulation; Affective valence is measured using the Feeling Scale (FS), range −5 (*very bad*) to +5 (*very good*); PAAS = Physical Activity Affect Scale, positive activated affect and fatigue PAAS subscales, range 0 (*definitely do not feel*) to 4 (*definitely feel*).

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Table 4

Odds of Having Very Strong Intentions and Exercising All 7 Days Given the Affective Response to Exercise

Affect ratings	IV = Very strong intentions to follow exercise prescription		IV = Exercising all 7 days as prescribed	
	OR	**95% CI**	***OR***	**95% CI**
Affective valence (Feeling Scale)				
Experienced during lab (T2)	**1.61**	**1.08, 2.41**	1.37	.92, 2.03
Remembered during lab	**1.84**	**1.25, 2.73**	**1.61**	**1.12, 2.31**
Anticipated during nonlab	**1.67**	**1.14, 2.45**	1.34	.94, 1.91
Positive activated affect (PAAS)				
Experienced during lab (T2)	**2.05**	**1.20, 3.52**	1.44	.82, 2.51
Remembered during lab	**2.48**	**1.37, 4.48**	**1.92**	**1.11, 3.31**
Anticipated during nonlab	**2.05**	**1.17, 3.60**	1.32	.79, 2.20
Fatigue (PAAS)				
Experienced during lab (T2)	.81	.46, 1.45	1.06	.51, 1.81
Remembered during lab	.72	.39, 1.32	.76	.42, 1.39
Anticipated during nonlab	.62	.35, 1.08	.96	.60, 1.72

Note. Statistically significant effects ($p < .05$) are represented in boldface font.