Effects of Acute Resistance Training of Different Intensities and Rest Periods on Anxiety and Affect

Wendy S. Bibeau,[1] Justin B. Moore,[2] Nathanael G. Mitchell,[3] Tiffanye Vargas-Tonsing,[4] and John B. Bartholomew[5]

[1]Department of Biostatistics and Epidemiology, School of Public Health, University of Maryland, Maryland; [2]Department of Public Health, Brody School of Medicine, East Carolina University, Greenville, North Carolina; [3]School of Professional Psychology, Spalding University, Louisville, Kentucky; [4]Department of Health and Kinesiology, College of Education and Human Development, University of Texas at San Antonio, San Antonio, Texas; and [5]Department of Kinesiology and Health Education, College of Education, University of Texas at Austin, Austin, Texas

Abstract

Bibeau, WS, Moore, JB, Mitchell, NG, Vargas-Tonsing, T, and Bartholomew, JB. Effects of acute resistance training of different intensities and rest periods on anxiety and affect. *J Strength Cond Res* 24(8): 2184–2191, 2010—The affective benefits associated with aerobic exercise are well documented. However, literature concerning resistance exercise has suggested a more variable response (i.e., a short duration increase in state anxiety, which eventually is reduced below baseline) and thus may play an important role in the adoption and maintenance of a resistance training program. The purpose of the current study was to examine the effects of different intensities and rest period during resistance exercise on anxiety, positive affect, and negative affect while holding volume constant and controlling for self-efficacy. Using an experimental design, individuals enrolled in a weight training class ($n = 104$) were randomly assigned 1 of 5 exercise conditions (control, low-long, low-short, high-long, and high-short), varying intensities, and rest time. Anxiety and positive and negative affect measurements were collected immediately following the exercise workouts. Data from separate analyses of covariance revealed a significant main effect for condition on positive affect ($p = 0.026$), in which the low-long group reported significantly higher positive affect than the control group, at 5-minute postexercise. Similar analysis indicated a significant main effect for time on anxiety ($p = 0.003$), with the highest anxiety detected at 5-minute postexercise, and significant reductions in anxiety at both 20-minute and 40-minute postexercise. In conclusion, these results suggest that the variation of intensity and rest time had a modest short-term effect on psychological states, following an acute bout of resistance exercise. Personal trainers and health professionals may want to emphasize light-intensity resistance programs for novice clients to maximize psychological benefits, which in turn, may positively affect compliance and adherence.

Key Words exercise, strength, psychological state

Introduction

There is an extensive body of research, which suggests that an acute bout of aerobic exercise is associated with a reduction in anxiety (11,19) while promoting general psychological well-being (17,20). Psychological benefits, such as reductions in state anxiety after acute bouts of aerobic exercise, are realized immediately after exercise and may continue for up to 4 hours following exercise cessation (33). In comparison with the large amount of literature regarding aerobic exercise, relatively few studies have examined the effect of anaerobic exercise, for example, resistance training, on affective states.

Taken together, early studies provide a modicum of support that low- or moderate-intensity resistance training may decrease or have little effect on anxiety (16,18). Conversely, high-intensity resistance training may be associated with an increase in state anxiety (1,35), which reflects a subjective, transitory emotional state that may vary in length and intensity (36). Results suggest exercise intensity may moderate the effect of resistance exercise on state anxiety (1,35). Considering the preliminary support that intensity may influence psychological responses, it is worthwhile to examine the postexercise responses of affect, which reflect intrapersonal valenced responses, such as positive or negative (12), and anxiety following an acute bout of resistance training that varies in intensity and rest periods and to examine if these effects sustained.

Address correspondence to Wendy S. Bibeau, wbibeau@umd.edu.

24(8)/2184–2191

Journal of Strength and Conditioning Research

Individual perception of personal capabilities is hypothesized as an integral cognitive mechanism that may moderate this relationship between resistance training and psychological states. In particular, self-efficacy, the perception of one's ability to carry out behavior with a known outcome, is a frequently cited psychosocial determinant of physical activity (27). For instance, individuals with low self-efficacy experience greater anxiety and depression, internalize failures, and tend to give up when faced with stressful stimuli (2). Alternatively, highly efficacious individuals tend to exert more effort, take on more challenging tasks, and persist longer during aversive events. McAuley et al. (28) successfully manipulated self-efficacy through bogus feedback and contrived data, with results showing the high-efficacy group achieving more positive affect and less negative affect. These results were consistent with prior research (22) in which reported changes in self-efficacy and changes in anxiety, across varying exercise intensities, have an inverse relationship. Consequently, self-efficacy is an important variable to consider.

