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Can Affective Response to Exercise be Improved with Training?

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Abstract

This study examined affective response data collected over the course of a longitudinal cardiorespiratory exercise training intervention. A total of $N = 76$ sedentary women were randomly assigned to one of four exercise training conditions fully crossed on intensity and duration. Participants were instructed to complete 4-bouts of supervised exercise per week, for 16-weeks. Core affective responses to exercise were measured using the Feeling Scale (FS) and Felt Arousal Scale (FAS) every 10 minutes over the course of a single exercise bout, during weeks 0, 4, 8, and 16. The goal of this study was to determine if core affective responses to exercise can improve with training, and if BMI moderates this response to exercise over time. The results showed no change in affective response over time for either measure. However, we found a significant, positive correlation between BMI and arousal.

Keywords: exercise, physical activity affective response, BMI, women's health, cardiorespiratory fitness

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Exercise is crucial for living a healthy lifestyle. Physical inactivity is the fourth leading risk factor for global mortality causing an estimated 3.2 million deaths worldwide annually (World Health Organization [WHO], 2014). Sedentary individuals in particular have a higher risk of developing cancer, heart disease, and many other health ailments (Schoenborn & Stommel, 2011). Regular physical activity participation, however, is strongly associated with reduced risk for all-cause mortality (Schoenborn & Stommel, 2011). Reduced risk of breast cancer may be an especially important benefit of cardiorespiratory exercise participation among women (Lee, 2003; Bryan, Magnan, Caldwell Hooper, Harlaar, & Hutchison, 2013) as approximately one in eight women will be diagnosed with breast cancer at some point during her lifetime (Howlader et al., 2011).

Lack of Exercise Participation: A Public Health Concern

Despite exercise being critically important for maintaining good health, most people do not get the recommended amount of weekly physical activity. The Physical Activity Guidelines for Americans recommend that all healthy, able-bodied adults get a minimum of 150 minutes of cardiorespiratory exercise per week (CDC, 2011). However, in 2008, 56.5% of American adults were not aerobically active, 71.6% were not highly aerobically active, and 81.8% did not meet the minimum recommended levels of aerobic activity (Carlson, Fulton, Schoenborn & Loustalot, 2010). Further, there are important gender differences in cardiorespiratory exercise participation such that according to national surveys, females are almost 10% less likely than males to meet the Physical Activity Guidelines for Americans (Centers for Disease Control [CDC], 2011), and across all age groups, women engage in less cardiorespiratory exercise than men of the same age (Carlson et al., 2010).

Positive Affective Response to Exercise as a Motivator for Future Exercise Behavior

For these reasons, it is important to develop interventions to increase exercise behavior, particularly among women, and doing so requires knowing what factors are most strongly associated with exercise motivation. For many people who are successful at maintaining physical activity, enjoyment of the activity is a strong motivator to continue exercising (Dishman, Sallis, & Orenstein, 1995). Specifically, prior studies have shown a relationship between positive affective responses to exercise and future exercise engagement (Ekkekakis, Parfitt, & Petruzzello, 2011). Williams and colleagues (2008) showed that sedentary women who experienced a positive affective response to an acute bout of moderate-intensity exercise reported engaging in more minutes of physical activity 6 and 12 months later. Similarly, Kwan and Bryan, (2010) assessed positive affect, tranquility, negative affect, and fatigue during a single bout of exercise at a moderate-intensity. They followed up with participants three months later, and showed that higher feelings of positive affect, together with lower feelings of fatigue during the exercise bout, were associated with higher amounts of voluntary exercise participation.

Factors that Influence Affective Responses to Exercise

Magnan, Kwan, and Bryan (2013) examined the relationship between current physical activity level and affective response to exercise, in an attempt to understand the mechanisms by which individuals who are more physically active tend to experience exercise as a more positive experience as compared to those who are sedentary. The results of their investigation showed that factors including higher cardiovascular fitness, greater amounts of current exercise behavior, smaller internal body temperature increases during exercise, and higher exercise-self efficacy were associated with better affective response to exercise. However, the researchers also point out that there is a lack of evidence about the direction of this effect; in other words, it is possible that people with higher self-efficacy choose to exercise more. Thus, it is unknown whether affective response to exercise can improve throughout time due to an individual increasing his or her physical activity level and amount of exercise training.

Another factor that influences affective response to exercise is exercise intensity. From a public health promotion perspective, making recommendations about the intensity level individuals should work at while exercising is complicated. High intensity exercise is more strongly associated with health benefits and reduced risk of all-cause mortality than low intensity exercise (Lee et al., 2011; Swain & Franklin, 2006), but past exercise intervention trials have shown better rates of adherence to low versus high intensity exercise prescriptions (Marcus et al., 2000; Perri et al., 2002). Part of the reason that adherence to high intensity exercise prescriptions is low is because high intensity exercise is associated with decreased positive affect, and increased pain and displeasure during exercise, especially among individuals who are highly sedentary (Ekkekakis, Hargreaves, & Parfitt, 2013; Ekkekakis et al., 2011).

The majority of work in this area has found that compared to the intensity of an exercise session, the duration of an exercise session has less of an influence on affective responses. However, exercise duration may effect affective responses if participants are not informed about the duration of the exercise they are about to perform, or the exercise session duration is suddenly increased during the exercise session (Ekkekakis et al., 2011; Welch, Hulley, & Beauchamp, 2010). In general, past work has found that the longer an individual spends exercising at a high level of intensity, the worse he or she is going to feel on average over the course of the bout (Ekkekakis et al., 2011).

