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Original article

Affective change as a function of exercise intensity in a group aerobics class

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Abstract

This study examined, in a naturalistic setting, affective changes in 15 women. Measurements were obtained presession, postsession, and at 10-minute intervals during three aerobics sessions that were conducted at high (HI), low (LI) and self-selected (SS) intensities. The intensity was manipulated *via* changes in music tempo and movement size. Scores on the Feeling Scale (FS) and the Felt Arousal Scale (FAS) were subjected to two-way repeated measures analysis of variance (ANOVA). Circumplex models were constructed to display the path followed by the affective changes throughout the course of each exercise session. A main effect for time and condition emerged in that the FS scores were more positive in the SS intensity participants than in the LI participants, and the post-test FS scores were more favorable than they were at pretest or at 10 minutes, 20 minutes, 30 minutes, or 40 minutes. The FAS scores were higher in the SS intensity participants and HI participants than in the LI participants. A difference only emerged between the SS intensity and HI participants at the 20-minute interval. Variability in the circumplex profiles was evident across each intensity level and for each participant. The study supports and extends previous work in confirming that: (1) exercise can positively influence affective changes in ecologically valid settings; (2) a self-selected intensity is the most beneficial for producing affective changes; (3) idiosyncratic patterns of affective change occur when exercising at different intensities. The implications of these findings for exercise professionals are discussed.

Keywords: Adherence; Affect; Circumplex

Introduction

Recent reports indicate that 70% of the United Kingdom (UK) population remain physically inactive,[1] despite the continued growth of evidence supporting the "feel good" benefits associated with exercise.[2–4] This apparent paradox should be viewed in light of research demonstrating that exercisers report unpleasant, as well as pleasant, affective experiences during periods of physical activity.[5,6] Variations in an individual's affective response to exercise are moderated by motivational orientation,[7] self-concept,[8] self efficacy,[9] perceptions of enjoyment,[10] and perceived level of exertion.[11] At a programmatic level, exercise intensity,[4,12–14] exercise duration,[15] and mode of exercise[16] have all been subjected to investigation. Despite the pervasive body of evidence, a lack of consensus—with respect to the optimal intensity and the duration and mode of exercise—continues to limit the practical value of this understanding to the applied context.

In a review of the exercise intensity–affect relationship, more than one-half of 31 studies evidenced no dose–response effects.[17] Inconsistencies in results across studies was attributed to a small sample size, a failure to control for pretest affect and the study participants' fitness level, the use of insensitive measures that did not tap appropriate affective states, and a lack of in-task assessment that may have allowed dose–response effects to dissipate before an affective measure was administered.[17] Of the 31 studies contained in this review, it is furthermore apparent that only one study was performed outside a laboratory setting while at the same time employing a self-selected intensity condition.[18] More recent work has studied

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affective change by employing a field-based protocol that required an untrained, university student group ($N = 96$) to jog at a self-selected intensity for 20 minutes.[19] The results showed that the total mood disturbance decreased from pretest-to-posttest, but no measures were obtained during the period of jogging, and therefore no indication of potential shifts in affect during exercise are available. Traditional nomothetic, pretest-to-posttest designs have established the veracity of an exercise–affect interaction; however, these approaches lack sufficient sensitivity in detecting intraindividual shifts in affect during exercise. Studies seeking to address these limitations have recently gained prominence with researchers employing experimental designs that are tailored to investigate intra-individual variation and in-task affective change.[5,12,13,20]

The circumplex model of affect has been utilized in a number of laboratory-based studies to track affective changes at the individual level throughout the time course of an exercise session.[5,12,20] The model proposes that all aspects of affect can be displayed on two orthogonal/bipolar dimensions: active valence (i.e., pleasure–displeasure) and perceived activation (i.e., arousal). The dimensions divide the circumplex into four quadrants: (1) high activation pleasant affect (i.e. energy or excitement); (2) high activation unpleasant affect (i.e. distress or tension); (3) low activation pleasant affect (i.e. calmness or relaxation); and (4) low activation unpleasant affect (i.e. fatigue or depression).