Affective processes in determining physical activity behavior, such as compliance and adherence, have received less consideration compared with environmental (38) and social mechanisms (8). The hedonic theory provides the basis as the theoretical underpinnings by which affective responses to exercise may relate to adherence (6). Simply put, individuals are governed by pleasure and pain. Several recent studies have applied this theory toward exercise behavior (13,15) and have proposed a causal chain connecting exercise intensity, affective responses, and adherence (15). Accordingly, even slight elevations of displeasure may have serious ramifications on exercise adherence. Considering the health benefits of resistance training (7) and the low rates of physical activity participation (25), understanding affective mechanisms are important for predicting physical activity behavior and implementing successful interventions.

Attrition rate is typically high during the beginning stages of a resistance training program. Because of this, affective responses to resistance training may play a critical role in the adoption and adherence of resistance training participation. As hypothesized by Tharion and colleagues (37), beginners may become easily discouraged from an exercise routine that elicits negative affect and increases anxiety, regardless of the transitory nature of these psychological states. To gain insight into the effects of various resistance training routines on affect and anxiety, the current study was designed to examine if exercise-induced changes in anxiety, positive affect, and negative affect could be manipulated by varying intensity and rest period during resistance training, holding volume constant.

The present study was designed to test 4 hypotheses: H1: Resistance training with a high-intensity workload and a short rest period would result in the greatest increases in anxiety compared with the other groups while controlling for self-efficacy. H2: Resistance training with a high-intensity workload and a short rest period would result in the greatest increases in negative affect compared with all other groups while controlling for self-efficacy. H3: Resistance training with a low-intensity workload and short rest period would produce the greatest increases in positive affect compared with the other groups while controlling for self-efficacy. H4: These changes would exhibit a dose-response relationship with the low-intensity long rest period group displaying the lowest increases in anxiety and negative affect, but having highest increases in positive affect, whereas the high-intensity short rest period group would experience the highest increases in anxiety and negative affect and lowest gains in positive affect.

Methods

Experimental Approach to the Problem

The main purpose of the paper was to examine the effects of manipulating intensities and rest periods during resistance exercise on anxiety, positive affect, and negative affect while holding volume constant and controlling for self-efficacy. Given the health benefits of regular resistance training (7,34) and the alarmingly low rates of physical activity among adults (25), understanding how the affective processes are affected during resistance exercise may be key in determining exercise behaviors, such as compliance and adherence. Furthermore, the influences of affective domains on exercise behavior remain relatively understudied compared with that of cognitive and social influences. Our experimental study design using 4 different exercise conditions and a comparison group allowed us to test for the effect of the independent variables (intensity and rest time) on the dependent variables (anxiety, positive affect, and negative affect). Details of the 5 randomly assigned groups are summarized in Table 1.

As volume is the summation of total number of repetitions multiplied by resistance, workload was approximately the same for all exercise conditions. Several studies have defined short rest periods between sets anywhere 30–60 seconds, whereas long rest periods have been defined anywhere between 1 and 3 minutes (23,29). Considering these ranges of rest periods, 30 seconds was defined as a short rest period and 90 seconds was defined as a long rest period.

Subjects

Subjects consisted of 104 undergraduate students (58 men, 46 women, mean age = 20.49, $SD = 2.73$) enrolled in weight training classes at a large university located in the southwestern U.S.A. We were able to note that the class, which met twice weekly for 90 minutes, used a periodization approach to resistance training and included cycles of both low-weight high-repetition and high-weight low-repetition exercises. All subjects were recruited midway through the semester. As a result, they had specific experience on the equipment and procedures used in this study. Unfortunately, data were not collected on current or prior resistance training experience. However, previous studies in similar populations

TABLE 1. The different exercise conditions.

Conditions (*n*)	Repetitions per set	Sets	Rest (s)	Total work
Condition 1 (18), no exercises				Control
Condition 2* (22)				Low intensity, short rest
Chest press	10–11	3	30	
Seated row	10–11	3	30	
Leg press	10–11	3	30	
Hamstring curl	10–11	3	30	
Condition 3* (24)				Low intensity, long rest
Same exercises	10–11	3	90	
Condition 4† (22)				High intensity, short rest
Same exercises	6–7	3	30	
Condition 5† (18)				High intensity, long rest
Same exercises	6–7	3	90	

*Performed at 50–55% of 1RM.
†Performed at 80–85% of 1RM.

(5,30) and anecdotal evidence in the study population suggest that our subjects ranged from those who began resistance training for the first time at the initiation of the course to more than 5 years of resistance training experience.

Each individual completed an informed consent form before participation and received class credit for their participation in this study. Subjects were allowed to withdraw at any time without penalty and were informed of any potential risks resulting from the study. All procedures were approved by the University's Internal Review Board.

Procedure

Subjects attended 2 sessions, scheduled at least 1 week apart, outside of their regularly scheduled weight training class. All subjects were advised not to engage in resistance and cardiovascular training 48 hours and 24 hours, respectively, prior to testing. In addition, all subjects were instructed not to eat 1 hour prior to testing. Otherwise, all subjects were advised to continue normal activities.