There is also strong evidence that affective responses to exercise are influenced by body mass index (BMI). A study by Ekkekakis and colleagues (2009) measured participants' affective responses to a bout of exercise performed on treadmill to see if women of different BMI classes would respond differently. Participants in this study were 24 middle-aged, sedentary women (9 were classified as “normal weight: [BMI<25 kg/m^2], 10 were classified as “overweight” [BMI ≥ 25 kg/m^2], and 8 were classified as “obese” [BMI >30 kg/m^2]). The results showed that even though there was no difference in terms of affective response to the exercise between the overweight and normal-weight women, the obese women’s affect ratings were significantly worse compared to the normal weight and overweight women.

Another study investigating the relationship between BMI and affective response found similar findings. Ekkekakis and Lind (2006) looked at a sample of 16 overweight (BMI ≥ 25 kg/m^2) and 9 normal weight (BMI < 25 kg/m^2) women and assessed their affective responses to treadmill walking first at a self-selected walking speed, and then a second time at an experimenter imposed walking speed. The experimenter imposed walking speed was set at 10% higher than the participants’ self-selected walking speeds. The results showed that the overweight women experienced a gradual decrease in positive affect over time whereas the normal weight women were able to maintain their affective response consistently across the bout of exercise.

Study Aims and Hypotheses

Although many studies have studied factors that influence affective response to exercise, there is a dearth of literature that examines the combined effects of exercise duration and intensity on affective response. Further, there are no studies, of which we are aware, that have explored whether or not affective response to exercise can become more positive as an individual becomes more trained. Following the recommendations for future directions by Magnan, Kwan, and Bryan (2013), this study will be investigating whether or not affective response to exercise can become more positive over the course of an exercise intervention due to training. Based on the literature stating that active individuals experience a more positive affective response to exercise (Ekkekakis et al., 2011), we hypothesize that affective response will become more positive over the course of the intervention.

Although past work has found a convincing association between BMI and affective response to exercise, there are still questions as to whether or not there is an interaction between exercise intensity/duration and BMI on the effect of training on affective response. Therefore, this study will also be investigating whether or not BMI moderates the effect of training on affective response. In other words, it is possible that affective response becomes more positive in response to training among normal weight individuals, but not among overweight or obese individuals. Based on past work demonstrating more favorable affective responses to exercise among normal weight women compared to overweight and obese women (Ekkekakis et al., 2009; Ekkekakis & Lind, 2006), we hypothesize that affective response will improve more with training among normal weight women compared to overweight or obese women.

The questions posed by this investigation have potential to contribute to the existing literature by answering the question of whether or not affective response can be "trained," and whether that depends on the intensity/duration of the exercise or the BMI of the individual. This information could be used to strengthen or create exercise interventions for increasing and maintaining exercise behavior among previously sedentary women.

Method

Participants

Participants included in the present analysis were a sample of women recruited to participate in a 10-month long randomized control trial (RCT; PI Bryan RO1 CA179963) designed to measure change in biological markers of breast cancer risk over time as a function of participation in a 16-week long cardiorespiratory exercise intervention. To date, only 76 participants have enrolled in the RCT; however, by the end of the recruitment phase a total of 240 participants are expected to enroll.

The focus of the present investigation is concerned only with data collected during the 16-week exercise-training intervention, and not the full duration of the parent RCT. Outcomes central to the parent RCT will not be addressed or discussed in this paper.

All participants were recruited from the Boulder-Denver metropolitan area and were required to meet eligibility criteria mandated by the parent RCT. Specifically, all participants were required to be female, 30 – 45 years old, physically sedentary (defined as < 40 minutes per week of cardiorespiratory exercise with no changes for the past 6-months), with no history of breast cancer. As an additional safety precaution, all participants enrolled in the RCT were required to receive a physical examination by a study physician prior to beginning any exercise training in order to rule out contraindications for moderate to vigorous intensity cardiorespiratory exercise (e.g., current or chronic injuries, cardiorespiratory disease, daily cigarette use, etc.).

A preliminary sample of 76 participants was used for analyses that follow. On average, these participants were 36.50 years of age (SD = 4.89) and most commonly identified as White (n = 45), although participants identifying as Black (n = 16), Asian (n = 8), American Indian or Alaskan Native (n = 2), Native Hawaiian or Pacific Islander (n = 1), and multiracial (n = 1) were also represented in the sample. Additionally, 14 participants identified as Hispanic, and 59 participants identified as non-Hispanic. Participant body mass index (BMI; measured as weight in kg/height in m^2) averaged 27.77 kg/m^2 (SD = 5.41) and ranged from 18.5 – 40.4. At the start of the exercise training intervention, 18 participants were within the normal weight range (BMI 18.5-24.9), 16 participants were in the overweight range (BMI 25-29.9), and 22 participants were in the obese weight range (BMI ≥ 30). BMI data was missing for 1 participant, and no participants in this sample were underweight. Across exercise training conditions, there were no statistically significant between group differences observed for age, race/ethnicity, or BMI (see Table 1).

