

Research article

ACUTE PSYCHOLOGICAL BENEFITS OF EXERCISE PERFORMED AT SELF-SELECTED WORKLOADS: IMPLICATIONS FOR THEORY AND PRACTICE

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ABSTRACT

Given that most studies to date examined the connection between exercise and affect without considering the participants' preferred exercise workload, in this research the affective-benefits of jogging or running at a participant-selected pace were investigated in a pilot field and a laboratory experiment. Ninety-six male and female students (19.5 yrs) took part in the pilot field experiment whereas 32 women (20.3 yrs) completed the laboratory experiment. In both experiments, the participants ran/jogged for 20 minutes at a self-selected pace. They completed an abbreviated version of a 'right now form' of the Profile of Mood States (POMS – Grove and Prapavessis, 1992) inventory before and after exercise. In both experiments all dependent measures changed significantly from pre- to post-exercise, except 'fatigue' and 'vigor' that did not change in the laboratory. Total mood disturbance (TMD) decreased significantly in both experiments (68% and 89%). No significant correlations were found between exercise intensity (expressed as percent (%) of maximal heart rate reserve) and the magnitude of changes seen in the dependent measures. It is concluded that exercising at a self-selected workload yields positive changes in affect that are unrelated to exercise intensity. These results suggest that the physiological theories linking exercise with positive changes in affect, *in which exercise intensity is instrumental*, could not account for the acute affective benefits of exercise. It is proposed that a 'cognitive appraisal hypothesis' may be more appropriate in explaining the acute affective benefits of exercise.

KEY WORDS: Aerobic, affect, emotion, exercise, mood, running, workload

INTRODUCTION

Research in epidemiology reveals that a physically active lifestyle yields numerous health benefits (Blair et al., 1989, 1993; Powell and Blair, 1994). Evidence also shows that physical activity is associated with positive mental well being (Biddle 1995; Biddle et al., 2000; Biddle and Mutrie, 2001; Brown et al., 2000) and reduced reactivity to cognitive stress (Norris et al., 1990, 1992; Stein and Boutcher, 1992). The mental benefits of chronic and acute exercise are the most prominent on measures of affect and anxiety (Berger and Motl, 2000; Biddle and Mutrie, 2001; Fontaine, 2000; O'Connor et al.,

2000; Paluska and Schwenk, 2000; Raglin, 1990; Scully et al., 1998). Acute exercise triggers immediate improvements in affect, which renders it a suitable antidote to the hassles and challenges of the everyday life, in addition to overcoming some ill effects of an increasingly sedentary lifestyle.

A thought-provoking question then is whether the effects of acute exercise are dose-dependent, in which case exercising harder or longer could buffer more stress or yield more affective benefits. Ekkekakis and Petruzzello (1999) recognize the important implication of this question in both theory and practice. However, their review based on over 200 studies did not yield an unambiguous answer.

Then the possibility that there is no dose-response relationship should be seriously considered. Indeed, there is evidence in the literature that physically passive interventions, used mainly as control treatments to exercise, trigger affective benefits that are comparable to exercise (Parente, 2000; Snowball and Szabo, 1999; Szabo et al., 1998; Wilson et al., 1981). These empirical results call for another look at the physiologically based dose-response relationship between exercise and affect.

A search on the "SPORT Discus" electronic database using the search terms "exercise" and (Boolean operator) "mood or anxiety" yielded 1042 records at the time of writing, but only a few of these also looked at exercise intensity. Indeed, Ekkekakis and Petruzzello (1999) could only locate 31 relevant research four years earlier, of which 26 inquiries examined the affective beneficence of acute aerobic exercise at different workloads. A majority (56%) of these studies did not find a dose-response relationship. The few studies that have found different affective responses at different exercise workloads showed that differences existed on specific measures only, such as physical fatigue, exhaustion, or state anxiety. Moreover, even these relatively minimal differences were often related to training or fitness level of the participants.

Another key problem in dose-response research is related to the ignorance of the fact that in real life most exercisers self-select both the duration and intensity of their workload. These are dynamic aspects of exercise behavior that vary with personal or situational factors ranging anywhere from physical state to external factors such as the tempo of music accompanying the exercise (Bacon and Hookway, 2002). Accordingly, experimenter-selected exercise intensity, even if that is relative to the fitness level of the participant, may not correspond to the *momentary preference* of that person and yield imprecise results. An even greater problem is that the selection of exercise intensity is often unjustified. Indeed, only two out of the 31 studies examined by Ekkekakis and Petruzzello (1999) were theory-driven.

Admitting that affect is not independent of personal choice or preference for exercise intensity, studies using a participant-selected exercise workload may offer valuable contribution to the understanding of exercise-affect relationship. In their analytical review, however, Ekkekakis and Petruzzello (1999) could only locate two published accounts about the affective benefits of *self-selected (not varying) exercise intensity*. In the first study, Farrell et al. (1982) have indirectly studied affect in only six well-trained athletes who run on a treadmill for 30 minutes at self-selected pace, at 60% VO_2 max and at 80% VO_2 max. Total mood disturbance

(TMD) from the Profile of Mood States (POMS) inventory (Lorr et al., 1971) was the only measure of affect which were not significantly different after the three exercise conditions. In the second study, Zervas et al. (1993) examined the mood states of female participants after 30 minutes of aerobics performed at self-selected intensity and at 40%, 60% and 80% of their maximal heart rate (MHR). Vigor and exhilaration increased after 60% and 80% MHR as well as after self-selected exercise intensity. However, the highest level of exercise enjoyment was reported by those participants who self-selected their exercise workload. More recently, Parfitt et al. (2000) compared the affective benefits of a 20 minute treadmill running at 65% VO_2 max to that of preferred exercise intensity and, matching the findings from the above two studies, found no statistically significant differences.