A common-use gymnasium was used for all exercise conditions. The initial testing session was scheduled to determine each subject's 1 repetition maximum (RM) on each of the 4 selected exercise machines. Upon arrival to the gym, subjects were asked to perform a 5-minute warm-up on a seated rowing machine following a short orientation. All subjects performed 4 different types of exercises in the following order: chest press, seated row, leg press, and hamstring curl. Warm-up exercises were required for each subject, before the 1RM, by performing 5–10 repetitions using a self-selected, light weight.

Taking into consideration the wear of sequential submaximal lifts on an individual's ability to provide a maximal effort in determining 1RM, the beginning weight was carefully negotiated based on the subject's experience to ensure a maximum of 3 attempts. Once the warm-up exercises were completed, subjects performed a 1RM. After a weight was successfully lifted, the subject was allowed adequate recovery time before attempting another lift with additional weight. This process was repeated until the subject failed on a lift or reported that he or she could not lift any more weight. Once a 1RM was determined for each lift, subjects were randomly assigned into 1 of 5 conditions. Students were not informed of their assigned condition until after the rowing machine warm-up on day 2.

On the second testing session, subjects began the session by filling out a preexercise affect and anxiety questionnaire to control for psychological states before exercise. Upon completion of this questionnaire, which lasted approximately 10 minutes, subjects were instructed to sit quietly without speaking. Once ready, subjects were then escorted to the exercise area where they again performed a 5-minute warm-up on a seated rowing machine. A rowing machine exercise was selected to provide a proper warm-up of the major muscle groups because rowing involves muscles of both the upper and lower body. Following the warm-up, subjects began a resistance training session lasting approximately 30 minutes. Upon finishing this session, subjects returned to the quiet area for postexercise measures that lasted approximately 10 minutes. Subjects were instructed to sit quietly in between lifting and were also asked not to speak during the transition from the weight room to the classroom where the questionnaires were completed. Once finished with the questionnaires, subjects were asked to sit quietly until all everyone was finished. Psychological states were assessed 4 times: before exercise and at 3 times after exercise (0–5, 20, and 40 minutes).

Instruments

State Anxiety. State anxiety was assessed via Spielberger's State Anxiety Inventory (STAI) (36). The STAI, a 20-item questionnaire that appraises subjects' anxiety levels, has been widely used in exercise research and has shown adequate internal consistency, with alpha ranging from 0.66 to 0.80 (14) and acceptable test-retest reliability ($R = 0.60$) (36).

Positive and Negative Affect. Positive and negative affects were assessed using the Positive Affect Negative Affect Scale (PANAS) (39). The PANAS contains 10-item positive affect and 10-item negative affect subscales. Positive affect reflects the extent to which a person feels enthusiastic and alert and includes such items as "interested," "strong," and "alert", whereas negative affect reflects aversive mood states (e.g., "guilty," "afraid," and "nervous"). Subjects rated their affect on a 5-point Likert scale from 1 (very slightly or not at all) to 5 (extremely). Subjects were instructed to indicate how they felt at the present moment. The PANAS was developed and validated on undergraduate college student samples and has been widely used in studies of mood (9,32). Internal consistency reliability coefficients for the positive affect and negative affect subscales were high, with coefficient alpha coefficients ranging from 0.84 to 0.90 (39). Test-retest reliabilities for an 8-week retest interval ranged from 0.45 to 0.70 (39).

Exercise Self-Efficacy. A modified version of the Exercise Self-Efficacy Scale, created by McAuley et al. (26) for use in an exercise setting, was used to indicate the degree of confidence they possessed to successfully complete the specific exercise routine for each of the possible conditions, excluding control. The scale consisted of 4 items, with each item representing an exercise condition (e.g., "at 50–55% of your maximal lift with 30 s rest between sets"). For each item on the scale, subjects were asked questions about his or her belief in his/her ability to "successfully complete all exercises without deviating from the pacing." The responses were scored on a 100-point percentage scale composed of 10-point increments from 0 (no confidence at all) to 100 (complete confidence). Total strength of self-efficacy was calculated by summing the confidence ratings and dividing by the total number of items in the scale, resulting in a maximum possible efficacy score of 100. The modified version of the Exercise Self-Efficacy Scale has shown high internal consistency alpha coefficients ranging above 0.90 (26,28).

Statistical Analyses

To test our hypotheses, separate analyses of covariance (ANCOVAs) were run on each of the dependent variables (positive affect, negative affect, and anxiety). As previous studies have shown sex differences, we included sex as an independent variable. If the interactions for sex on the dependent variables were not significant, the data were collapsed for both men and women in the remaining analyses. If sex was found to be significant, it was entered as a covariate in the model. In addition, baseline measures of the dependent variable and self-efficacy were entered as covariates in the model. We recorded the observed power for each ANCOVA. For all analyses, alpha was set at $p \leq 0.05$. However, Bonferroni adjustments were applied when multiple comparisons were performed.

Results

Positive Affect and Negative Affect

Descriptive data of state anxiety, positive affect, and negative affect at each data point are represented in Figure 1.