Study Design

Exercise intervention-training conditions. Participants enrolled in the parent RCT were randomly assigned to one of four training conditions that varied in a fully crossed design by (a) intensity and (b) duration. The four training conditions were: (1) "Tx1" = low/moderate intensity and short duration, (2) "Tx2" = low/moderate intensity and long duration, (3) "Tx3" = high intensity and short duration, and (4) "Tx4" = high intensity and long duration. Information about the number of participants enrolled in each exercise training condition is displayed in Table 2.

Exercise training prescription. Participants assigned to the low/moderate intensity conditions completed supervised exercise within a target heart (HR) zone = 55-65% of heart rate reserve (HRR[1]), and participants assigned to the high intensity conditions completed supervised exercise within a HR zone = 75 – 85% of HRR. As previously stated, exercise training bouts lasted 20 minutes for participants in the short duration condition, and 40 minutes for participants in the long duration condition.

Common across the 4 conditions, participants were asked to complete 4 supervised exercise-training sessions per week, every week for all 16 weeks of the intervention. Therefore,

[1] HRR = heart rate max (HRM) – heart rate at rest (RHR); exercise target HR = %HRR intensity*(HRM – RHR) + RHR.

up through the mid-point in the intervention (i.e., week 8), participants completed up to 32 supervised exercise sessions. However, data relevant to the present analyses were only collected once per week (i.e., during one of the four assigned sessions per week) and only during certain weeks (i.e., week 0, 4, 8, and 16). Therefore, there are 4 data collection points (i.e., recorded exercise bouts) for the present investigation.

The primary mode of exercise training for this intervention was treadmill walking or running. Elliptical- or arc-trainers were also used in the event that a participant expressed joint discomfort because elliptical- and arc-trainers are designed to decrease impact forces while maintaining a high cardiovascular stimulus (Turner, Williams, Williford, & Cordova, 2010).

Procedure

All exercise testing and supervised training sessions were conducted at the IMAGE (Investigations in Metabolism, Aging, Gender, and Exercise) Laboratory at CU Denver. After providing informed consent to participate in the parent RCT, all participants completed a laboratory-based graded maximal oxygen capacity treadmill test (VO_2 max test) prior to beginning the exercise-training intervention. This test is considered by the American College of Sports Medicine (ACSM) to be the gold standard procedure for providing individualized exercise prescriptions that require a specific intensity range (Garber et al., 2011).

Participants scheduled their first supervised exercise-training session and began the intervention as soon as possible after completing the VO_2 max test appointment. At each exercise-training session, participants wore a digital heart rate monitor while they exercised, and it was the job of the research assistant supervising the session to ensure that participants reached and stayed within the intensity range (in terms of heart rate value) corresponding to their assigned training condition. The goal was to maintain participants' heart rates within ±5% of the target intensity.

On one out of the four days that participants came to the laboratory to complete an exercise training session during the first ("week0"), fourth ("week4"), eighth ("week8"), and sixteenth ("week16") weeks of the intervention, the research assistant supervising the session was tasked with measuring participants' affective responses to exercise every 10 minutes starting from the minute participants reached their prescribed intensity zone (i.e., "minute 0").

Outcome Measures

The feeling scale (FS). The FS (Hardy & Rejeski, 1989) is an 11-point measure of the valence (pleasure) dimension of core affect (Russell & Feldman Barrett, 1999). Participants were asked to report how "good" or "bad" they felt during exercise on a scale of - 5 to + 5 (see Appendix A). Verbal anchors for the FS are provided on odd integers and the zero point (i.e., +5 = *very good*, 3 = *good*, 1 = *fairly good*, 0 = *neutral*, -1 = *fairly bad*, - 3 = *bad*, - 5 = *very bad*).

The felt arousal scale (FAS). The FAS (Svebak & Murgatroyd, 1985) is a 6-point measure of the arousal dimension of core affect (Russell & Feldman Barrett, 1999). Participants were asked to report how "worked up" or "activated" they felt during exercise on a scale from 1 = *low arousal* to 6 = *high arousal* (see Appendix B).

Results

There was a large amount of data missing across time points. There are 4 reasons why data are missing. First, the affective response measures were not being reliably collected at the beginning of the parent RCT; thus, affective responses were not initially collected from the first participants who started the intervention. Second, some participants terminated their exercise session bouts early (before 20 minutes or 40 minutes had elapsed, depending on condition) due to discomfort or safety concerns (e.g., feeling faint or nauseous). Third, due to the fact that recruitment for the intervention is still ongoing, there are fewer participants in the later weeks of the training period (i.e., weeks 8 and 16) compared to the earlier weeks (i.e., weeks 0 and 4). And lastly, as is very common in exercise training interventions, some participants began the exercise training intervention, but later withdrew their participation before their expected end-date. The following analyses are based on the data most recently available to date from the baseline week 0 up through week 16.

In order to account for the missing data, analyses were performed using full information maximum likelihood (FIML) estimation procedures. This allows for all of the possible data points to be used, and for missing data values to be estimated using the expectation-maximization algorithm (Schafer & Graham, 2002). The main affective response analyses were conducted using a random coefficient regression (RCR) framework via SAS Proc Mixed.