Research has employed the circumplex model to record affective responses in 12 recreationally fit male participants during a 90-minute intermittent shuttle test.[5] In this study, statistical analyses failed to show any pretest-to-posttest improvements in affect; however, during exercise the participants reported affective states that were located in all four quadrants of the circumplex. Studies employing a similar methodology have used the circumplex model to record affective responses during exercise sessions conducted at prescribed and self-selected intensities.[12] In this work, the participants completed a 20-minute treadmill exercise under four conditions: (1) below the lactate threshold (LT); (2) at the LT; (3) above the LT; and (4) at a preferred LT. A significant inter-individual variability in circumplex profiles emerged, although the data again failed to identify any significant pretest-to-posttest changes in affect. The failure of the study to support the hypothesized pretest-to-posttest positive shift in the affective state was attributed to elevated baseline measures of mood. In support of this assertion, previous work has indicated that the pre-exercise affect moderates postexercise responses.[21] Recent endeavors in this field continue to fail to account for the potentially confounding influence of pretest effect on in-task and post-test affective responses to exercise.[4]

A large volume of work has been completed in the exercise-affect domain, but numerous areas remain disproportionately underrepresented in the literature. For example, little is known about how the intensity level influences interindividual patterns of affective change that are reported during exercise. Furthermore, only a limited number of investigations in the area have been conducted in ecologically valid settings.[3] Therefore, the purpose of the present study was to investigate the impact of exercise intensity on affective change at the group level and the individual level in a naturalistic setting, while taking into account the participants' level of pre-exercise affect.

Materials and methods

Participants

Fifteen female participants [(Mage = 35.08; SD = 12.8) 35.08 (12.84)] were recruited *via* posters, which were placed around a local leisure facility and advertised four free aerobic sessions. Thirteen participants self-reported themselves as "Fit" and two as "Highly Fit." The participants indicated that, at the time of the study, they attended 1.93 (0.70) group aerobic sessions per week and accumulated a weekly average of 7.1 (7.69) hours of physical activity. All participants signed consent forms and were informed that they could withdraw from the study at any stage. The study received ethical approval from the first author's institution.

Procedure

The participants attended four exercise sessions (i.e., familiarization, self-selected exercise intensity, high exercise intensity, and low exercise intensity). At the familiarization session, the participants were provided with an information sheet outlining the nature of the study, an informed consent form, and a physical activity readiness questionnaire. After completing these forms, the participants were introduced to the Feeling Scale (FS), the Felt Arousal Scale (FAS), and the Rate of Perceived Exertion (RPE) Scale (also called the Borg Scale). A 10-minute familiarization period followed. The instructor led the participants through a moderate intensity aerobic warm-up period. The participants completed the scales every 3 minutes. After the warm-up and the familiarization period were completed, the instructor invited questions from the group concerning the completion of the scales. The participants then performed a regular aerobics session with no further measures.

At weekly intervals, the participants returned to the same venue at the same time to complete a 50-minute aerobics session, which included a warm-up period, followed by aerobic training and a cool down session. The session was structured to follow a standardized format.[22] The same routine was completed at each visit in one of three exercise intensity conditions: self-selected intensity (SS), high intensity (HI), or low intensity (LI). The sequence of moves, length of session, music type, and exercise environment remained constant across the experimental conditions. All sessions were led by a YMCAfit Level 2 qualified aerobics instructor.

Self-selected intensity

At the beginning of the SS session, the instructor led the participants through a series of demonstrations and indicated how an aerobics routine could be manipulated to increase or decrease the physical demand. The instructions centered on altering the range of movement and how to complete multiple repetitions while retaining synchronicity with the music. The participants were instructed that they could add or take away levels from their "Step" aerobics box, as appropriate. Instructions were read out to the participants immediately before the session commenced, requesting that the participants "select an intensity that you prefer that can be sustained for 50 minutes and that you would feel happy to do regularly."[23] The participants were informed that they could alter the intensity of their session at any stage throughout the course of the workout. The aerobics session was set against a music speed of 130 beats per minute (bpm).[22]