To examine whether or not differential effects existed for men and women on positive and negative affect, 2 separate 2(gender) $\times$ 5(condition) $\times$ 3(time) ANCOVAs were run on the dependent variables, controlling for baseline measures of the dependent variable and self-efficacy. The results indicated that there were no significant interactions or main effects for gender on positive or negative affect. For this reason, data were collapsed for men and women for the remaining analyses investigating positive affect and negative affect. When investigating the impact on positive affect, the results indicated a significant main effect for group, $F(4,97) = 2.95$, $p = 0.026$ (observed power = 0.78, $\eta^2 = 0.11$), with the low-long group reporting significantly higher positive affect than the control group. The results also indicated a significant main effect for time, $F(2,194) = 6.01$, $p = 0.005$ (observed power = 0.88, $\eta^2 = 0.06$), with subjects reporting significantly higher positive affect at 5 minutes compared with both 20 and 40 minutes. A significant group $\times$ time interaction was also found $F(8,194) = 2.19$, $p = 0.039$ (observed power = 0.85, $\eta^2 = 0.08$) (Figure 2). To elucidate the nature of this interaction, simple effects of each group within each level of time were conducted.

At 5 minutes following the exercise, there were significant differences in positive affect among the different groups, $F(4,97) = 5.25$, $p = 0.001$. Bonferroni adjustments used in post hoc analyses revealed significantly higher positive affect for the low-long group compared with the control group. Any significant differences among the groups were no longer present at both 20 minutes following the exercise, $F(4,97) = 1.98$, $p = 0.10$, and 40 minutes following exercise, $F(4,97) = 1.01$, $p = 0.41$.

No significant main effects for group, $F(2,192) = 1.287$, $p = 0.275$ (observed power = 0.58, $\eta^2 = 0.01$); time, $F(4,96) = 1.40$, $p = 0.240$ (observed power = 0.62, $\eta^2 = 0.06$), or a significant interaction effect (group $\times$ time, $F(8,192) = 1.28$, $p = 0.266$) was observed for negative affect.

State Anxiety

A significant multivariate interaction effect (gender $\times$ time) was observed for state anxiety. Consequently, gender was entered as another covariate. A 5(condition) $\times$ 3(time) ANCOVA was conducted with state anxiety as the dependent variable, controlling for baseline measures of the state anxiety, gender, and self-efficacy. Although the results did not indicate

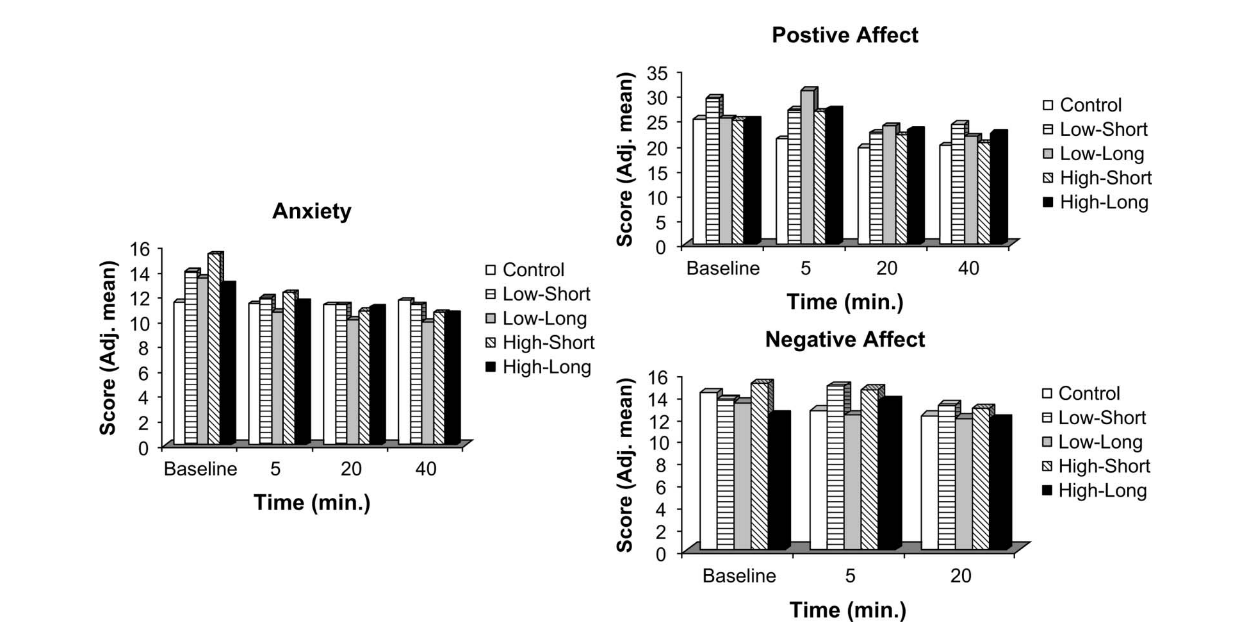

Figure 1. Average adjusted scores for each dependent variable.

a significant main effect for group, $F(4,96) = 1.11$, $p = 0.341$ (observed power = 0.98, $\eta^2 = 0.09$), the results indicated a significant main effect for time, $F(2,192) = 9.61$, $p = 0.003$ (observed power = 0.96, $\eta^2 = 0.08$), with the highest anxiety at 5 minutes following exercise and significant reductions in anxiety at both 20 and 40 minutes following exercise. A significant interaction effect for group × time was found for state anxiety, $F(8,192) = 2.018$, $p = 0.031$ (Figure 3).

