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Improving Exercise Adherence and Physical Measures in Latina Women

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UNIVERSITY OF MIAMI

IMPROVING EXERCISE ADHERENCE AND PHYSICAL MEASURES IN LATINA WOMEN

By

Lorena Martin

A DISSERTATION

Submitted to the Faculty
of the University of Miami
in partial fulfillment of the requirements for
the degree of Doctor of Philosophy

Coral Gables, Florida

August 2013
UNIVERSITY OF MIAMI

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

IMPROVING EXERCISE ADHERENCE AND PHYSICAL MEASURES IN LATINA WOMEN

Lorena Martin

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Improving Exercise Adherence and Physical Measures in Latina Women

Abstract of a dissertation at the University of Miami.

Dissertation supervised by Professor Arlette C. Perry
No. of pages in text (33).

**Purpose.** Epidemiological data have established that lack of physical activity increases risk factors for chronic diseases. Data also suggests that physical activity participation is lowest in women minorities particularly Latina women and that the nature of the exercise and attitudes toward the importance of exercise may influence exercise adherence. The purpose of this study was to determine the effect of hypertrophy training (HT) or power training (PT) used concomitantly with evaluative conditioning (EC), or neutral conditioning (NC) as a control, on exercise adherence as well as changes in body composition, neuromuscular performance, functional capacity, and psychosocial variables in Latina women. The EC is a behavioral method using paired stimuli to develop and strengthen new associations in memory. **Methods.** 142 Latina women (mean ± SD, age 36.8±15.9 yrs.) were randomly assigned to standard HT or high-speed circuit PT and then further stratified to receive EC or NC. Availability to training sessions was unlimited and training volumes were equilibrated between HT and PT. **Results.** For HT, EC produced significantly greater exercise time across the training period than NC, while PT coupled with EC or NC produced significantly higher adherence levels than HT for the NC condition. All body composition variables, except lean body mass (LBM) improved regardless of training or conditioning status; while LBM declined for NC (p < 0.05). For all exercises with the exception of the leg extension, there were significant increases in strength due to training (p < 0.05); however, no increase in leg press power
was detected. Training also positively impacted all functional variables except usual gait speed ($p < 0.05$). Both self-esteem and body esteem improved with training ($p < 0.05$) and for EC, exercise self-efficacy was significantly increased from pretest to post-test.

**Conclusion.** EC can positively impact exercise adherence and exercise self-efficacy in Latina women; while body composition, neuromuscular performance, and functional capacity can be increased using HT and PT independent of psychological conditioning.

**Key Words:** EVALUATIVE CONDITIONING, IMPLICIT ASSOCIATIONS, RESISTANCE TRAINING, CIRCUIT TRAINING, PHYSICAL ACTIVITY, BODY COMPOSITION
Acknowledgements

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I would also like to thank my Dissertation Committee for allowing me the privilege to develop and pursue my own research interests. I want to thank Drs. Arlette C. Perry and Joseph F. Signorile as my main mentors and professors, who were both truly outstanding and supportive throughout the entire process. No matter what day or time I needed help, they would always make time to see me. I would like to thank Dr. Signorile for providing me with invaluable expertise. I would also like to thank Drs. Andrew W. Perkins and Barbara E. Kahn for advising me throughout the entire research study and for making themselves available from remote places in different parts of the country and also for responding in such a prompt manner whenever I needed their assistance. I would also like to acknowledge Dr. Ahn for her excellent ability to teach me how to appreciate the art of statistics. Finally, I would like to thank Dr. Perry for not only being a tremendous mentor, but also for becoming my friend and always being in my corner. I will always be indebted to you for giving the opportunity to complete my doctoral education at the University of Miami.
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Chapter 1

Introduction

Epidemiological data have established that a lack of physical activity increases risk factors for chronic diseases (9) and is reportedly responsible for up to 250,000 deaths per year, most of which are preventable (47). Unfortunately, less than one-half (49.1%) of U.S. adults meet the Centers for Disease Control and Prevention (CDC)/American College of Sports Medicine (ACSM) physical activity recommendations (11, 26). Despite awareness of the importance of regular exercise, the National Health Interview Survey data, 2010 reports that 33% of adults in this country do not engage in any leisure time physical activity and 49% do not meet aerobic or resistance training federal guidelines for physical activity (12).