High intensity

The HI condition required participants to complete the standardized routine utilizing large body movements and high propulsion/impact actions. The session was set against a music speed of 140 bpm.[22]

Low intensity

The LI condition required participants to complete the standardized routine by using small body movements and minimizing any lifting or propulsion actions. The routine was set against a music speed of 125 bpm.[22]

Measures

Feeling Scale

The Feeling Scale (FS)[24] measures affective valence along a pleasure-displeasure continuum. Verbal anchors were provided that assisted the participants in interpreting the scale: +5 (very good); +3 (good); +1 (fairly good); +0 (neutral); −1 (fairly bad); −3 (bad); and −5 (very bad).[12] The participants were instructed to mark the scale, based on their feelings at the time of completion.

Felt Arousal Scale

The Felt Arousal Scale (FAS)[25] measures perceived activation along a 6-point scale ranging from low arousal (1 point) to high arousal (6 points). Verbal anchors were provided with high arousal described by states such as excitement, anxiety, and anger, and with low arousal described by states such as relaxation, calmness, and boredom.[12] The participants were instructed to mark the scale on the basis of their feelings at the time of completion. The FS and FAS have been used extensively in previous research; when used in combination, they are a valid and reliable assessment of a wide spectrum of affective states.[26]

Rate of Perceived Exertion (RPE)

The Rate of Perceived Exertion (RPE), also called the Borg scale,[26] requires participants to rate their perceived level of exertion along a scale of 6–20 points. Verbal anchors were provided to aid in interpretation; these anchors included: "very, very light" (6 points); "very light" (8 points); "fairly light" (10 points); "somewhat hard" (13 points); "hard" (15 points); and "very, very hard" (18 points).

Each participant was issued with a new response pack at the outset of each exercise condition. The FS, FAS, and RPE Scale were measured immediately before the exercise class, on the cessation of the exercise class, and at 10-minute intervals throughout the exercise class. To facilitate the completion of the scales during the exercise class, the instructor designed an aerobics session in which, at pre-determined time points, activities were included that required participants to perform a 10-second isometric core strength activity in a stationary position on the ground. This approach enabled participants to remain physically engaged in the aerobics session during the completion of the scales. The FS, FAS, and RPE Scale, with accompanying anchors, were enlarged and placed on the wall at the front of the class and served as a visual prompt throughout the session.

Music

The music the aerobics classes were set against was purchased from a reputable aerobics instructor website, along with the necessary Phonographic Performance Limited (PPL) music license. The music was identical for all three conditions—only the tempo was adjusted.

Data analysis

Quantitative

Rate of Perceived Exertion

A 3 × 4 within factor ANOVA [three intensity (SS, HI, and LI) × four time periods (10 minutes, 20 minutes, 30 minutes, 40 minutes)] was performed. The RPE served as the dependent measure. *Post-hoc* analyses consisted of a one-way repeated measures ANOVA for each of the four time points with follow-up Bonferroni corrected paired *t* tests.

Feeling Scale and Felt Arousal Scale

Pretest FS and FAS scores were subjected to a one-way ANOVA. This result informed subsequent analyses with respect to whether pretest scores should be included as a covariate or as an additional level of the independent variable. The main analyses consisted of a 3 × 6 within factor ANOVA [three intensities (SS, HI, LI) × six time periods (pretest, 10 minutes, 20 minutes, 30 minutes, 40 minutes, post-test)]. The FS and FAS scores served as the dependent variable in two separate analyses. Bonferroni corrected *post hoc* analyses were computed to investigate main effects with a one-way repeated measures ANOVA for each of the six time points with follow-up Bonferroni-corrected paired *t* tests to locate the interaction. When assumptions of sphericity were violated, Greenhouse-Geisser corrections were utilized.

Qualitative

Individual circumplex models displaying FS and FAS scores were constructed.