To elucidate the nature of this interaction, simple effects of each group within each level of time were conducted. At 5 minutes following exercise, significant differences among the groups were found, $F(4,96) = 3.04$, $p = 0.02$. After Bonferroni adjustments, post hoc analyses revealed significantly higher state anxiety for the high-short group compared with the control group. Significant differences among the groups were no longer present at both 20 minutes following the exercise,

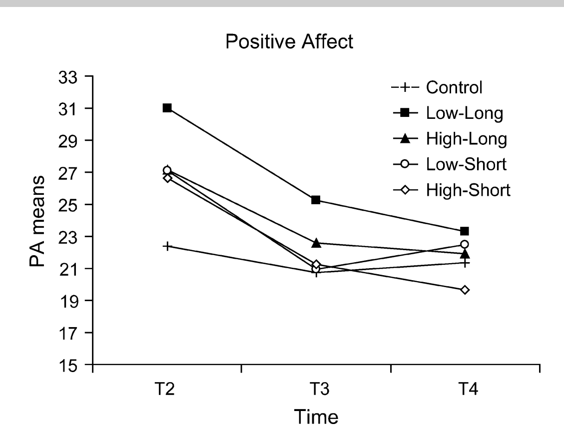

Figure 2. Interactions between experimental groups regarding time and positive affect (PA).

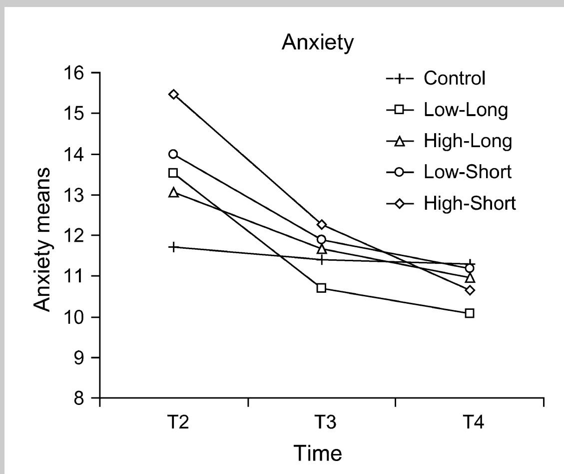

Figure 3. Interactions between experimental groups regarding time and anxiety.

$F(4,96) = 0.699$, $p = 0.59$, and 40 minutes following exercise, $F(4,97) = 0.642$, $p = 0.63$.

Discussion

The main purpose of this study was to examine the effects of intensity and rest period manipulation on exercise-induced changes in anxiety, positive affect, and negative affect in the context of improving compliance and attrition with resistance training. Our results did not support our first 2 hypotheses (H1 and H2). Instead of observing significant differences between all groups on anxiety, we detected significant differences between the high-short and control groups. However, immediate increases in anxiety in all groups compared with controls, with the highest gains found in the short rest groups (low intensity, short rest; high intensity, short rest), appear to be congruent with prior literature with respect to exercise intensity (3,4). The lack of significant findings with negative affect, again in contrast to Arent and colleagues (1), was surprising. Although Arent and colleagues had subjects in the high-intensity group perform 10 repetitions of 100% of 10RM, the high-intensity group in this study performed 6–7 repetitions at 80–85% of 1RM. Although rest time between repetitions was manipulated for this study, an accurate high-intensity condition may not have been replicated. As a result, it is likely subjects did not feel a high level of exertion, explaining the lack of negative affect.

Regarding our third hypothesis (H3), higher positive affect was found among all groups compared with the control, with the largest increase in positive affect among the low-long group. This is in contrast to previous research (1), which found that low-intensity groups produced the largest decrease in positive affect. The conflicting data are interesting and may be a function of the differences in samples used. For instance, Arent and colleagues (1), who recruited "active aerobic exercisers," reported that several subjects in their low-intensity condition felt displeasure and boredom. This lack of interest and enjoyment may be explained by the inexperience of resistance training by subjects who normally partake in aerobic activities. However, subjects in this study showed a predisposed interest in resistance training through their volunteered enrollment in the weight training classes.

For our final hypothesis (H4), it was also expected that low-intensity workloads with long rest periods would produce the highest increases in positive affect and lowest increases in negative affect. The current results only reflected these hypotheses at 5 minutes following exercise and were only associated with positive affect and anxiety. Group differences were no longer observed at 20 and 40 minutes postexercise. As significant differences were not detected between groups for negative affect, a dose-response relationship was not found between intensity and rest periods and psychological states.