Why is then the exercise psychology literature virtually void of studies using participant-selected exercise intensity in studying the affective benefits of exercise when common sense begs for such a protocol? The limited evidence, stemming from studies in which the self-selected exercise condition was not the point of the inquiry, clearly shows that self-selected exercise workloads are at least as effective as pre-set relative workloads in yielding affective benefits. If this is a replicable finding, than a number, if not most, of physiological models connecting exercise and affect, such as the endorphin hypothesis (Dunn and Dishman, 1991; Farrell et al., 1987), the amine hypothesis (Dunn and Dishman, 1991; Kety, 1966; Morgan and O'Connor, 1988), or the thermogenic hypothesis (Koltyn, 1997; Petruzzello et al., 1991), may be incomplete.

Therefore, the two exploratory studies reported here represent a first attempt to directly examine the affect-enhancing properties of self-selected exercise, of equal modality and duration, in a pilot field experiment and in a follow-up laboratory experiment. It was hypothesized that self-selected exercise would yield improvements in mood that are not related to the exercise intensity selected by the participants.

STUDY 1 – PILOT, FIELD EXPERIMENT

METHODS

Participants

Ninety-six first year university students enrolled in Sport and Exercise Psychology lectures were invited to participate in this research as part of a practical session. This method eliminated the problem of self-selection, but to adhere to ethical standards students were asked not to take part in the study if they suspect that there may be any medical or health

reason that could result in negative consequences to them. They were also instructed not to disclose their names for the sake of maximal confidentiality, but they were requested to report their gender and age. Out of the 96 students 66 men and 27 women complied with the requirements of the study (mean age = 19.5 years SD = 2.0). Three students did not disclose their sex. Upon completion of the experiment, the research details were discussed collectively and several educational tasks, in relation to the study, were completed jointly in and out of the class.

Instruments

An abbreviated version (Grove and Prapavessis, 1992) of the Profile of Mood States (POMS) inventory was the main instrument used in these studies. This tool is claimed to be the most popular instrument in sport and exercise context (LeUnes and Burger, 2000), it is sensitive to affective changes induced by exercise performed for only 20 minutes (Berger and Motl, 2000), and it was reported that it possesses adequate psychometric properties for use in sport and exercise psychology research (Fleming et al., 1992). This version of the POMS consists of a 40-item questionnaire containing 7 subscales of which 2 measure positive affect and 5 measure negative affect. The 40 items are rated on a 5-point Likert scale ranging from “not at all” to “extremely” to measure affective states like “Lively”, “Confused”, “Annoyed”, “Helpless”, “Vigorous” etc. In a past research the internal consistencies (Cronbach alpha) of the 7 subscales were found to be: fatigue = .90, anger = .90, vigor = .93, esteem = .70, tension = .87, confusion = .76 and depression = .93 (Wann et al., 1999).

Procedure

Participants reported for their Exercise Psychology practical session ready dressed for exercise. The testing phase of the practical session was held in a large sports hall. Before this session, students were trained in the palpation of the radial artery for estimating heart rate during exercise (Pronk et al., 1995). After several refresher exercises of this method, all participants completed a copy of the POMS in the presence of two experimenters. Talking and other forms of interactions were prohibited during the course of the study. Five minutes after the completion of the POMS, students were instructed to start running or jogging at self-selected pace. However, walking was not permitted, because that would introduce another exercise modality that could act as a confound. Fifteen minutes into their exercise, participants were requested to take their pulse for 10 seconds, as prescribed by Pronk et al. (1995). Given the pilot

nature of the field experiment, absolute accuracy of heart rate was not a major issue, but it was taken to estimate the workload at which students chose to run or jog and to establish the range of the self-selected exercise intensities. Pronk et al. (1995) reported that palpation is an accurate method for gauging heart rate during exercise. However, some contrary reports exist in the literature (e.g., Bell and Bassey, 1996; Erdmann et al., 1998). The target duration of the exercise was set to 20 minutes. This period was based on the reviews of Ekkekakis and Petruzzello (1999) and Berger and Motl (2000) showing that this interval is usually sufficient for tapping exercise-induced changes in affect. A 5-min rest period followed this exercise. Subsequently, the participants completed the POMS again. The questionnaires were collected and later scored using subscale-tailored templates.

Data reduction

The exercise workload at 15-minute period was calculated in terms of the percent (%) of the maximal heart rate reserve (MHRR) derived from the *Karvonen formula* (Karvonen et al. 1957). Accordingly, heart rate reserve (HRR) = 220 – age – baseline heart rate (BHR), and then MHRR = (exercise heart rate – BHR) / HRR * 100. It should be noted that in this pilot field experiment a single heart rate assessment at 15-minutes into exercise only reflected the momentary workload.

RESULTS

The POMS scores before and after exercise were analyzed with a multivariate repeated measures analysis of variance (MRM-ANOVA). This analysis yielded a statistically significant period (pre- to post-exercise) main effect, $F(7, 89) = 20.67, p = .001$. Follow up univariate analyses revealed that pre- to post-exercise changes were statistically significant for all seven dependent measures derived from the subscales of the POMS. These results are summarized in Table 1.

A total mood disturbance (TMD) score was calculated by subtracting the sum of the ratings on the two positive subscales of the POMS from the sum of the ratings on the five negative subscales (Grove and Prapavessis, 1992). Employing a pre- to post-exercise repeated measures ANOVA it was found that TMD decreased by 68% which was statistically significant $F(1, 95) = 28.22, p = .001$, effect size (d) = .49.