Physical activity participation is also lowest among minority groups; particularly Latina women (16) and Latinas constitute the largest minority group in the United States. According to the U.S. Department of Health and Services Office of Women´s Health, six out of 10 Latinas are not physically active, adding to the burden of high chronic disease rates that can be prevented by regular exercise (23). By 2050, they are expected to represent 42% of the U.S. population (60). Therefore, it is essential to seek effective health promotion strategies to increase physical activity participation in this growing segment of our population.

Even among persons who have made a conscious decision to engage in exercise programs, poor compliance and high dropout rates are a central issue (38, 61). The average attrition rate for physical activity and exercise programs has been estimated to be 55% (33, 67), with the majority of dropouts occurring within the first four weeks of
training (20). The poor adherence rates observed in these supervised exercise training programs further exacerbate the current low levels of physical activity participation among Latina women (5).

Although a number of factors, such as cultural norms, socioeconomic status, and social support systems, may affect levels of physical activity, research indicates that the individual’s attitude concerning the importance of exercise is one of the most important controlling factors. In a study by Eyler et al. (23) attitudes toward physical activity in Latina women were an important contributing factor affecting their activity levels. Heesch et al. (29) reported that Latina women had reasons for not being active including exercise being a low priority and insufficient time available to exercise. Lack of exercise self-efficacy and low body esteem have been reported as contributing factors obstructing physical activity participation (57, 58).
Chapter 2

Background

Resistance training has been added to the exercise guidelines proposed by ACSM and the Surgeon General’s Report on Physical Activity and Health (1, 65). The nature of a resistance training intervention is commonly described using four factors, loads, movement speed, modality and patterns. The loading continuum is defined as the maximum number of repetitions (RM) an individual can complete with a specific load before stopping. It typically includes a 3-5RM range for strength, an 8-12RM range for hypertrophy, and a 20-28RM range for endurance (10). When power is the primary goal, increases in speed are superimposed over these basic loading patterns. The balance between load and velocity, often termed optimal load, depends upon specific factors such as training goals (18), joint biomechanics (59) and training status (34). The modality used may vary from free weights, through selectorized machines and even bands or rubber tubing. Finally, the typical patterns involve either single or multiple sets, or circuits.

Currently, the two loading patterns that dominate the literature on fitness- and health-based interventions in non-athletic populations are hypertrophy training (HT) and power training (PT). Although there is not a linear relationship between changes in strength and muscle cross-sectional area, HT is often considered synonymous with strength training in the literature (28, 32). While HT at 70-80% 1RM (8-12RM) has been used to increase muscle cross-sectional area and strength, lower weights (40-60% 1RM) have typically been used to achieve the optimal PT load associated with the greatest product of load and velocity in untrained individuals. Although both forms of training have been effectively used to enhance health-related outcomes, no single study, to our
knowledge, has examined the effects of HT and PT on body composition, neuromuscular, functional, and psychosocial variables.

Exercise adherence may have important implications for resistance training programs, since these interventions have been shown to positively influence body composition, neuromuscular, functional, and psychosocial variables (8, 13, 43).

Evaluative Conditioning (EC) is a method proposed for modifying behavior by pairing stimuli with the objective of strengthening or developing new associations (19, 36). Since this technique has been used to reduce smoking and racial biases, and alter food choices (3, 44); it may be useful in modifying physical activity behavior, specifically exercise adherence. It is not known whether HT or PT combined with EC will result in better adherence rates among Latina women.

The purpose of this study is to determine whether HT or PT used concomitantly with EC can result in better adherence to resistance training programs in Latina women. A secondary purpose is to determine whether HT or PT in combination with EC will lead to similar changes in body composition, neuromuscular, functional, or psychosocial variables in Latina women.
Chapter 3

Methods

Subjects. Two hundred and ninety female participants were recruited from the local Miami area through advertisements in local magazines, newspapers, university campuses, and radio stations. Eligibility criteria included: (1) Latina females between the ages of 18-69; (2) willingness to attend EC or neutral conditioning (NC) sessions conducted once every three weeks; and, (3) ability to attend resistance training sessions one or more times per week. Exclusion criteria were: (1) any known cardiovascular, metabolic, neuromuscular, or pulmonary disease, (2) pregnancy, (3) any clinical mental disorders, or (4) any other medical conditions or situations precluding adherence to and completion of the resistance training protocols. Six subjects were excluded for medical issues, leaving a total of 284 individuals available for participation. After an initial introductory session, 269 participants or 94.7% of available subjects verbally committed to the study. A total of 145 or 54% of subjects completed all pre and posttests on body composition, neuromuscular, functional, and psychosocial variables described below. All testing and training procedures were approved by the University of Miami Institutional Review Board and subjects completed signed informed consents prior to participating in the study.