Main Effects of the Intervention on Affective Response Outcomes

Feeling Scale (FS). First, FS scores collected throughout the intervention were used as the dependent measure, and time was used as the independent variable. Results did not reveal a significant effect of time on the FS responses ($est = -0.11$, $SE = 0.11$, $p = 0.34$). In other words, core affective valence did not change over time (see Figure 1). Next, we investigated whether or not average FS scores differed across exercise training conditions. A marginal affect(FS)Xcondition interaction was observed, $F(3, 107) = 2.46$, $p = 0.07$, such that FS scores change over time differed by condition. As can be seen in Figure 1, affective response in the Tx2 condition slightly decreased in comparison to the other three conditions.

Felt Arousal Scale. First, FAS scores collected throughout the intervention were used as the dependent measure, and time was used as the independent variable. There was not a significant effect of time on FAS scores ($est. = -0.04$, $SE = 0.07$, $p = 0.50$). Specifically, core affective arousal did not change significantly over time (see Figure 2). Next, we investigated whether or not average FAS scores differed across training conditions. Here, the affect(FAS)Xcondition interaction effect was found to be non-significant, $F(3,107) = .27$, $p = 0.85$.

BMI on valence (FS) and arousal (FAS). Next, we wanted to explore the relationship between BMI (normal weight, overweight, and obese) and FS scores across time (see Figure 3). BMI was split into three categories: normal weight (less than 24.9 kg/m^2), overweight (greater than 24.9 kg/m^2 but less than 29 kg/m^2), and obese (greater than 29 kg/m^2). The BMIXtime interaction on FS scores was non-significant (*est.* = -0.01, *SE* = 0.02, $p = 0.67$). There was a significant BMIXconditionXtime interaction on FS scores (*est.* = 0.047, *SE* = 0.023, $p < .05$), such that among normal weight participants, FS scores improved over time for those participants in condition Tx1, but decreased over time for those participants in conditions Tx2, Tx3 , and Tx4. For overweight participants, FS scores improved over time for those participants in conditions Tx2 and Tx4, but decreased over time for those participants in conditions Tx1 and Tx3. Finally, among obese participants, FS scores improved over time for those participants in conditions Tx3 and Tx4, but decreased over time for those participants in conditions Tx1 and Tx2. Overall, no clear pattern of response emerges from these data. This finding should be interpreted with great caution because the number of participants represented across BMI class and condition in the later weeks is very small (and sometimes = 0, i.e.; obese participants in condition Tx1).

Next we examined the relationship between BMI and FAS scores. There was not a significant BMIXtime interaction on arousal (*est.* = -0.02, *SE* = 0.01, $p = 0.18$). However, there was a significant main effect of BMI on arousal (*est.* = 0.07, *SE* = 0.02, $p = 0.01$) (see Figure 4). The positive sign of this coefficient suggests that women with higher BMI experienced higher perceived arousal during exercise. There was no significant BMIXconditionXtime interaction on FAS scores (*est.* = 0.01, *SE* = 0.014, *p* = 0.279). Unfortunately, the sample size is simply too small at this point to reliably understand the pattern of this interaction.

Discussion

The findings from this investigation did not support our hypothesis that affective responses will become more positive over the course of an intervention due to training. We did not find evidence that core affective valence (FS) or arousal (FAS) scores change over the course of the 16-week exercise intervention. Although insignificant, it is interesting to note that affective response in the Tx2 condition decreased across the 16 weeks. Participants in this condition qualitatively reported that they did not enjoy the exercise because it was too light. We speculate that because the participants are required to engage in an unsatisfactory activity for a longer amount of time, that it leads to a gradual deterioration in affect over the course of the 16 weeks.

The data did not support our hypothesis that the valence dimension of affective response varies based on BMI. Interestingly, despite literature that shows strong associations between BMI, intensity, and the feeling scale (Ekkekakis et al., 2009; Ekkekakis & Lind, 2006), these particular data did not find such a relationship. The data did partially support our hypothesis that the arousal dimension of affective response varies based on BMI. There was a significant, positive correlation between BMI and arousal. We speculate that because individuals with a higher BMI have little to no experience exercising, they may have to work harder during exercise, thus leaving them feeling more activated. However, all of the participants in this study are sedentary and inexperienced with exercise to begin with, therefore leading us to suspect other mechanisms are at play. Perhaps body fat percentage is a factor leading the women with higher

BMIs to feel as though they are working harder, leading them to feel more activated. It is interesting to note that across the intervention, the training seems to have an opposite effect of what we would expect. One would think that over the course of the intervention, as the participants became more trained, that they would feel a decrease in activation because they would become more acclimated to the exercise.

Limitations and Future Directions

A very important limitation to note is the low number of participants in week 16 (see Table 1) and the sample size as a whole. The sample size of 76 participants may be too low to power the investigation to detect significance. Perhaps with a more robust sample size, as more participants are enrolled in the intervention, possible effects could be detected. Another limitation is the missing data varying across conditions due to dropout, incompletion, lack of participant commitment, and researcher error.

Participant adherence to their assigned appointments poses a potential issue for this particular investigation. If certain participants only show up once or twice a week and miss the other two assigned exercise sessions, whereas other participants show up for each session ultimately becoming more trained over time, this could pose a challenge in being able to truly see the effects of training on affective response. Once the parent RCT is completed, we will include data collected on actual participant adherence to the intervention (e.g., using a continuous variable to show how many total minutes were completed for each participant). This way, we will be able to discuss the relationship between training amount on affective responses to exercise over time more accurately. It is important to note that in our data analyses, the effect size is unknown for the significant relationship between BMI and arousal. Even though the relationship is significant, we are not certain of the magnitude of the relationship or the extent of its clinical significance.