The percent (%) of the MHRR at which the participants exercised at the 15th minute mark was calculated to be moderate ($M = 52, SD = 15.78$). However, the range of individual exercise

Table 1. Means and standard deviations (n brackets) in seven dependent measures and TMD pre- and post-exercise performed at self-selected exercise intensity in the field experiment.

Dependent measure	Pre-Exercise	Post-Exercise	Effect size (<i>d</i>)	Significance
Anger	8.62 (3.97)	7.08 (2.11)	.39	<i>p</i> = .001
Confusion	6.59 (2.62)	5.25 (2.06)	.51	<i>p</i> = .001
Depression	9.96 (4.38)	8.19 (2.20)	.40	<i>p</i> = .001
Fatigue	9.81 (4.31)	11.43 (4.97)	.38	<i>p</i> = .01
Self-esteem	20.30 (3.23)	21.82 (3.20)	.47	<i>p</i> = .001
Tension	10.86 (3.94)	8.18 (2.45)	.68	<i>p</i> = .001
Vigor	11.86 (3.34)	13.94 (4.05)	.62	<i>p</i> = .001
TMD	13.69 (18.91)	4.35 (13.03)	.49	<i>p</i> = .001

intensities, in terms of %MHR, was high (65) indicating that participants self-selected a wide range of exercise workloads. To examine whether the individually selected workloads had any relationship to the magnitude of changes in the measures of affect, difference scores were calculated for the latter by subtracting the pre- from the post-exercise scores. The correlations between workload and difference scores were not significant for any of the affective measures (Table 2), including TMD (Figure 1).

DISCUSSION

The results of this pilot field experiment clearly show that a 20-minute bout of acute aerobic exercise, performed at participants-selected exercise intensity, generates significant affective-benefits. The lack of correlation between the calculated workload at the 15th minute of exercise and the magnitude of changes in mood (difference scores) suggests that exercise intensity may not mediate the affective benefits of exercise. If this is the genuine case, then as proposed by Stoll (1997) some of the physiological theories, or models, accounting for the exercise-affect relationship may be invalid. It is possible that the 'classical' models including the endorphin, amine, and thermogenic hypothesis may better explain the chronic rather than acute affective beneficence of exercise.

However, it may be argued that the workload, expressed in terms of MHR and calculated on the basis of a single palpated pulse 15 minutes into exercise, is an imprecise reflection of the exercise intensity. Indeed, error due to palpation may have occurred, but proper training in palpation, which was the case in this research, could yield an accurate pulse rate measure (Pronk et al., 1995). Still, it may be argued, that the momentary heart rate does not represent the overall or average workload in the exercise session. While this argument is also valid, a steady state is often reached early during exercise and, therefore, an average workload could be expected to be close to the calculated workload even on the basis of a momentary pulse rate. But such assumptions do not satisfy the required rigor in scientific research and hence they are speculative but noteworthy enough to call for further more systematic inquiry that was attempted in the laboratory experiment presented later.

Another finding that has emerged from this pilot field experiment is that the participants have selected a wide range of exercise intensities. This observation may contain a powerful message: Imposed exercise intensity is highly unlikely to match what a participant would (otherwise) choose for her/his exercise workout. Therefore, experimenter-imposed exercise intensity may be perceived as stressful, compliance demanding,

Table 2. Pearson correlation coefficients (*r*) obtained between self-selected exercise intensity, expressed as percentage (%) of maximal heart rate reserve, and pre- to post-exercise change scores of eight measures of affect in two experiments.

Dependent measure	Pilot field Experiment	Significance	Laboratory Experiment	Significance
Anger	<i>r</i> = .02	<i>p</i> = .87	<i>r</i> = .26	<i>p</i> = .15
Confusion	<i>r</i> = .16	<i>p</i> = .12	<i>r</i> = .32	<i>p</i> = .08
Depression	<i>r</i> = .02	<i>p</i> = .84	<i>r</i> = .15	<i>p</i> = .42
Fatigue	<i>r</i> = .13	<i>p</i> = .20	<i>r</i> = .29	<i>p</i> = .11
Esteem	<i>r</i> = .09	<i>p</i> = .39	<i>r</i> = .08	<i>p</i> = .68
Tension	<i>r</i> = -.10	<i>p</i> = .32	<i>r</i> = -.06	<i>p</i> = .73
Vigor	<i>r</i> = .10	<i>p</i> = .30	<i>r</i> = .06	<i>p</i> = .73
TMD	<i>r</i> = .06	<i>p</i> = .56	<i>r</i> = .19	<i>p</i> = .31