Results

Rate of Perceived Exertion

[Note: Only participants 1–6 are presented in the results. For a full set of circumplexes contact the lead author.] A 3 × 4 within factor ANOVA [three intensities (SS, HI, LI) × four time periods (10 min, 20 min, 30 min, 40 min)] with RPE as the dependent variable indicated a main effect for time [$F(1.75, 42) = 45.19$; $p < 0.01$], a main effect for intensity [$F(2, 28) = 74.68$; $p < 0.01$], and an interaction effect [$F(3.37, 84) = 5.45$; $p < 0.05$]. Follow-up analyses indicated that HI group (M = 15.18) reported a higher exertion than either the LI group (M = 10.38) or the SS group (M = 13.50). The SS and LI groups were also statistically different with respect to the RPE scores. Across time, the RPE at 10 minutes (M = 10.71) was lower than at either 20 minutes (M = 13.49), 30 minutes (M = 14.18), or 40 minutes (M = 13.71). The interaction indicated that the RPE was higher in the HI condition than in the LI and SS conditions at the 20-minute, 30-minute, and 40-minute intervals ($p < 0.017$). After 10 minutes, the RPE was higher in the HI condition than in the LI condition, but no difference between HI and SS was evident at this timepoint. The RPE was higher in the SS condition than in the LI condition at the 20-minute, 30-minute, and 40-minute intervals ($p < 0.017$). After 10 minutes, no difference was observed between the SS and the LI conditions. These analyses support the construction of high and low exercise intensities and indicate that, in the SS condition, the participants elected to work at a moderate level that was situated between the high and low intensities.

Feeling Scale and Felt Arousal Scale

One-way ANOVA demonstrated that across groups differences were evident in the pretest scores for the FS [$F(2, 28) = 3.89$; $p < 0.05$] and the FAS [$F(2, 28) = 5.69$; $p < 0.05$] (Table 1). Follow-up *t* tests indicated that the FS scores were significantly more positive in the HI condition than in the LI condition ($p < 0.017$). The FAS scores were higher in the SS condition than in the LI condition ($p < 0.017$). These preliminary analyses indicate that pretest affect and arousal were inconsistent among the participants across the three exercise conditions. The FS and FAS scores were not naturally occurring, which precluded the use of these pretest scores as a covariate. Therefore, the data was entered as an additional level of the independent measure in all subsequent analyses.

A 3 × 6 within factor ANOVA [three intensities (SS, HI, LI) × six time periods (pretest, 10 minutes, 20 minutes, 30 minutes, 40 minutes, post-test)], using FS as the independent variable, produced a main effect for time [$F(2.47, 70) = 8.76$; $p < 0.01$; $\eta_p^2 = 0.39$; observed power = 0.98] and main effect for intensity [$F(2, 28) = 6.65$; $p < 0.01$, $\eta_p^2 = 0.32$, observed power = 0.88]. There was no interaction evident [$F(3.84, 140) = 1.67$; $p > 0.05$, $\eta_p^2 = 0.11$, observed power = 0.47]. *Post hoc* analyses indicated that the FS was more positive in the SS condition (M = 2.88) than in the LI condition (M = 1.66). Differences were also evident between the HI condition (M = 2.37) and the LI condition (M = 1.66) ($p < 0.05$). The FS scores were higher at the post-test (M = 3.49) than at the pretest (M = 2.38), 10 minutes (M = 2.27), 20 minutes (M = 2.04), 30 minutes (M = 1.69), or 40 minutes (M = 1.91).

A 3 × 6 within factor ANOVA [three intensities (SS, HI, LI) × six time periods (pretest, 10 minutes, 20 minutes, 30 minutes, 40 minutes, and post-test)], using FAS as the independent variable, produced a main effect for time [$F(2.20, 70) = 3.35$; $p < 0.05$, $\eta_p^2 = 0.20$, observed power = 0.64], a main effect for intensity [$F(2, 28) = 18.16$; $p < 0.01$, $\eta_p^2 = 0.57$, observed power = 1.00], and an interaction [$F(5.15, 140) = 4.10$; $p < 0.05$, $\eta_p^2 = 0.23$, observed power = 0.95]. *Post hoc* analyses indicated that the FAS was higher in the SS condition (M = 3.62) and the HI condition (M = 3.93) than in the LI condition (M = 2.57). There were no differences evident between the SS and HI conditions. The FAS score was higher at the 20-minute (M = 3.62), 30-minute (M = 3.69), and 40-minute (M = 3.51) intervals than at pretest (M = 2.82). There were no other differences across time. The interaction

Table 1
Means and standard deviations for Rate of Perceived Exertion (RPE) Scale, Feeling Scale (FS) and Felt Arousal Scale (FAS) during self-selected, high-intensity, and low-intensity conditions.