Potential design confounds could eventually pose an issue due to the fact that participants are allowed to listen to music and/or watch TV, potentially influencing affect. However, the fact that participants are allowed to listen to music or watch TV increases ecological validity. In the real world, individuals beginning a long-term exercise training program are unlikely to continue without any music or TV at their disposal, especially while running on a treadmill 4 days per week.

Another possible limitation is that the type of exercise engaged in throughout the intervention could be unpleasant or even boring to certain participants, which could possibly lead to a decrease in enjoyment and affective response. Perhaps if the participants could engage in an exercise that they could pick on their own, it would yield more positive affective response scores overall, as prior work has shown that affective response to exercise is influenced by a sense of autonomy and choice (Vazou-Ekkekakis& Ekkekakis, 2009). However, given that this investigation is still early and ongoing, this speculation may prove unfounded as more affective response data is collected and as more participants are enrolled.

Future research should focus on investigating the follow-up data at the conclusion of the parent RCT. Follow-up data can provide insight into whether or not and how participants continued exercising after the intervention. Other research interventions should eventually look at whether or not the type of exercise influences affective response and ultimately the adherence to an exercise program.

Conclusion

Currently, the ASCM Guidelines for Exercise Testing and Prescription (2013) recommend that exercise interventions should focus on increasing sedentary or insufficiently active adults' participation in exercise by encouraging low intensity exercise regimens. The grounds for this recommendation are rooted in findings demonstrating that low-moderate intensity exercise leads to more favorable affective responses. The rationale here then is that individuals will adhere better to low intensity exercise prescriptions. However, as mentioned previously, vigorous intensity exercise yields the greatest health benefits. It is still the goal that as the data continues to be collected and as a more substantial sample size is established, we may find that affective response does become more favorable over time. If this were to be found, we might consider adjusting the recommendations laid out by the ACSM to involve more high intensity exercise to maximize health benefits while encouraging participants to continue training because exercise will eventually start to feel better.

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Table 1

Participant Demographics

Characteristic	M Tx1	M Tx2	M Tx3	M Tx4	Test Statistic	*p*
Age	36.69 (5.82)	37.69 (4.61)	35.35 (4.94)	35.71 (4.12)	$F(3, 72) = 1.01$	.393
BMI	25.98 (4.04)	27.62 (5.49)	28.67 (5.99)	28.85 (5.80)	$F(3, 71) = .950$	.421
Ethnicity					$\chi^2(3, N = 73) = 2.38$	.497
n Hispanic	5	3	3	3		
n non-Hispanic	11	21	16	11		
Race					$\chi^2(15, N = 73) = 15.99$	.383
n American Indian or Alaskan Native	1	0	0	1		
n Asian	1	3	4	0		
n Black	2	7	4	3		
n Native Hawaiian or Pacific Islander	0	0	0	1		
n White	10	16	10	9		
n Multiracial	1	0	0	0		

Note. Tx1 = training condition 1 (low/moderate intensity, short duration), Tx2 = training condition 2 (low/moderate intensity, long duration), Tx3 = training condition 3 (high intensity, short duration), Tx4 = training condition 4 (high intensity, long duration); BMI = body mass index; standard deviations (*SD*) for “age” and “BMI” are in parentheses.

Table 2

Training Condition Descriptives

		N
Week 0		76
Participants per training condition (*n*)		
	Tx1	16
	Tx2	26
	Tx3	20
	Tx4	14
Week 4		65
Participants per training condition (*n*)		
	Tx1	13
	Tx2	25
	Tx3	16
	Tx4	11
Week 8		53
Participants per training condition (*n*)		
	Tx1	12
	Tx2	17
	Tx3	15
	Tx4	9
Week 16		46
Participants per training condition (*n*)		
	Tx1	12
	Tx2	16
	Tx3	10
	Tx4	8

Note. Tx1 = training condition 1 (low/moderate intensity, short duration), Tx2 = training condition 2 (low/moderate intensity, long duration), Tx3 = training condition 3 (high intensity, short duration), Tx4 = training condition 4 (high intensity, long duration).