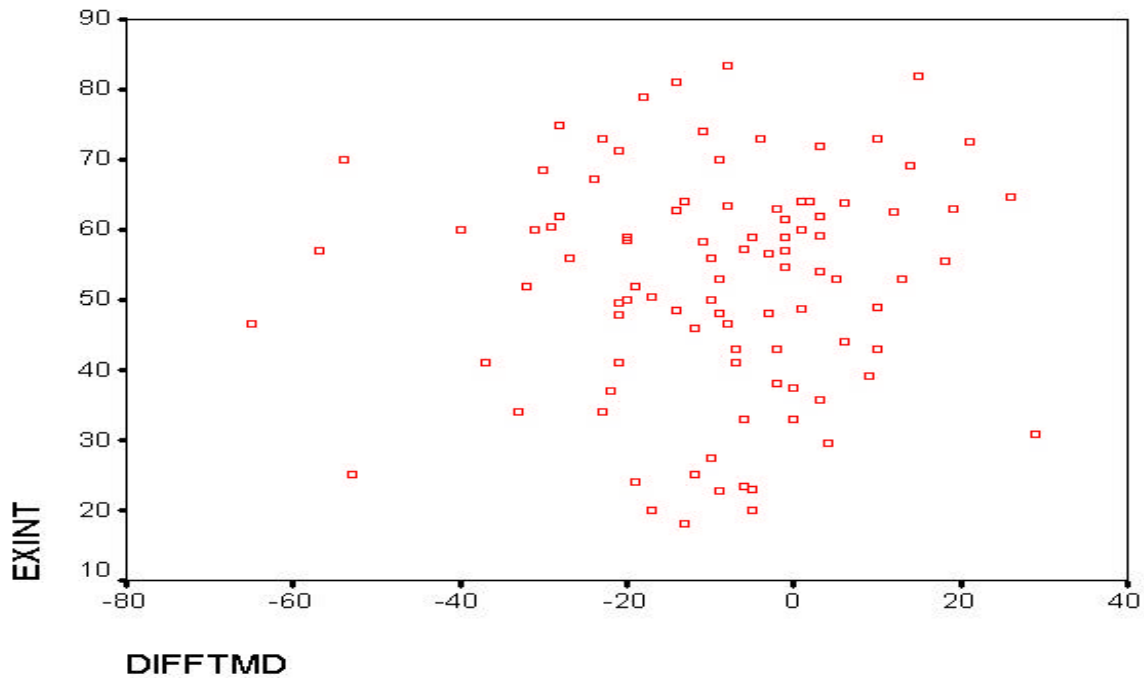


Figure 1. Scatter plot depicting the relationship between self-selected exercise intensity (EXINT), expressed as percentage (%) of maximal heart rate reserve, and pre- to post-exercise difference or change scores (DIFFTMD) of total mood disturbance, a global or composite score of affect, in the pilot field experiment.

and/or annoying. The net result would be an improvement in affect but not due to exercise itself but rather to being *'through with it'* (it = a chore). Similar findings were revealed in previous research in relation to state anxiety (Szabo et al., 1993).

Consequently, given that the results of this pilot field-experiment raised some significant theoretical and practical questions, a laboratory experiment was designed to explore whether such findings could also be obtained in a more controlled environment.

STUDY 2 – LABORATORY EXPERIMENT

METHODS

Participants

Due to the fact that a female research assistant was conducting the testing, female participants were recruited through a campus-wide call for participation at a large urban university. Thirty-five students volunteered for the study and 32 (mean age = 20.3 years, SD = 2.4; height = 164.8 cm, SD = 5.4; weight = 64.3 kg, SD = 6.1) showed up for testing. All participants have read and signed an informed consent form. They were informed that the purpose of the study was to determine whether a relatively

short exercise bout could influence their feeling states. More detailed explanations were provided only upon debriefing after participation.

Instruments

Mood measures were obtained with the POMS, like in Study 1. A *Powerjog* treadmill (model GM200; manufactured by Sport Engineering Ltd.) was used for exercising. Heart rate was measured with a *Polar* heart rate monitor (Model S610) comprised of a receiver unit and a chest transmitter (Model T61; both manufactured by Polar Electro Oy). Heart rate records obtained at 5-second intervals were downloaded to a computer via infrared link using the polar precision performance (SW3) software.

Procedure

Upon entering the laboratory, the participant was greeted and the experimental protocol was explained to her. Subsequently, she was fitted with the heart rate monitor by the female experimenter, following which she was invited to sit and relax until a stable reading of heart rate was obtained (approximately 5-minutes). This heart rate was recorded as 'baseline' heart rate and it was used for the calculation of maximal heart rate reserve. After the recording of a stable baseline heart rate, the participant was given the POMS for completion. Five minutes later she was invited to the treadmill. The controls of the

Table 3. Means and standard deviations (in brackets) in seven dependent measures and TMD pre- and post-exercise performed at self-selected exercise intensity in the laboratory experiment. (NS = statistically not significant; $p > .05$).

Dependent measure	Pre-Exercise	Post-Exercise	Effect size (d)	Significance
Anger	7.78 (2.49)	6.47 (1.02)	.53	$p = .001$
Confusion	7.22 (2.41)	5.75 (1.14)	.61	$p = .001$
Depression	8.25 (1.83)	7.38 (1.04)	.48	$p = .001$
Fatigue	9.44 (3.25)	9.34 (3.82)	.03	NS
Self-esteem	17.38 (2.37)	18.75 (2.16)	.58	$p = .01$
Tension	9.91 (3.60)	7.03 (1.33)	.80	$p = .001$
Vigor	14.47 (4.47)	16.03 (4.96)	.35	NS
TMD	10.75(11.19)	1.19 (7.79)	.85	$p = .001$

treadmill to which the participant had easy access during running were explained, and she was invited to set a pace at which she feels like exercising on that day (i.e., at the time of testing). She was told that both running and jogging are acceptable, but walking is not permitted because in the latter she would use a different motor program and, hence, a different form of exercise. The participant then started to run or jog for 20 minutes. After the exercise, she was invited to rest quietly for 5-minutes and then she was given the POMS again for completion. At the very end of the session her questions (if any) were answered and she was debriefed.

Data reduction

The exercise intensity for the 20-minute period was defined as percent (%) of MHRR like in the pilot experiment. However, instead of a single heart rate measurement, it was based on the average of the second-by-second heart rate records throughout the 20-minute exercise period. Therefore, continuous heart rate monitoring in this laboratory experiment yielded an overall measure of workload, in terms of calculated MHRR, for the 20-minute exercise session.