	Pretest		10 min		20 min		30 min		40 min		Post-test	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
RPE												
Self-selected			11.13	2.17	13.73	1.58	14.27	1.62	14.87	2.39		
High intensity			11.73	2.69	15.67	1.23	16.93	1.39	16.40	1.50		
Low intensity			9.27	1.58	11.07	1.22	11.33	1.68	9.87	1.55		
FS												
Self-selected	2.33	1.40	2.73	1.53	2.93	1.39	2.67	1.80	2.73	1.98	3.80	0.86
High intensity	3.20	1.47	2.47	1.46	1.73	2.46	1.27	2.89	1.60	2.59	3.93	1.03
Low intensity	1.60	1.35	1.60	1.55	1.47	1.60	1.13	1.25	1.40	1.72	2.73	1.83
FAS												
Self-selected	3.27	1.03	3.40	1.12	3.67	1.18	4.07	1.10	4.00	1.13	3.33	1.18
High intensity	3.07	1.28	3.73	1.03	4.67	0.83	4.60	0.83	4.13	0.64	3.40	1.60
Low intensity	2.13	1.12	2.60	1.06	2.53	0.99	2.40	1.12	2.40	1.18	3.33	1.63

M = mean; SD = standard deviation.

indicated that the FAS was greater in the HI condition than in the LI condition at the 10-minute, 20-minute, 30-minute, and 40-minute intervals. The FAS was also greater in the SS condition than in the LI condition at pretest and at the 20-minute, 30-minute, and 40-minute intervals. The FAS was higher in the SS condition than in the HI condition at the 20-minute interval. There were no differences evident at post-test. All *post hoc* analyses were performed with the significance set at $p < 0.017$.

Circumplex models of affect

Figs. 1–18 present individual participant responses (P1 to P6) to the FAS and FS measures across the three intensity conditions.

Discussion

The results demonstrated a positive pretest-to-posttest shift in the FS scores, irrespective of the intensity of exercise. This finding supports existing literature advocating the role exercise plays in contributing to positive affective change.[27–29] A main effect for intensity was also evident with higher FS scores in the SS and HI conditions than in the LI condition. The results demonstrate that, in a naturalistic setting, workouts conducted at high or self-selected intensities may facilitate a more positive affective response, compared to a low intensity session. This finding has clear implications for exercise professionals seeking to maximize physiological and psychological outcomes from their sessions. The results suggest that trained exercisers should be encouraged to work at elevated intensity levels or sessions should provide scope for clients to personally modify workouts during activity. The results also provide encouragement for practitioners working with specialist populations, given that low-intensity workouts also appear sufficient to elicit positive psychological outcomes. Further work employing participants from an "untrained" group would confirm the veracity of these proposals.

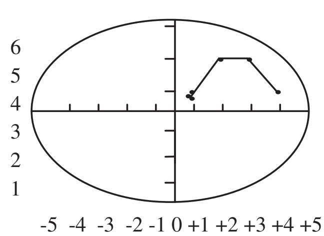

Fig. 1. Participant 1 (SS).

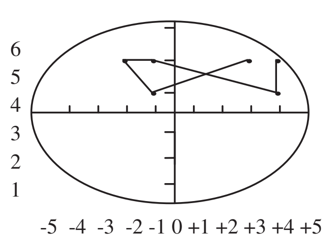

Fig. 2. Participant 1 (HI).

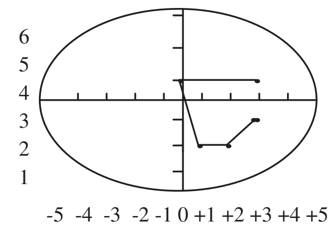

Fig. 3. Participant 1 (LI).