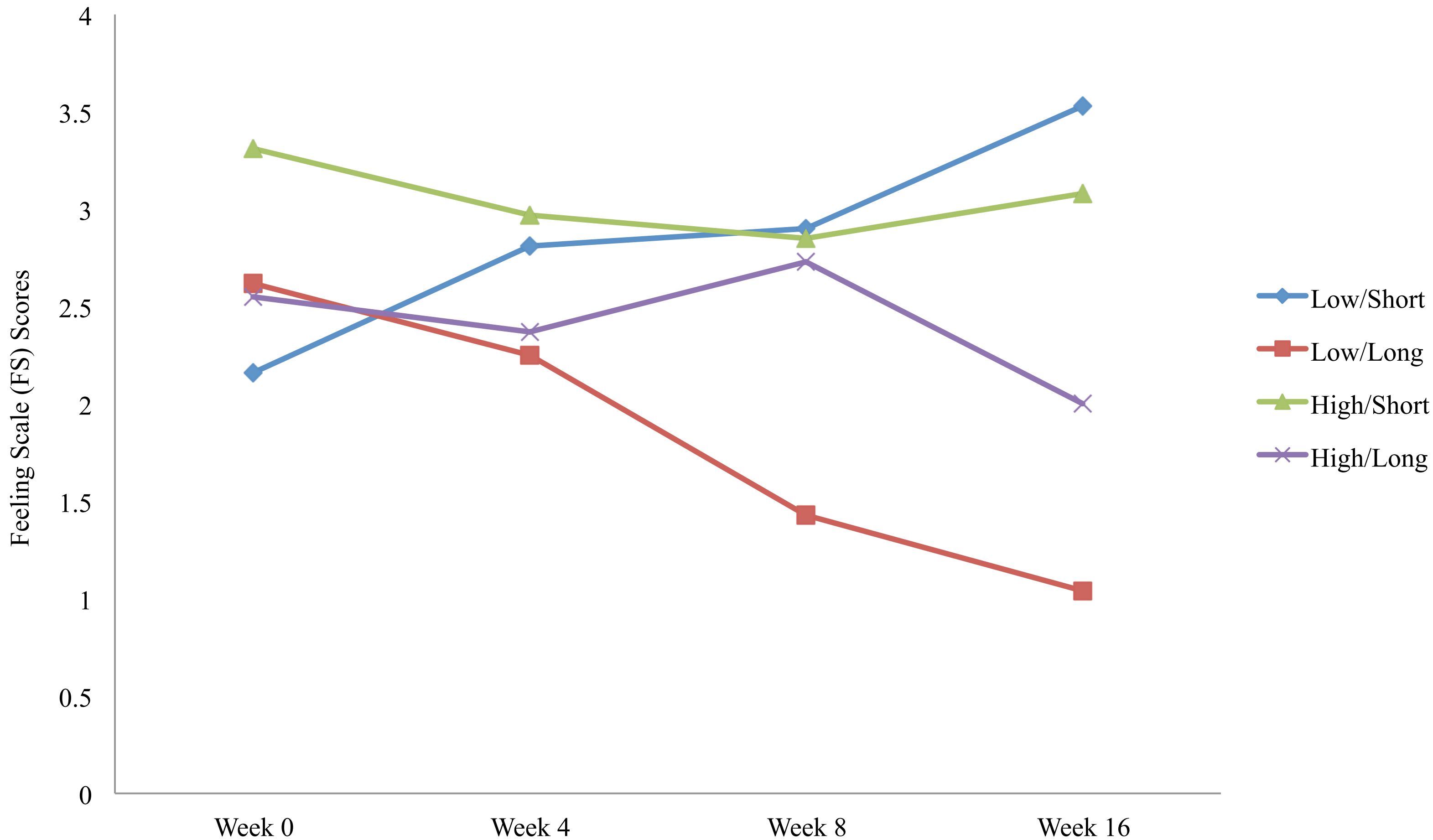

Figure 1. Change in feeling scale (FS) scores by condition from week 0 to week 16.