The results of simple effects for each group within each level of time reveal a diminishing effect of resistance training on positive affect within the low-intensity group. It is possible that significant gains in positive affect were not observed because of the insufficient assessment duration of affect. There is evidence that observations of anxiolytic benefits following acute episodes of resistance training may occur between 90 and 180 minutes postexercise (31). With respect to state anxiety, insufficient assessment duration may also explain the lack of significant findings among the low-intensity group compared with the control. This possible rationalization is corroborated by Focht and Koltyn (16), who found a significant decrease in state anxiety within the low-intensity resistance training group (50% 1RM) 180 minutes after exercise.

There are, however, 2 alternative explanations for the contrasting findings. Again, differences in sample experience, with respect to weightlifting, may have supplemented the lack of negative affective responses. The present study used subjects enrolled in a weight training class, whereas Arent and colleagues' (1) sample had refrained from a strength training program for 4 months before enrollment. As well, the current study used a relatively young and healthy sample. An older, medically vulnerable sample may exhibit a different array of affective responses that would probably reflect a more negative affective state.

From answering our research hypotheses, there are 2 key messages that need to be underscored. First, resistance exercise, regardless of intensity, does not negatively affect psychological states following exercise, as seen with the lack of significant group differences on changes in negative affect. From our results, low-intensity resistance workouts may not generate negative feelings, and therefore may be more likely to comply and adhere to the resistance training program. This is consistent with a recent study that found a 10% increase in exercise intensity above self-selected intensity among sedentary women resulted in a decrease in pleasure (15). Although these findings may seem trivial, repeated experiences of displeasure following exercise may lead to high attrition rates among new exercisers. These results lend further support to the hedonic principle that stipulates individuals will maximize or prolong pleasant feelings while minimizing or avoiding pain. Furthermore, our message may greatly help with those who shy away from high-intensity exercise routines that on average generate negative feelings (24).

Second, the importance of this study lay with understanding the affective responses to resistance exercise and how that applies toward exercise adherence. Given the low rates of physical activity among adults, it is important to understand the mechanisms that help explain exercise behavior. From our results, it may be inferred that resistance exercise of differing intensity levels and rest periods can have a positive impact on psychological state and may aid in exercise attrition and adherence. Albeit the increases in positive affect were short term, it still may help explain exercise adherence. For instance, Williams (40) found that baseline affective responses to moderate-intensity exercise predicted exercise participation at 6 and 12 months follow-up. Although there are no norms established for the change in affect or anxiety, we are not aware of any work that has established a nadir of postexercise psychological responses that are associated with reduced adherence. As a result, we cannot speak to the impact of these scores.

However, it is interesting to note that Williams (40) found that even neutral mood had potentially negative consequences. Specifically, on a scale of −5 to 5, scores below −1 were not observed, and yet, variation in mood was a strong predictor of subsequent exercise adherence. Thus, it may not be the absolute score that is important, but the relative response within the sample. Furthermore, it is important to note that Williams used an aerobic exercise trial and not resistance exercise. An important follow-up to these data would, therefore, be to relate changes in mood with adherence to resistance exercise programs. It may be that the present level of mood disturbance represents the normal expectations of a resistance training program. Given the paucity of research on resistance exercise and mood, the present data represent an important initial step in examining these relationships, but they must be extended to adherence data and, ideally, compared with aerobic exercise to more fully appreciate their impact.

While this study offers additional insight into this area, it is important to note that limitations were present. For example, there are several possible physiological mechanisms that may drive affective responses to acute bouts of exercise, which were not measured in the current study. There is some evidence that changes in lactate accumulation and peripheral fatigue explains the psychological states, whereas other research implicates the hypothalamic-pituitary-adrenal axis or the autonomic nervous system (1). Without any measurement of autonomic nervous system activity, it is impossible to discern any type of causal relationship between resistance training and affective responses.

In spite of these limitations, overall these results are consistent with previous research examining the effect of resistance training on anxiety and affect. Within this study, immediate increases in anxiety were observed in all groups compared with controls, with the highest increase found in the short rest groups, regardless of exercise intensity, experience, gender, and volume of exercise.

Practical Applications

Although our hypotheses were not entirely supported, our data have practical applications with respect to understanding how exercise intensity may influence psychological states, which in turn, may help explain exercise attrition and adherence. Although intensity and rest period were not selected by subjects, the varying results dependent on the intensity and rest periods indicate that perhaps novice weightlifters may gain the most. For instance, resistance exercise does not require high levels of intensity to garner important results.

Therefore, the main message to novice lifters is that they do not have to incorporate a high-intensity workout to receive health benefits. For example, the data suggest short-term psychological benefits of resistance training for those performing low-intensity exercises. As such, single episodes of resistance training may confer with improved affect for both novices and experienced weightlifters and may convey a more palatable alternative of exercise to subgroups that need or prefer lighter intensity workouts.