Design. A randomized, 10-week intervention was conducted in the Laboratories of Clinical and Applied Physiology and Neuromuscular Research and Active Aging of the University of Miami to determine the effects of EC together with resistance training on body composition, neuromuscular, functional, and psychosocial variables. The participants were randomly assigned to either HT or PT groups and then further
randomized to receive EC or NC. Assignment of participants to 10-week treatment
groups was done using a table of random permutations, which balanced the number of
participants in each group. The table was prepared in advance by a function created in
Excel (Microsoft Office Corp., Seattle, WA) that generates random number assignments
for each participant. Investigators were blinded to the subjects’ assignments to either EC
or NC, however, they were aware of the type of resistance training participants received.
Only the head investigator and her assistant knew which subjects received EC or NC
(Fig. 3.1).

Prior to testing, all personnel were required to attend a mandatory two-weekend
workshop during which time they practiced testing and training procedures. Following
this workshop, inter-rater reliability ranged from 0.93 to 0.98 for body composition,
neuromuscular, and functional variables.

*Hypertrophy Training (HT).* HT sessions consisted of three sets of eight
repetitions performed for nine exercises (biceps curl, leg extension, leg curls, shoulder
press, leg press, back row, chest press, lat pull-down, and triceps dips) at 80% of
participants’ 1RM. Concentric and eccentric portions of the lift averaged between one
and two seconds. Two-minute rest intervals were provided between sets.

*Power Training (PT).* PT sessions consisted of three sets of 13 repetitions using
aforementioned exercises mentioned performed at 50% of participants’ 1RM with two-
minute rest intervals between sets. The concentric portion of each exercise was
performed as explosively as possible concentrating on maximal load-dependent velocity,
while the eccentric portion was performed at the same speed used for HT training. The
number of repetitions, eight and 13, for HT and PT, respectively, were chosen to provide an equivalent volume of work during each protocol.

*Evaluative Conditioning (EC).* On scheduled EC training days, participants were escorted to the Behavioral Research Laboratory prior to their resistance training sessions to complete EC. Participants were instructed to sit in a chair in front of a desktop computer, place on earphones, and input their ID numbers when prompted by the instructions displayed on the computer screen. Once their IDs were recorded, the assigned EC was automatically initiated. During the EC sessions, participants were presented with positive words paired with images of healthy behaviors or neutral words paired with images unrelated to healthy behaviors. They were then instructed to click on the spacebar whenever they were presented with the target images (Fig. 3.1) associated with “healthy behaviors” (39). Three conditioning trials were provided approximately every three weeks throughout the 10-week intervention.

*Neutral Conditioning (NC).* The same procedure as EC was followed, with the exception that the NC group received a dummy task containing unrelated target images paired with neutral words unrelated to the focus variables.

*Testing Procedures*

*Exercise Adherence.* Exercise adherence was assessed using the amount of time spent training quantified in minutes. For each training session the subject logged in and out using a designated laboratory computer. Only training performed in the laboratory was used to calculate adherence levels.
*Body Composition.* Body composition variables included body mass index (BMI), percent body fat, lean body mass, and waist and hip circumferences. BMI was calculated as weight in kilograms divided by height in meters squared. Percent body fat and lean body mass was evaluated using bioelectrical impedance (Inbody 520; GE Healthcare; Waukesha, WI). The Inbody 520 is an established measure of adiposity and lean body mass (48). Waist and hip circumferences were taken using a spring-loaded tape (Gay Mills, WI). Waist circumference was measured mid-way between the lowest rib and the iliac crest, while hip circumference was measured at the level of the greater trochanter.

*Neuromuscular Performance.* A 1RM testing protocol was used to assess the maximal force production for both the Cybex plate-loaded machines and the Keiser pneumatic leg press (41). For Keiser lower body power testing, a modification of the protocol by Thomas et al (62) was used in which participants performed three repetitions as rapidly as possible at 50% of their 1RM for leg press.