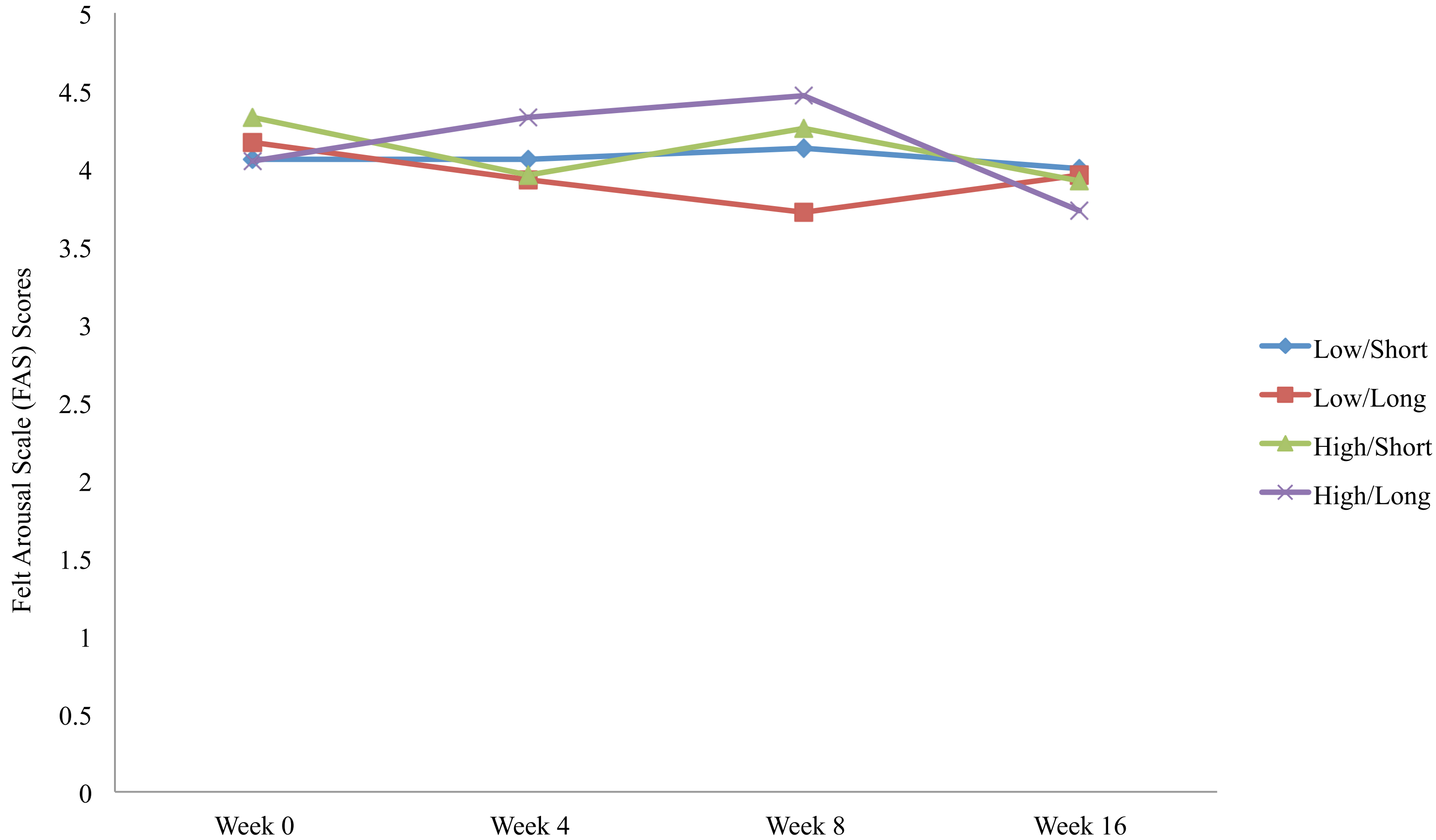

Figure 2. Change in felt arousal scale (FAS) scores by condition from week 0 to week 16.

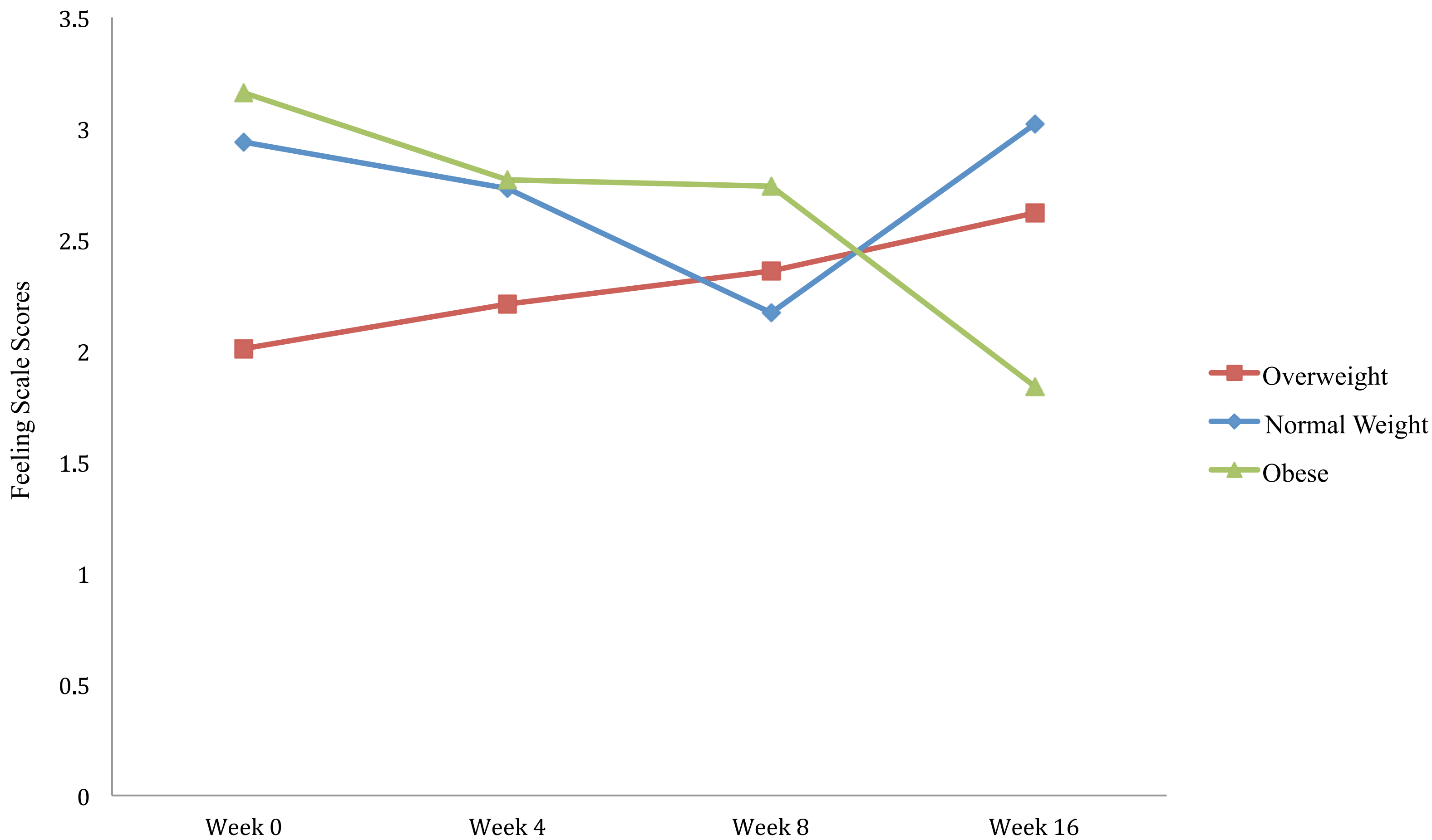

Figure 3. BMI changes in feeling scale scores from week 0 to week 16.