RESULTS

Like in the field experiment, the POMS scores before and after exercise were analyzed with MRM-ANOVA. This analysis yielded a statistically significant period main effect, $F(7, 25) = 5.98$, $p = .001$. The follow up univariate analyses revealed that the pre- to post-exercise changes were statistically significant in five out of the seven dependent measures. No significant pre- to post-exercise changes were seen in fatigue and vigor. Participants' TMD decreased significantly from pre- to post-exercise $F(1, 31) = 30.98$, $p = .001$, $d = .85$. These results are summarized in Table 3.

The average percent (%) of the MHRR at which the 32 participants chose to exercise during

the 20-minute treadmill session was calculated to be relatively high ($M = 71$, $SD = 13.00$). Similar to the field experiment, the range of individual exercise intensities, in terms of %MHRR, was wide (67). Like in the field experiment, change scores, or pre- to post-exercise difference scores, were calculated for each dependent measure. Their relationship to exercise intensity, operationalised as % of MHRR, was examined through correlation analyses. The results, matching those obtained in the field experiment, were not significant neither for the POMS subscales (Table 2) nor for TMD (Figure 2).

DISCUSSION

The results of the laboratory experiment mimicked those obtained in the field experiment during the pilot work. Again, a 20-minute bout of running or jogging that was performed at participants' preferred exercise intensity yielded significant positive affective changes. In this lab experiment, however, the increase in vigor did not reach the accepted level of statistical significance, which could have been due to relatively high vigor scores reported before exercise. Indeed, examination of Tables 1 and 2 reveal that average vigor scores pre-exercise in the laboratory experiment were higher than those recorded post-exercise in the field experiment. A possible explanation for this finding is that in the laboratory experiment the participants were volunteers who may have looked forward to an exercise session where they had control over workload, while in the field experiment participants were required to take part to fulfill an educational exercise that may be associated with lesser initial enthusiasm and hence vigor. The same explanation may account for the finding that perceived fatigue increased post-exercise in the field but not in the lab.

Another important finding, matching the results of the pilot field experiment, was the lack of correlation between exercise intensity and change scores or difference scores in measures of affect. In contrast to the field experiment where the workload

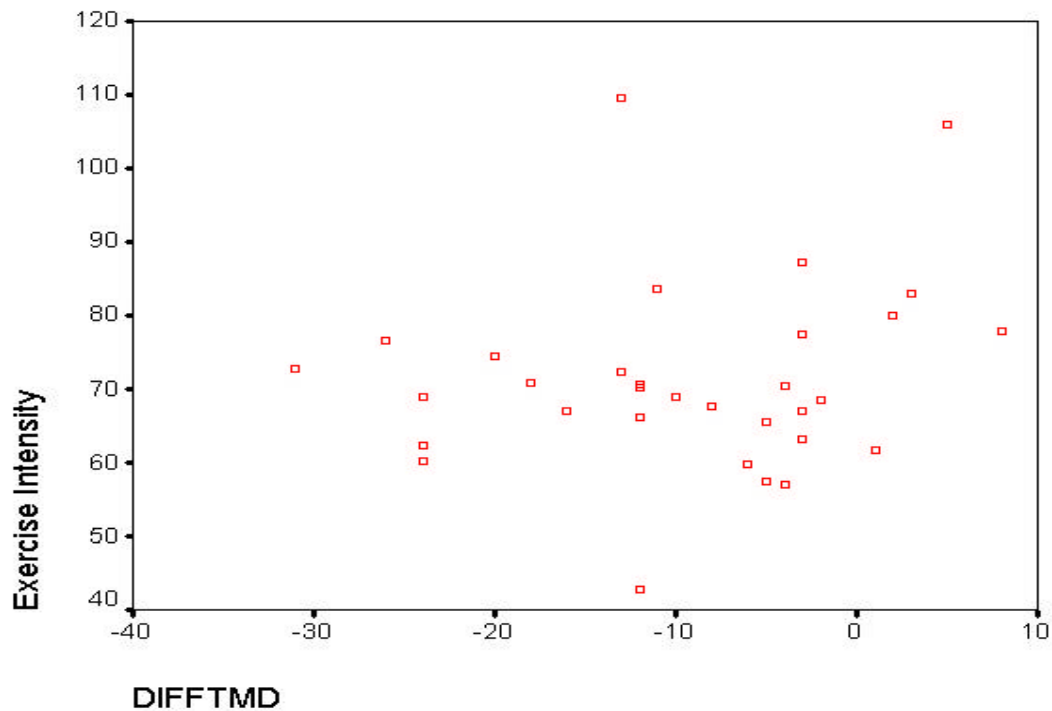


Figure 2. Scatter plot depicting the relationship between self-selected exercise intensity, expressed as percentage (%) of maximal heart rate reserve, and pre- to post-exercise difference or change scores (DIFFTMD) of total mood disturbance, a composite score of affect, in the laboratory experiment.

was based on a single pulse rate measurement, here it was calculated from the continuous heart rate records, thus giving greater weight to the results. This lack of correlation is noteworthy because it implies that the magnitude of affective-benefits is unrelated to exercise intensity. Consequently, physiological mechanisms, relying on exercise-dose as a mediating factor in the affective beneficence of exercise, may not account for the findings in this study and possibly for the findings in several previous investigations of similar nature as discussed later.

A final result, again mimicking those obtained in the field, was the wide range of exercise workloads selected by the participants. This finding justifies the rationale for using a self-selected workload protocol by showing that preferred workload varies to a large extent among research participants. Past research has overlooked this fact, which may have affected sensitive affective measures and their results.