*Functional Capacity.* Functional variables included the 30s Arm Curl (30sAC) (53), 30s Chair Stand (30sCS) (53), usual (GS_{usl}) and maximum gait speeds (GS_{max}) (52), reactive balance (RB; Proprio 5000; Perry Dynamics Inc., Decatur, IL) (14), and the single leg stand test (SLS) (7).

*Psychosocial Self-Reports.* Psychosocial measures included the Rosenberg Self-Esteem Scale (RSE), the Exercise Self-efficacy scale (ESES), and the Body Esteem scale (BES). The RSE is a widely used measure of global self-esteem (54) and has high internal consistency of 0.77, with a minimum Coefficient of Reproducibility of 0.90. The ESES is a questionnaire in which participants rate their confidence level on their ability to perform exercise, regardless of the situation, on a scale from 0-100. Bandura's ESES
scale has a single factor structure with high internal consistency (0.95) (4). The BES is a questionnaire in which participants indicate how they feel about each body part and function of their bodies using a five point Likert scale (25). Internal consistency has been evaluated with values ranging from .82 to .94.

STATISTICAL ANALYSIS

All data was analyzed using SPSS 19 for Windows. Standard statistical methods were used to calculate means, standard deviations, confidence intervals, skewness, and kurtosis on all dependent variables. A 2X2 ANOVA was used to examine the effects of two types of resistance training (HT or PT) and conditioning (EC or NU) on exercise adherence measured by the total number of minutes. Several repeated-measure analyses were conducted to examine the relationship between pre and post scores on body composition (BMI, percent body fat, lean body mass, and waist and hip circumference), neuromuscular performance (upper and lower body strength and power), functional capacity (30 second chair stand, 30 second arm curl, usual gait speed and maximal gait speed tests, Proprio 5000, and the single leg stand), and psychosocial variables (self-esteem, exercise self-efficacy, and body esteem) by resistance (HT or PT) training and by conditioning (EC or NU). An alpha level of .05 was used for all analyses.
Chapter 4

RESULTS

Subject characteristics including age, weight, height and BMI are presented in Table 4.1. As indicated by BMI, subjects were on average, overweight, but not obese. The age of subjects ranged from 18-69 with a mean age of 36.8 years.

Our principal findings were that both training modality and EC had an impact on exercise adherence in Latina women. There was a significant training x conditioning interaction for exercise adherence (Fig. 4.1). For HT, the EC group demonstrated a significantly longer time spent training than the NC group, \( F_{1,184} = 11.874, P < 0.001, \eta^2_p = .061 \). Power to detect the effect was .929. For PT, there was no significant difference between EC and NC groups in time spent training; however, both groups spent significantly more minutes training than the NC group engaged in HT.

Table 4.2 presents the pretest and posttest means ± SD for body composition, neuromuscular, functional, and psychosocial variables. For BMI, percent body fat, waist circumference and hip circumference, a main effect showing improvement in these variables was seen with training \( (P < 0.001) \). For neuromuscular performance, all exercises with the exception of the leg extension, showed significant increases in strength following training \( (P < 0.05) \). For the Keiser pneumatic leg press, a significant increase in strength was observed following training \( (P = 0.048) \); however, no increase in power was detected. Training also resulted in significant improvements in all functional variables \( (P < 0.05) \) with the exception of usual gait speed. For psychosocial variables, self-esteem and body esteem including sexual attraction, weight concern, and physical
condition, all improved following training \((P < 0.05)\). A trend toward improvement was also seen in exercise self-efficacy following training \((P = 0.061)\).

Additionally, a significant time \(\times\) condition interaction was found for lean body mass, \((F_{1, 76} = 5.138, P < 0.05, \eta^2_p = .063)\) (Fig. 4.2). Power to detect the effect was \(.609\). Pairwise comparisons showed that for NC, lean body mass declined across the training period, while no significant difference in LBM was seen for the EC group.

A significant time by condition interaction was also observed for exercise self-efficacy \((p<0.05;\) Fig. 4.3). For the EC condition, exercise self-efficacy significantly increased from pretest to post-test, \((F_{1, 52} = 6.536, P < .05, \eta^2_p = .112)\). Power to detect the effect was \(.709\).
Chapter 5

DISCUSSION

Of the 284 persons available to participate in the study, 142 subjects each were pre-tested and randomly assigned to HT and PT groups. Of these subjects, 90 subjects in the HT group (EC = 42; NC = 48) completed post-testing and 55 subjects in the PT group (EC = 28; NC = 27) completed post-testing.