Perhaps more important for novice weightlifters is the absence of negative feelings. If behavior is shaped by the tendency to maximize pleasure and minimize displeasure, then adherence and compliance of beginners may improve when affective responses taken into account. Considering our results, personal trainers and interventionists alike may want to focus on lighter intensity resistance training programs when dealing with novice clients, to maximize psychological benefits, improve early attrition, and adherence.

From a practical and public health perspective, these results may possess ramifications when considering the rapid growth of popularity, over the past 25 years, of using resistance training as a protective health behavior (10). The American Heart Association combined with the American Sports College Association recommends that adults perform physical activities that enhance and maintain muscular strength and endurance on at least 2 days per week (21). However, less than half of American adults meet current recommendations. Thus, understanding what influences individuals' exercise behaviors is important in the implementation of successful exercise interventions.

Acknowledgments

This study did not receive funding from any source. The authors would like to thank the proof reading skills of Lynn Scully and Sonja Williams.

References

1. Arent, SM, Landers, DM, Matt, KS, and Etnier, JL. Dose-response and mechanistic issues in the resistance training and affect relationship. *J Sport Exerc Psychol* 27: 92–110, 2005.
2. Bandura, A, Cioffi, D, Taylor, CB, and Brouillard, ME. Perceived self-efficacy in coping with cognitive stressors and opioid activation. *J Pers Soc Psychol* 55: 479–488, 1988.
3. Bartholomew, JB and Linder, DE. State anxiety following resistance exercise: The role of gender and exercise intensity. *J Behav Med* 21: 205–219, 1998.
4. Bartholomew, JB, Moore, J, Todd, J, Todd, T, and Elrod, CC. Psychological states following resistant exercise of different workloads. *J Appl Sport Psychol* 13: 399–410, 2001.
5. Bartholomew, JB, Stults-Kolehmaine, MA, Elrod, CC, and Todd, JS. Strength gains after resistance training: the effect of stressful, negative life events. *J Strength Cond Res* 22: 1215–1221, 2008.
6. Bentham, J. *An Introduction to the principles of Morals and Legislation.* New York: Dover Publications, 2007.
7. Braith, RW and Stewart, KJ. Resistance exercise training: Its role in the prevention of cardiovascular disease. *Circulation* 113: 2642–2650, 2006.
8. Brassington, GS, Atienza, AA, Perczek, RE, DiLorenzo, TM, and King, AC. Intervention-related cognitive versus social mediators of exercise adherence in the elderly. *Am J Prev Med* 23: 80–86, 2002.
9. Christensen, AJ, Moran, PJ, and Wiebe, JS. Assessment of irrational health beliefs: Relation to health practices and medical regimen adherence. *Health Psychol* 18: 169–176, 1999.

10. Deschenes, MR and Kraemer, WJ. Performance and physiologic adaptations to resistance training. *Am J Phys Med Rehabil* 81: S3–S16, 2002.

11. Dunn, AL, Trivedi, MH, Kampert, JB, Clark, CG, and Chambliss, HO. Exercise treatment for depression: Efficacy and dose response. *Am J Prev Med* 28: 1–8, 2005.

12. Ekkekakis, P. Pleasure and displeasure from the body: Perspectives from exercise. *Cogn Emot* 17: 213–239, 2003.

13. Ekkekakis, P, Backhouse, SH, Gray, C, and Lind, E. Walking is popular among adults but is it pleasant? A framework for clarifying the link between walking and affect as illustrated in two studies. *Psychol Sport Exerc* 9: 246–264, 2008.

14. Ekkekakis, P, Hall, EE, and Petruzzello, SJ. Practical markers of the transition from aerobic to anaerobic metabolism during exercise: Rationale and a case for affect-based exercise prescription. *Prev Med* 38: 149–159, 2004.

15. Ekkekakis, P and Lind, E. Exercise does not feel the same when you are overweight: The impact of self-selected and imposed intensity on affect and exertion. *Int J Obes* 30: 652–660, 2006.

16. Focht, BC and Koltyn, KF. Influence of resistance exercise of different intensities on state anxiety and blood pressure. *Med Sci Sports Exerc* 31: 456–463, 1999.

17. Fox, KR. The influence of physical activity on mental well-being. *Public Health Nutr* 2: 411–418, 1999.

18. Garvin, AW, Koltyn, KF, and Morgan, WP. Influence of acute physical activity and relaxation on state anxiety and blood lactate in untrained college males. *Int J Sports Med* 18: 470–476, 1997.

19. Hale, BS, Koch, KR, and Raglin, JS. State anxiety responses to 60 minutes of cross training. *Br J Sports Med* 36: 105–107, 2002.

20. Hall, EE, Ekkekakis, P, and Petruzzello, SJ. The affective beneficence of vigorous exercise revisited. *Br J Health Psychol* 7: 47–66, 2002.