GENERAL DISCUSSION

Results based on two different research methodologies clearly show that a 20-minute bout of exercise performed at a participant-selected

workload yields positive changes in affect. The effect sizes (Tables 1 and 3) obtained in these two experiments were comparable or higher than those previously reported in literature (Berger et al., 1997, 1998). The findings agree with most findings emerging from acute exercise and affect research (Berger and Motl, 2000). However, unlike the research reviewed by Berger and Motl (2000) the studies reported here involved participant-selected exercise intensities. Matching the results of research using experimenter-delimited workloads, as well as that of those few inquiries that used a self-selected exercise protocol (Farrell et al., 1982; Parfitt et al., 2000; Zervas et al., 1993), the current studies clearly show that exercise intensity is not instrumental in the acute affective beneficence of exercise.

These findings are further amplified by the fact that no correlation between the magnitude of change in affect and self-selected exercise intensity was found. Previous research did not examine this correlation. Berger and Motl (2000) think that setting the exercise intensity for affective benefits is mainly guesswork that is based on exercise intensities from past research that led to positive changes in affect. These authors see moderate exercise to be the most beneficial. This contemplation could be justified by the fact that

moderate intensity exercise is the least different from one's preferred or self-selected workload. Berger and Motl (2000) also posit that individuals' personal preference for exercise intensity may influence the exercise-affect relationship. On the basis of the current results, it is safe to suggest that a participant-set workload may be the most beneficial for immediate or acute psychological gains.

The wide range in the observed participant-selected exercise intensities in both studies reported here indicates that there is high variability in individuals' momentary preferences for exercise workload. This finding means that a single experimenter-set workload is in fact an *imposed* workload to many research participants. The affective benefits observed after an imposed-treatment reflect relief rather than gain emerging from such treatment. Self-selected exercise intensity, perhaps combined with self-set duration, could be the way forward in future research to solve this dilemma. To date, however, no studies have directly examined the role of one's control in such research.

From a theoretical perspective these findings seem to support Stoll's (1997) contention that physical models may not properly account for positive changes in affect after exercise. Alfermann and Stoll (1996) observed that both exercise and relaxation interventions yielded identical affective benefits and, hence, Stoll (1997) concluded that physical effort is not necessary for affective benefits to occur. His conclusion is backed up by several studies in the literature showing that physically effortless activities yield affective benefits similar to exercise (Berger and Owen, 1992; Parente, 2000; Snowball and Szabo, 1999; Szabo, 2003; Szabo et al., 1998; Wilson et al., 1981). These findings and the current results show that physical effort, especially in a dose-response context, is not instrumental in the acute affective effects of exercise. Consequently, a number of physiological models like the endorphin, thermogenic, or aminergic hypotheses may be incomplete. It is agreed with Stoll (1997) that psychological explanations could better account for these results.

A further dilemma is that even the existing psychological theories may not fully account for the acute affective effects of exercise. For example, unless there is some ongoing stress the distraction hypothesis (Morgan, 1985) does not apply. A mastery or self-efficacy hypothesis (Paluska and Schwenk, 2000) may only apply if something has been accomplished through the activity. However, the positive changes in affect, similar to exercise, observed after passive activities (Parente, 2000; Snowball and Szabo, 1999; Szabo, 2003; Szabo et al., 1998; Wilson et al., 1981) cannot be linked to

achievement behaviors. Therefore, a mastery hypothesis may only be relevant in some achievement situations. Finally, the social interaction model (Ransford, 1992) could not account for positive mood changes in laboratory experiments where social interaction is absent.

A more likely explanation for acute affective benefits of exercise (and some other passive treatments) may be linked to the mental interpretation of the activity that the participant is engaged in. In light of this 'cognitive appraisal hypothesis' (that was proposed in relation to stressful experiences by Lazarus in 1988) immediate beliefs and thoughts influence the view one takes on the situation or an activity. Consequently, any life-experience interpreted as pleasant is likely to trigger positive affect (Sandlund and Norlander, 2000). Currently, this is the only common denominator between affective improvements after a bout of exercise and quiet rest, for example (Koltyn and Schultes, 1997). Again, it is stressed that the cognitive appraisal hypothesis only accounts for the *immediate* pre- to post-treatment changes. It is uncontested that physiological models (La Forge, 1995) could be instrumental in the delayed affective beneficence of exercise for which evidence has been produced in the literature (Cox et al., 2000; Raglin and Wilson, 1996). Future research will need to investigate more closely the duration of the affective benefits of various forms of exercise protocols in contrast to rival or control treatments while keeping in perspective the evidence-based controversy surrounding the current models. In such an effort, the rated perceived exertion (RPE) as an additional index of exercise intensity has to be assessed, along the heart rate, in future inquiries.

CONCLUSION

The results of two studies revealed that exercise intensity is unimportant in the generation of positive affective benefits after a single bout of aerobic exercise. While only limited measures of affect were examined in this research, such data call for the revisiting of the physiological models advanced in the explanation of acute affective benefits of exercise. It is more likely that affective changes triggered by exercise in the immediate post-exercise period are regulated by the subjective cognitive appraisal of the whole exercise session in which control over exercise workload is instrumental. A wide range was found in the participant-selected exercise intensities, which demonstrates that *experimenter-imposed* exercise workloads, that represent an arbitrary research decision, could have been erroneously employed in past research.