Our hypothesis that EC would increase exercise adherence in Latina women was supported when EC was combined with HT which employed fewer repetitions and heavier loads than PT. This may be due to the fact that EC coupled with HT served to offset the negative effect of perceived intensity on adherence due to the higher loads associated with HT. Rhodes et al (2006) found that the type of exercise performed did not impact overall adherence rates (71); however, Ekkekakis (22) found that as exercise intensity increased, there was a decrease in pleasure, and as a consequence, a negative impact on exercise adherence.

In contrast, PT produced similar adherence rates for both EC and NC. The same reason may have accounted for the limited effectiveness of EC with PT due to the effect of a lower perceived intensity on adherence with reduced loads using PT. As White et al. (66) noted in their review of factors related to physical activity adherence in women, low-intensity exercise may result in greater adherence than high-intensity programs, especially during the early stages of training. This may explain why adherence for the PT group was independent of EC or NC. Our results are also supported by the findings of the S.W.E.A.T. Study (Sedentary Women Exercise Adherence Trial), which showed that
moderate intensity exercise produced a higher level of exercise training retention than vigorous exercise.

The present study confirms earlier findings that both HT and PT can positively impact BMI, percent body fat, and waist circumference. Although studies have shown that declines in BMI can be found following resistance training (46), results are equivocal showing increases (6) and no change (63) in this variable due to resistance training. These divergent results are not difficult to explain since, as Prentice and Jabb (49) have stated, BMI is merely a surrogate measure of body composition and an ineffectual measure of body fat in individuals who have increased muscle mass due to training. Our results demonstrating a decrease in waist circumference and percent body fat with both HT and PT also reflect those reported in previous studies using circuit and standard resistance training (21, 46).

Waist circumference is an excellent indicator of central obesity. Given the fact that our subjects showed reduced waist circumference levels, this may have important health implications, particularly in Latina women, who suffer from higher rates of diabetes and hypertension than Caucasian women (23). To our knowledge the reduction in hip circumference observed in Latina women in this study has not previously been reported; however, these results coincide with the decreases found in BMI and waist circumference. The significant decrease in lean body mass for the NC group may be explained by the fact that a lesser amount of time was spent training by participants in this group compared to the EC group.

Our findings that significant gains in upper and lower body strength were seen for both HT and PT groups are consistent with previous results. In younger women,
Cullinen and Caldwell (17) reported significant increases in elbow and knee flexion and extension following twelve weeks of moderate intensity resistance training performed twice per week using a combination of free weight and selectorized machine exercises. Holviala et al. (31) examined the effects of 21 weeks of progressive resistance training and demonstrated significant increases in bilateral leg extension 1RM, and maximum isometric force and average force developed within the first 500ms of an isometric bilateral leg extension. Reflective of our results showing significant increases in maximal gait speed, single leg stand, and Proprio 5000 DMA score, the improvements in strength seen in the study by Holviala et al translated into improvements in both gait speed and dynamic balance.

The significant increase in pneumatic strength, and not power, for the HT group has been reported elsewhere by Adams et al. (2). The lack of difference in leg power between the PT (pretest: 78.3±11.1W; post test: 83.9±8.9W) and HT (pretest: 77.3±14.8W; post test: 81.5±12.4W) protocols was unexpected and causal factors are not apparent. One reason for the lack of distinction between the two groups may have been the reluctance of subjects to provide maximal efforts during the power-testing component of the Keiser evaluation; however, this was not discernible during testing. A second possibility may have been the use of selectorized machines for PT. Preliminary results from our laboratories indicate that resistance is not maintained throughout the entire range of motion when these machines are employed during high-speed training (JF. Signorile, personal communication).

Our data showing significant improvements in all functional variables with the exception of usual gait speed is supported by results of previous studies incorporating
both younger and older women. In their systematic review of progressive resistance training and older adults using 3674 participants across 62 trials, Latham et al (35) reported increases in chair rise and gait speed due to training. Additionally, standard resistance training has been shown to produce training frequency-dependent increases in timed up-and-go, chair stand and gait speed in active 60-year old women (24). Our improvements in the 30-second arm curl, 30-second chair stand, single leg stand, maximal gait speed test, and Proprio tests also reflect gains in power and balance demonstrated in other studies (35, 75).