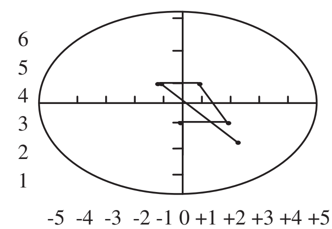

Fig. 4. Participant 2 (SS).

As Table 1 shows, the mean FS scores did not follow a positive linear path during the aerobics session. The scores instead decreased during the middle portion of the session, before rising sharply to an elevated post-test score. These findings support the suggestions of previous authors who propose that a participant's affective response to exercise may not always follow a uniform path.[26] The most notable negative deviation to occur during exercise is evident in the HI condition, although the HI post-test FS scores are higher than in the SS condition or LI condition. The circumplex models qualified these proposals by identifying the unique and distinctive way in which an individual responds to exercise at different intensities. The finding that, within the HI condition, participants 1, 2, 3, and 4 (Figs. 2, 5, 8 and 11) all reported at least one time point of negative FS. These individual participant accounts are in line with findings from previous work that show significant increases in depression, anger, fatigue, and

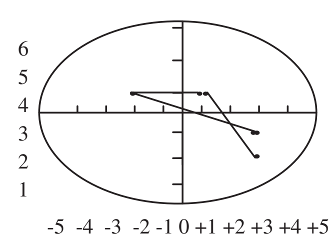

Fig. 5. Participant 2 (HI).

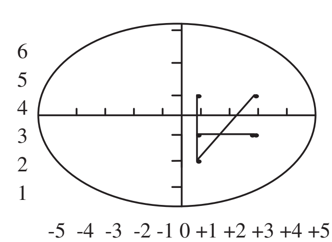

Fig. 6. Participant 2 (LI).

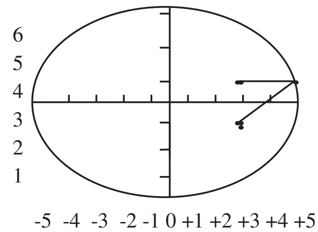

Fig. 7. Participant 3 (SS).

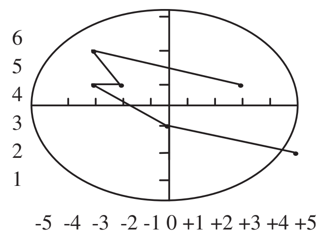

Fig. 8. Participant 3 (HI).

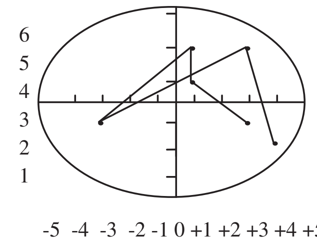

Fig. 11. Participant 4 (HI).

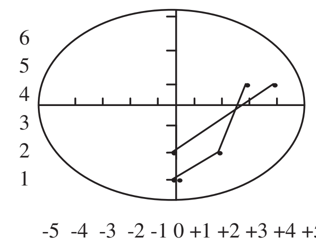

Fig. 12. Participant 4 (LI).

confusion that result from high-intensity bouts of exercise.[30] These observations altogether suggest an increased potential for participants to experience a period of low affect during these sessions, although the outcomes associated with a high-intensity session may be rewarding. Exercise professionals should therefore consider implementing strategies during the middle portion of a workout that divert attention away from negative internal states and thereby maximize positive affective experiences during an aerobics session.[31]

The ease with which the circumplex model can be completed means that it lends itself to research conducted in applied exercise environments.[32] However, the use of single-item measures has been the subject of some debate.[26] Given the valuable insight that has been gained from recent studies employing single-item in-task measures of affective change, further work is warranted to more fully establish the validity and reliability of such measures. Research should seek to respond to the current suggestion of a trade-off between gains in measurement breadth derived from the use of single-item measures against the potential sacrifice of measurement specificity.