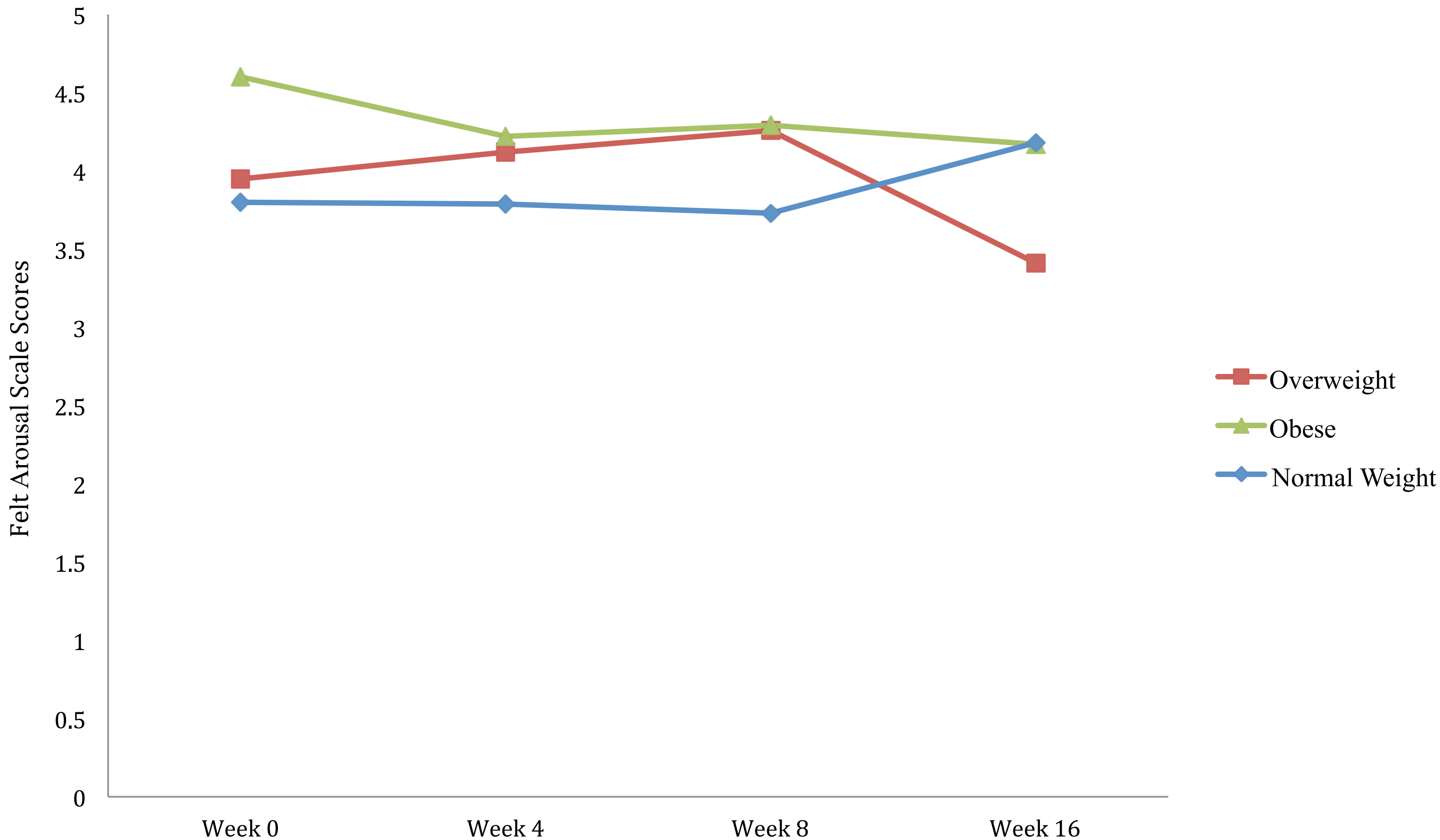

Figure 4. BMI changes in felt arousal scores from week 0 to week 16.

Appendix A

The Feeling Scale (FS)

While participating in exercise it is common to experience changes in mood. Some individuals experience pleasure during exercise, whereas others experience displeasure.

Additionally, feelings may change over time. That is, one might feel good and bad a number of times during the same exercise session.

Please choose the number that best describes how you feel right now.

-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
Very Bad		Bad		Fairly Bad	Neutral	Fairly Good		Good		Very Good

Appendix B

The Felt Arousal Scale (FAS)

Please estimate how aroused you currently feel. By "arousal" we mean how "worked-up" you feel. You might experience high arousal in one of a variety of ways, for example as excitement or anxiety or anger. Low arousal might also be experienced by you in one of a number of different ways, for example as relaxation or boredom or calmness. Please indicate how aroused you feel right now.

1	2	3	4	5	6
Low					High
Arousal					Arousal