21. Haskell, WL, Lee, IM, Pate, RR, Powell, KE, Blair, SN, Franklin, BA, Macera, CA, Heath, GW, Thompson, PD, and Bauman, A. Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* 116: 1081–1093, 2007.

22. Katula, JA, Blissmer, BJ, and McAuley, E. Exercise intensity and self-efficacy effects on anxiety reduction in healthy, older adults. *J Behav Med* 22: 233–247, 1999.

23. Kraemer, WJ, Adams, K, Cafarelli, E, Dudley, GA, Dooly, C, Feigenbaum, MS, Fleck, SJ, Franklin, B, Fry, AC, Hoffman, JR, Newton, RU, Potteiger, J, Stone, MH, Ratamess, NA, and Triplett-McBride, T. American College of Sports Medicine position stand. Progression models in resistance training for healthy adults. *Med Sci Sports Exerc* 34: 364–380, 2002.

24. Lind, E, Ekkekakis, P, and Vazou, S. The affective impact of exercise intensity that slightly exceeds the preferred level: 'Pain' for no additional 'gain'. *J Health Psychol* 13: 464–468, 2008.

25. Macera, CA, Ham, SA, Yore, MM, Jones, DA, Ainsworth, BE, Kimsey, CD, and Kohl, HW. Prevalence of physical activity in the United States: Behavioral Risk Factor Surveillance System, 2001. *Prev Chronic Dis* 2: A17–A17, 2005.

26. McAuley, E, Courneya, KS, and Lettunich, J. Effects of acute and long-term exercise on self-efficacy responses in sedentary, middle-aged males and females. *Gerontologist* 31: 534–542, 1991.

27. McAuley, E, Elavsky, S, Motl, RW, Konopack, JF, Hu, L, and Marquez, DX. Physical activity, self-efficacy, and self-esteem: Longitudinal relationships in older adults. *J Gerontol B Psychol Sci Soc Sci* 60: P268–P275, 2005.

28. McAuley, E, Talbot, HM, and Martinez, S. Manipulating self-efficacy in the exercise environment in women: Influences on affective responses. *Health Psychol* 18: 288–294, 1999.

29. Miranda, H, Fleck, SJ, Simao, R, Barreto, AC, Dantas, EH, and Novaes, J. Effect of two different rest period lengths on the number of repetitions performed during resistance training. *J Strength Cond Res* 21: 1032–1036, 2007.

30. Moore, JB, Mitchell, NG, Kilpatrick, MW, Bartholomew, JB. The physical self-attribute questionnaire: development and initial validation. *Psychol Rep* 100: 627–642, 2007.

31. O'Connor, PJ, Bryant, CX, Veltri, JP, and Gebhardt, SM. State anxiety and ambulatory blood pressure following resistance exercise in females. *Med Sci Sports Exerc* 25: 516–521, 1993.

32. Paez, D, Velasco, C, and Gonzalez, JL. Expressive writing and the role of alexythimia as a dispositional deficit in self-disclosure and psychological health. *J Pers Soc Psychol* 77: 630–641, 1999.

33. Petruzzello, S, Landers, DM, Hatfield, BD, Kubitz, KA, and Salazar, W. A meta-analysis on the anxiety-reducing effects of acute and chronic exercise. Outcomes and mechanisms. *Sports Med* 11: 143–182, 1991.

34. Pollock, ML, Franklin, BA, Balady, GJ, Chaitman, BL, Fleg, JL, Fletcher, B, Limacher, M, Pina, IL, Stein, RA, Williams, M, and Bazzarre, T. AHA Science Advisory. Resistance exercise in individuals with and without cardiovascular disease: Benefits, rationale, safety, and prescription: An advisory from the Committee on Exercise, Rehabilitation, and Prevention, Council on Clinical Cardiology, American Heart Association; Position paper endorsed by the American College of Sports Medicine. *Circulation* 101: 828–833, 2000.

35. Raglin, JS, Turner, PE, and Eksten, F. State anxiety and blood pressure following 30 min of leg ergometry or weight training. *Med Sci Sports Exerc* 25: 1044–1048, 1993.

36. Spielberger, CD, Gorsuch, DL, and Lushene, RE. *State-Trait Anxiety Inventory*. San Francisco, CA: Consulting Psychologists' Press, 1983.

37. Tharion, WJ, Harman, EA, Kraemer, WJ, and Rauch, TM. Effects of different weight training routines on mood states. *J Strength Cond Res* 5: 60–65, 1991.

38. Trost, SG, Owen, N, Bauman, AE, Sallis, JF, and Brown, W. Correlates of adults' participation in physical activity: Review and update. *Med Sci Sports Exerc* 34: 1996–2001, 2002.

39. Watson, D, Clark, LA, and Tellegen, A. Development and validation of brief measures of positive and negative affect: the PANAS scales. *J Pers Soc Psychol* 54: 1063–1070, 1988.

40. Williams, DM. Exercise, affect, and adherence: An integrated model and a case for self-paced exercise. *J Sport Exerc Psychol* 30: 471–496, 2008.