Previous literature has suggested that PT is the optimal training modality for improvements in functionality in persons over the age of 50 (64). Independent of the type of training, both HT and PT groups evidenced significant improvements on tests of functionality. This finding may be related to the wider age range of the Latina group, 18-69, thereby diluting results and potential increases typically observed in elderly men and women using PT.

Our results showing that self-esteem, body esteem, and to a lesser extent, exercise self-efficacy, improved following training, mirror those reported by other researchers. In a study examining the influence of a 20-week exercise program on self-esteem and exercise self-efficacy in middle-aged adults, McAuley et al (40) reported significant improvements in global self-esteem and physical self-worth. They noted that the improvements in self-esteem and physical self-worth were correlated to perceptions of physical condition and body attractiveness, and that changes in exercise self-efficacy and aerobic capacity accounted for the changes in self-esteem. Related specifically to our training intervention, Moore et al (42) found that a 12-week resistance training program
resulted in significant improvements in self-esteem, physical self-worth, and attractive body in 120 college students.

The effect of EC on exercise self-efficacy has not been previously examined; however, a study by Hollands et al (30) examined the impact of a single bout of EC on food choices, concerns about diet, health consequences, coherence between representations and recommended behavior, and self-efficacy. In contrast to our findings, these researchers reported no impact of EC on any of these variables except implicit attitudes. The difference between our findings and those of Hollands et al as they relate to self-efficacy, may be attributed to two major factors. First, the measurements made during our study reflected changes in attitudes developed over a 10-week intervention, while Hollands et al examined immediate responses to a single bout of EC. Second, the nature of the conjoined interventions that included exercise, food choices, dietary concerns, and health consequences, may have affected final outcomes.

There are several limitations with regard to our study. First, women were required to attend at least one session per week and those attending at least 50% of those sessions were included in the analyses. This may have affected the amount of time subjects spent training. Second, a substantial percentage of women dropped out of the HT and PT groups since they did not want to commit to receiving any psychological conditioning. Third, no attempt was made to control diet, which may have influenced some of the outcome variables.

Our study sample size ($n = 284$) was larger than those commonly seen in other training studies examining exercise behaviors which have ranged from 20-60 participants (70,72). Although women were asked to attend at least one session per week, participants
were provided the opportunity to train up to six days per week. Furthermore, participants received three sessions of EC in comparison to previous studies in which only one session was provided (37, 55). The three sessions were equally distributed across the 10-week training program in order to maximize the impact of EC while minimizing the possibility of a learning effect (45). Moreover, we chose to employ the suggestion of previous EC studies to include a neutral conditioning (NC) group (19). Finally, a subtle EC paradigm was incorporated in which associations were presented (i.e. bicycling in an outdoor scenery) to minimize awareness of our purpose and reduce social desirability and demand characteristics (45, 56).

CONCLUSION

The results of the current study suggest that EC can positively impact exercise adherence and exercise self-efficacy in Latina women by associating healthy behaviors with positive words and images. The impact of EC on exercise adherence, however, appears to be modulated by the nature of the exercise used during the intervention, with EC having a greater impact on higher intensity HT versus lower intensity PT (74). Our findings further support the fact that body composition, neuromuscular performance, functional capacity, and psychosocial variables can be increased using either HT or PT without the use of EC. Further research in the domain of physical activity and exercise adherence using EC is suggested to clarify its value in reducing attrition rates using other exercise paradigms.
FIGURE LEGENDS

Figure 1. Evaluative conditioning demonstrating pairing of positive (joyful) and negative (terrible) targets paired with images representing healthy (a) and unhealthy (b) behavior.

Figure 2. Exercise adherence to hypertrophy and power training utilizing evaluative or neutral conditioning. Values represent means + SEM. *Significantly greater than neutral conditioning during hypertrophy training, $p < 0.01$. ** Significantly greater than neutral conditioning during hypertrophy training, $p < 0.001$.

Figure 3. Pre and posttest lean body mass scores for evaluative and neutral conditioning. Values represent means + SEM. * Significantly lower than pretest scores, $p < 0.05$.

Figure 4. Pre and posttest exercise self-efficacy scores utilizing evaluative and neutral conditioning. Values represent means + SEM. * Significantly greater than pretest, $p < 0.05$. 
Figure 3.1

(a)

Joyful

(b)

Terrible
Figure 4.1
Figure 4.2
Figure 4.3
TABLES

Table 4.1 Subject characteristics ($N = 145$).