It is acknowledged that the present study has numerous limitations: (1) a limited sample size; (2) the absence of any postexercise follow-up measures; (3) the lack of randomization of experimental conditions; and (4) the use of a highly active participant group. Despite these shortcomings, statistically significant results were obtained with encouraging power and effect sizes. Research employing repeated postexercise mood state measures show that the full psychological benefits of exercise may not be realized until complete recovery

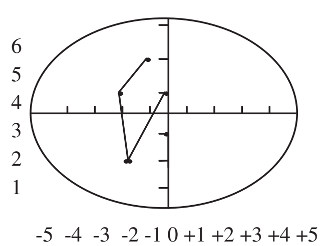

Fig. 9. Participant 3 (LI).

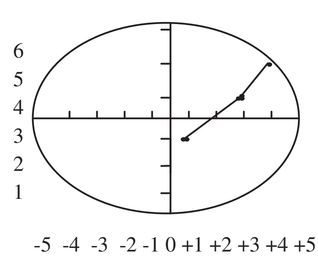

Fig. 10. Participant 4 (SS).

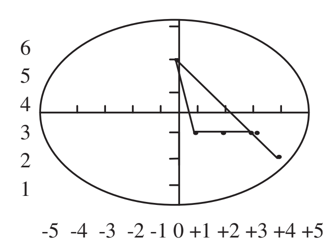

Fig. 13. Participant 5 (SS).

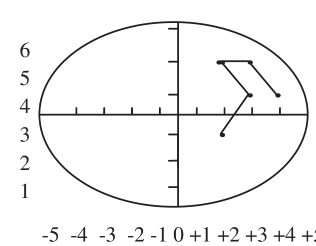

Fig. 14. Participant 5 (HI).

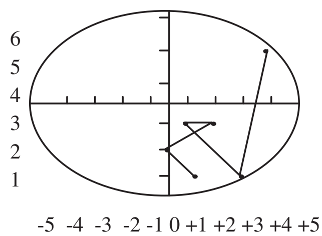

Fig. 15. Participant 5 (LI).

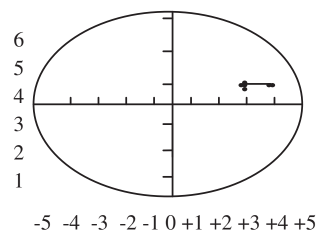

Fig. 16. Participant 6 (SS).

occurring up to 2 hours postexercise.[33] It is therefore encouraging that the present study observed affective changes from pretest to post-test over a 50-minute period. This suggests that further gains could justifiably be expected. The real-world nature of the present work required that certain compromises to prevent unduly disrupting the participants' normal daily schedules. Therefore, follow-up measures were not possible. The same consideration with respect to experimental design with the aerobics sessions (high, low, and self-select intensities) were delivered in a set order to all participants, thereby avoiding the need to run multiple sessions in a randomized order with a minimum of 3 weeks between classes. Participants were not purposefully sampled (with respect to activity level status) which helped to maintain the naturalistic, real-world focus of the research. The inclusion of a high intensity condition in the study required participants to have a sound pre-existing exercise capacity. Replication of the present study with participants recruited from specific target groups (e.g., exercise referral programs) may yield results that are of interest to practitioners involved in designing and delivering exercise interventions to specialist populations.

In investigating the impact of exercise intensity on affect in a real-world, ecologically valid setting, the present study builds on previous laboratory-based research, while further elucidating the factors that influence the exercise-affect interaction. Given the prominent position that exercise has assumed in contributing to current international health

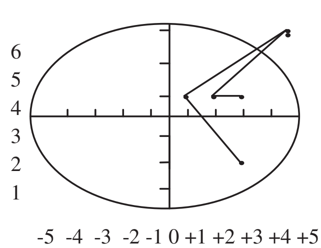

Fig. 17. Participant 6 (HI).

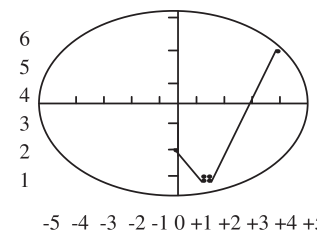

Fig. 18. Participant 6 (LI).

agendas, further work in this domain would appear warranted to help in the planning of future physical activity interventions.

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