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REFERENCES

- Alfermann, D. and Stoll, O. (1996) Befindlichkeitsveränderungen nach sportlicher Aktivität (Mood changes after physical exercise). *Sportwissenschaft* **26**, 406-422.
- Bacon, C.J. and Hookway, S. (2002) *The effect of musical selections on submaximal exercise parameters and self-selected exercise intensity in aerobics participants*. 12th Commonwealth International Sport conference, July 2002, Manchester, United Kingdom. Abstract Book, London: Association of Commonwealth Universities. 119.
- Bell, J.M. and Bassey, E.J. (1996) Postexercise heart rates and pulse palpation as a means of determining exercising intensity in an aerobic dance class. *British Journal of Sports Medicine* **30**, 48-52.
- Berger, B.G., Grove, J.R., Prapavessis, H. and Butki, B.D. (1997) Relationship of swimming distance, expectancy, and performance to mood states of competitive athletes. *Perceptual and Motor Skills* **84**, 1199-1210.
- Berger, B.G. and Motl, R.W. (2000) Exercise and mood: A selective review and synthesis of research employing the Profile of Mood States. *Journal of Applied Sport Psychology* **12**, 69-92.
- Berger, B.G. and Owen, D.R. (1992) Mood alteration with yoga and swimming; aerobic exercise may not be necessary. *Perceptual and Motor Skills* **75**, 1331-1343.
- Berger, B.G., Owen, D.R., Motl, R.W. and Parks, L. (1998) Relationship between expectancy of psychological benefits and mood alterations in joggers. *International Journal of Sport Psychology*, **29**, 1-16.
- Biddle, S. (1995) Exercise and psychological health. *Research Quarterly for Exercise and Sport* **66**, 292-297.
- Biddle, S.J.H., Fox, K.R. and Boutcher, S.H. (2000) *Physical activity and psychological well-being*. London: Routledge.
- Biddle, S.J.H. and Mutrie N. (2001) *Psychology of physical activity*. London: Routledge.
- Blair, S.N., Kohl, H.W. and Barlow, C.E. (1993) Physical fitness and all-cause mortality: A prospective study of healthy men and women. *Journal of the American College of Nutrition* **12**, 368-371.
- Blair, S. N., Kohl, H. W., Paffenbarger, R. S., Clark, D. G., Cooper, K. H. and Gibbons, L. W. (1989) Physical fitness and all-cause mortality: A prospective study of healthy men and women. *Journal of the American Medical Association* **262**, 2395-2401.
- Brown, W.J., Mishra, G., Lee, C. and Bauman, A. (2000) Leisure Time Physical Activity in Australian Women: Relationship with Well Being and Symptoms. *Research Quarterly for Exercise and Sport* **71**, 206-216.
- Cox, R.H., Thomas, T.R. and Davis, J.E. (2000) Delayed anxiolytic effect associated with an acute bout of aerobic exercise. *Journal of Exercise Physiology Online* **3**, 59-66.
- Dunn, A.L. and Dishman, R.K. (1991) Exercise and the neurobiology of depression. *Exercise and Sport Sciences Reviews* **19**, 41-98.
- Ekkekakis, P. and Petruzzello, S.J. (1999) Acute aerobic exercise and affect: Current status, problems and prospects regarding dose-response. *Sports Medicine* **28**, 337-374.
- Erdmann, L.D., Dolgener, F.A. and Hensley, L.D. (1998) A comparison of the postexercise heart rates by telemetry and self-pulse palpation in middle-school-age boys. *Measurement in Physical Education and Exercise Science* **2(4)**, 199-204.
- Farrell, P.A., Gates, W.K., Maksud, M.G. and Morgan, W.P. (1982). Increase in plasma beta-endorphin/beta-lipotropin immunoreactivity after treadmill running in humans. *Journal of Applied Physiology: Respiratory, Environmental and Exercise Physiology* **52**, 1245-1249.
- Farrell, P.A., Gustafson, A.B., Morgan, W.P. and Pert, C.B. (1987) Enkephalins, catecholamines, and psychological mood alterations: effects of prolonged exercise. *Medicine and Science in Sports and Exercis*, **19**, 347-353.
- Fleming, S., Bourgeois, A.E., LeUnes, A. and Meyers, M.C. (1992) *A psychometric comparison of the full scale Profile of Mood States with other abbreviated POMS scales in selected athletic populations*. The Association for the Advancement of Applied Sport Psychology, Colorado Springs, CO.
- Fontaine, K.R. (2000) Physical activity improves mental health. *Physician and Sportsmedicine* **28**, 83-84.
- Grove, J.R. and Prapavessis, H. (1992) Preliminary evidence for the reliability and validity of an abbreviated Profile of Mood States. *International Journal of Sport Psychology* **23**, 93-109.
- Karvonen, M., Kentala, K. and O. Mustala, O. (1957) The effects of training heart rate: a longitudinal study. *Annales Medicinae Experimentalis et Biologiae Fenniae* **35**, 307-315.
- Kety, S.S. (1966) Catecholamines in neuropsychiatric states. *Pharmacological Reviews* **18**, 787-798.
- Koltyn, K. F. (1997) The thermogenic hypothesis. In: *Physical activity and mental health..* Ed: Morgan W.P. Washington: Taylor and Francis. 213-226.
- Koltyn, K.F. and Schultes, S.S. (1997) Psychological effects of an aerobic exercise session and a rest session following pregnancy. *Journal of Sports Medicine and Physical Fitness* **37**, 287-291.
- La Forge, R. (1995) Exercise-associated mood alterations: A review of interactive neurobiological