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<thead>
<tr>
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<td>Height (m)</td>
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<td>Body Fat (%)</td>
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<td>Waist Circumference</td>
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<td>Hip Circumference</td>
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<td><strong>Neuromuscular</strong></td>
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<td>1188 ± 464.99</td>
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<td>Keiser Leg Press</td>
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<td>Leg Extension (kg)</td>
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<td>51.6 ± 12.8</td>
</tr>
<tr>
<td>Biceps Curl Strength</td>
<td>12.3 ± 3.9</td>
<td>15.0 ± 3.5</td>
</tr>
<tr>
<td>Leg Curl Strength</td>
<td>37.4 ± 8.8</td>
<td>45.4 ± 14.5</td>
</tr>
<tr>
<td>Shoulder Press</td>
<td>21.0 ± 5.4</td>
<td>24.2 ± 5.3</td>
</tr>
<tr>
<td>Leg Press Strength</td>
<td>82.0 ± 27.1</td>
<td>94.1 ± 28.0</td>
</tr>
<tr>
<td>Back Row (kg)</td>
<td>39.6 ± 7.7</td>
<td>44.2 ± 9.1</td>
</tr>
<tr>
<td>Chest Press (kg)</td>
<td>34.9 ± 10.0</td>
<td>43.5 ± 12.8</td>
</tr>
<tr>
<td></td>
<td>Group 1 Mean ± SD</td>
<td>Group 2 Mean ± SD</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td><strong>Lat Pulldown (kg)</strong></td>
<td>23.7 ± 7.3</td>
<td>28.4 ± 7.2</td>
</tr>
<tr>
<td><strong>Assisted Triceps Dips (kg)</strong></td>
<td>52.6 ± 23.9</td>
<td>37.4 ± 21.7</td>
</tr>
<tr>
<td><strong>Functionality</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 second arm curl (repetitions)</td>
<td>17.09 ± 3.75</td>
<td>23.89 ± 4.59</td>
</tr>
<tr>
<td>30 second chair stand</td>
<td>19.26 ± 5.21</td>
<td>26.15 ± 6.05</td>
</tr>
<tr>
<td><strong>Usual Gait Speed (s)</strong></td>
<td>7.99 ± 1.32</td>
<td>8.12 ± 1.32</td>
</tr>
<tr>
<td><strong>Maximal Gait Speed (s)</strong></td>
<td>5.10 ± .842</td>
<td>5.32 ± .785</td>
</tr>
<tr>
<td><strong>Proprio 5000 DMA Score</strong></td>
<td>631.68 ±</td>
<td>588.57 ± 162.05</td>
</tr>
<tr>
<td></td>
<td>143.47</td>
<td></td>
</tr>
<tr>
<td><strong>Single Leg Stand (s)</strong></td>
<td>89.41 ± 37.65</td>
<td>103.58 ± 29.76</td>
</tr>
<tr>
<td><strong>Psychosocial</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise Self-Efficacy</td>
<td>1204.11 ±</td>
<td>1293.66 ±</td>
</tr>
<tr>
<td></td>
<td>304.90</td>
<td>275.67</td>
</tr>
<tr>
<td>Self-Esteem</td>
<td>7.25 ± 1.40</td>
<td>4.57 ± 0.37</td>
</tr>
<tr>
<td><strong>Body Esteem</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sexual Attraction</td>
<td>49.09 ± 8.02</td>
<td>51.61 ± 8.79</td>
</tr>
<tr>
<td>Weight Concern</td>
<td>27.86 ± 7.88</td>
<td>34.07 ± 10.18</td>
</tr>
<tr>
<td>Physical Condition</td>
<td>29.82 ± 6.91</td>
<td>35.63 ± 7.33</td>
</tr>
</tbody>
</table>

Values are mean ± SD.
REFERENCES


38. Marcus BH, Williams DM, Dubbert PM, Sallis JF, King AC, Yancey AK, Franklin BA, Buchner D, Daniels SR, Claytor RP. Physical activity intervention studies what we know and what we need to know: A scientific statement from the american heart association council on nutrition, physical activity, and metabolism (subcommittee on physical activity); council on cardiovascular disease in the young; and the interdisciplinary working group on quality of care and outcomes research. *Circulation.* 2006; 114(24): 2739-52.


59. Signorile JF, Carmel MP, Czaja S, Asfour S, Morgan RO, Khalil T, Ma F, Roos B. Differential increases in average isokinetic power by specific muscle groups of older