- mechanisms. *Medicine, Exercise, Nutrition and Health* **4**, 17-32.
- Lazarus, R.S. (1988) The psychology of stress and coping. In: *Stress and Anxiety*. Ed: Spielberger C.D. and Sarason I.G. New York: Hemisphere Publishing. 399-418.
- LeUnes, A. and Burger, J. (2000) Profile of Mood States research in sport and exercise psychology: past, present, and future. *Journal of Applied Sport Psychology* **12**, 5-15.
- Lorr, M., McNair, D.M. and Droppleman, L.F. (1971) *Manual for the profile of mood states*. San Diego, CA: Educational and Industrial Testing Service.
- Morgan, W.P. (1985) Affective beneficence of vigorous physical activity. *Medicine and Science in Sports and Exercise* **17**, 94-100.
- Morgan, W.P. and O'Connor, P.J. (1988). Exercise and mental health. In: *Exercise Adherence: Its impact on Public Health*. Ed: Dishman R.K. Champaign, IL: Human Kinetics. 91-121.
- Norris, R., Carroll, D. and Cochrane, R. (1990) The effects of aerobic and anaerobic training on fitness, blood pressure, and psychological stress and well-being. *Journal of Psychosomatic Research* **34**, 367-375.
- Norris, R., Carroll, D. and Cochrane, R. (1992) The effects of physical activity and exercise training on psychological stress and well-being in an adolescent population. *Journal of Psychosomatic Research* **36**, 55-65.
- O'Connor, P.J., Raglin, J.S. and Martinsen, E.W. (2000) Physical activity, anxiety and anxiety disorders. *International Journal of Sport Psychology* **31**, 136-155.
- Paluska, S. A. and Schwenk, T.L. (2000) Physical activity and mental health: current concepts. *Sports Medicine* **29**, 167-180.
- Parente, D. (2000) Influence of aerobic and stretching exercise on anxiety and sensation-seeking mood state. *Perceptual and Motor Skills* **90**, 347-348.
- Parfitt, G., Rose, E.A. and Markland, D. (2000) The effect of prescribed and preferred intensity exercise on psychological affect and the influence of baseline measures of affect. *Journal of Health Psychology* **5**, 231-240.
- Petruzzello, S.J., Landers, D.M., Hatfield, B.D., Kubitz, K.A. and Salazar, W. (1991) A meta-analysis on the anxiety-reducing effects of acute and chronic exercise. *Sports Medicine* **11**, 143-182.
- Powell, K.E. and Blair, S.N. (1994) The public health burdens of sedentary living habits: Theoretical but realistic estimates. *Medicine and Science in Sports and Exercise* **26**, 851-856.
- Pronk, N.P., Pronk, S.J. and Sisco, A.W. (1995) Accuracy of the palpation technique to assess exercise heart rate during bench stepping exercise. *Journal of Strength and Conditioning Research* **9**, 27-31.
- Raglin, J.S. (1990) Exercise and mental health: beneficial and detrimental effects. *Sports Medicine* **9**, 323-329.
- Raglin, J. S. and Wilson, M. (1996) State anxiety following 20 minutes of bicycle ergometer exercise at selected intensities. *International Journal of Sports Medicine* **17**, 467-471.
- Ransford, C.P. (1982) A role of amines in the antidepressant effects of exercise: a review. *Medicine and Science in Sports and Exercise* **4**, 1-10.
- Sandlund, E.S. and Norlander, T. (2000) The effects of tai chi chuan relaxation and exercise on stress responses and well-being: An overview of research. *Journal of Stress Management* **7**, 139-149.
- Scully, D., Kremer J., Meade, M.M., Graham, R. and Dudgeon, K. (1998) Physical exercise and psychological well-being: A critical review. *British Journal of Sports Medicine* **32**, 111-120.
- Snowball, J. and Szabo, A. (1999) Anxiety, affect and exercise: Preliminary evidence lends support to the Distraction Hypothesis. *Journal of Sport Sciences* **17**, 67-68.
- Stein, P.K. and Boutcher, S.H. (1992) The effect of participation in exercise training program on cardiovascular reactivity in sedentary middle-aged males. *International Journal of Psychophysiology* **13**, 215-223.
- Stoll, O. (1997) Endorphine, Laufsucht und runner's high. Aufstieg und Niedergang eines Mythos (Endogenous opiates, "runner's high" and "Exercise Addiction" - The rise and decline of a myth). *Leipziger Sportwissenschaftliche Beiträge* **28**, 102-121.
- Szabo, A. (2003) The acute effects of humor and exercise on mood and anxiety. *Journal of Leisure Research* **35**, 152-162.
- Szabo A., Mesko, A., Caputo, A. and Gill, É. (1998) Examination of exercise-induced feeling states in four modes of exercise. *International Journal of Sport Psychology* **29**, 376-390.
- Szabo, A., Péronnet, F., Boudreau, G., Côté, L., Gauvin, L. and Seraganian, P. (1993) Psychophysiological profiles in response to various challenges during recovery from acute aerobic exercise. *International Journal of Psychophysiology* **14**, 285-294.
- Wann, D.L., Inman, S., Ensor, C.L., Gates, R.D., and Caldwell, D.S. (1999) Assessing the psychological well-being of sport fans using the Profile of Mood States: the importance of team identification. *International Sports Journal* **3**, 81-90.
- Wilson, V.E., Berger, B.G. and Bird, E.I. (1981) Effects of running and of an exercise class on anxiety. *Perceptual and Motor Skills* **53**, 472-474.
- Zervas, Y., Ekkekakis, P., Emmanuel, C., Psychoudaki, M. and Kakkos, V. (1993) The acute effects of increasing levels of aerobic exercise intensity on mood states. In: *Proceedings: VIII World Congress of Sport Psychology. Sport psychology: integrated approach*. Ed: Serpa, S., Alves, J., Ferreira, V. and Paula-Brito A. Lisbon: International Society of Sport Psychology. 620-624.

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