

**THE EFFECT OF A SINGLE BOUT OF AEROBIC EXERCISE ON MOOD:  
CO-EXAMINATION OF BIOLOGICAL AND PSYCHOLOGICAL PARAMETERS  
IN A CONTROLLED FIELD STUDY<sup>1,2</sup>**

***Pantelis EKKEKAKIS & Yannis ZERVAS***

Laboratory of Motor Behavior and Sport Psychology  
Department of Physical Education and Sport Science  
University of Athens, Greece

**KEYWORDS:** acute aerobic exercise, mood, state anxiety, enjoyment of physical activity, field study.

### INTRODUCTION

The psychological effects of acute aerobic exercise constitute a research theme which has gained increasing momentum in the field of exercise psychology in recent years. The affective benefits of various aerobic activities, in particular, have attracted much attention (Morgan, 1987; Petruzzello, Landers, Hatfield, Kubitz & Salazar, 1991; Tuson & Sinyor, 1993), due to their apparent practical significance in a stress-burdened society, their theoretical interest, but also due to the ostensibly minimal requirements of the methodological paradigms which seem appropriate for addressing this issue.

As a consequence of the latter observation, despite the fact that the results from this line of research have been largely unequivocal, the reviews of the field adopt a very critical position (Hughes, 1984; Morgan & O'Connor, 1988). Some of the commonly identified shortcomings are the lack of control groups, of placebo plots, of blind designs, the lack of control for volunteerism and certain expectancy effects (e.g. Hawthorne), the use of small and non-randomly assigned samples, and the inattention to crucial demand characteristics (intensity, duration). However, the classification of the studies as "pre-experimental", "quasi-experimental", and "true-experimental" based on the presence or absence of control groups and the random or non-random assignment seems rather elusive; subjects may be assigned to conditions at random, but this still does not control for volunteerism, since all subjects participate voluntarily in the first place, nor does it guarantee that the responses of subjects in the control condition are not the product of mere boredom due to the passive or unpleasant nature of the chosen control condition (Jamieson & Flood, 1993). Moreover, "true-experimental" studies usually involve fewer subjects assigned to treatment conditions, are mostly restricted to recruited college students, increase the likelihood of a strong expectancy bias, and their results possess dubious, if any, external validity.

It thus appears that there is a strong need for very carefully designed and conducted field research. It is puzzling that, although the main focus of exercise psychology is the area of

---

<sup>1</sup> Address correspondence to Pantelis Ekkekakis, Laboratory of Motor Behavior and Sport Psychology, Department of Physical Education and Sport Science, University of Athens, 41 Ethnikis Antistasis Street, 172 37 Dafne, Athens, Greece.

<sup>2</sup> Sincere appreciation is extended to Andreas Benakis and his staff in "PALMOS" Exercise Center for their invaluable assistance in data collection.

organized health-related exercise for the general population (Biddle & Mutrie, 1991), studies of such a real-life orientation examining the affective concomitants of acute aerobic exercise are very infrequently found in the literature (e.g. Maroulakis & Zervas, 1993). However, despite the fact that random assignment is impracticable in most field studies, such an approach does not necessarily entail the absence of rigorous controls. In fact, techniques, such as individual- or group-matching, within-subjects designs and the thoughtful selection of control conditions may outweigh the potential weaknesses, while maintaining a high degree of external validity (Graziano & Raulin, 1989).

Within the context described above, the purpose of this study is to examine the effect of a typical aerobics session on the mood of adult exercising women. However, the study was designed to allow for multiple levels of analysis. Basically, a pretest-posttest natural control-group design was employed, using an equivalent- and motivational/placebo-control-group. In addition, a 2 (treatment-control) by 2 (pre-post) within-subjects design was used, serving the purposes of (a) controlling for response sets, and (b) examining the "distraction hypothesis", which has been suggested to account for exercise-induced mood enhancement (Morgan & O'Connor, 1988). Finally, for a sub-sample of the main treatment group, a replication was undertaken, fifteen days later, to control for regression to the mean.

## METHOD

### Subjects

Forty-nine healthy female members of a privately-owned fitness club (Age,  $M=23.24$ ,  $SD=5.6$  years; Weight,  $M=63.5$ ,  $SD=10.66$  kg; Training experience,  $M=2.72$ ,  $SD=2.70$  months) were recruited to form the main treatment group, while 35 non-exercising women (Age,  $M=24.76$ ,  $SD=6.07$  years) attending foreign-language and introductory computer courses in a community education program from the same area formed the control group ( $N=84$ ). Although intact groups were used, instead of assigning subjects to conditions at random, no subjects refused participation in either condition and the groups did not differ substantially in age, trait anxiety or any of the dependent variables under baseline conditions (see Table 1). Furthermore, the rationale for selecting this particular control group lies in the regular albeit non-compulsory nature of participation, the fact that it, like exercise, provides a means of self-improvement, through post-school education, and the liberal teaching methods followed, which allow for a more energetic form of attendance. Thus, in essence, by employing an equivalent-and placebo-control group not only were the methodological problems created by the non-random assignment to conditions overcome, but motivational factors were also controlled for, while at the same time safeguarding the external validity of the study.

A sub-sample of the exercise group, consisting of 28 subjects, was used as a replication sample, while 26 of the subjects participated in the control condition for the within-subjects analysis.

## **Measures**

The abbreviated version of the Profile of Mood States (POMS; McNair, Lorr & Droppleman, 1971), proposed by Shacham (1983), was used as a measure of Tension/Anxiety, Depression/Dejection, Anger/Hostility, Vigor/Activity, Fatigue/Inertia, Confusion/ Bewilderment, and Total Mood Disturbance. The rigorous psychometric properties of the 65-item original questionnaire seem to be well preserved in this 37-item easier-to-administer form (Grove & Prapavessis, 1992). Moreover, state anxiety was measured by the 20-item state-anxiety subscale of the State-Trait Anxiety Inventory (SAI; Spielberger, Gorsuch & Lushene, 1970). In all cases, POMS and SAI were administered in a counterbalanced order, which was reversed at the posttest.

Two additional questionnaires were filled-in post-treatment only by the subjects in the exercise conditions. The Physical Activity Enjoyment Scale (PACES; Kendzierski & DeCarlo, 1991) was used to assess post-exercise degree of enjoyment, while subjective exercise intensity was determined by responses to the Rating of Perceived Exertion (RPE; Borg & Noble, 1974) at the last minute of each exercise session.

A number of trait variables were also assessed, in order to examine their role in mood alteration. Among these, trait anxiety was considered as a potential intervening variable, so subjects in both the treatment and the control groups completed the trait-anxiety subscale of the State-Trait Anxiety Inventory (TAI; Spielberger *et al.*, 1970). On the other hand, only the subjects in the exercise conditions completed the following additional questionnaires:

- (a) the Social Desirability Scale (SDS; Crowne & Marlowe, 1960),
- (b) the Exercise Objectives Locus of Control scale (EOLOC; McCready & Long, 1985), and
- (c) the Bortner Rating Scale for the Type-A Behavior Pattern (BRS; Bortner, 1969).

All the psychological instruments used in this study were translated in Greek following a standard procedure involving the discussion of multiple alternative wordings by a group of five bilingual experts. Furthermore, large-scale cross-cultural psychometric examination procedures were previously undertaken for most of the questionnaires used.

Moreover, maximal aerobic capacity was measured by a submaximal fitness test on a computer-controlled step-machine (Lifestep; Rippe, Wilkie, Hanley, Freeson, Zwiren, Kalmes, Crawford & Ward, 1987). The algorithm of the test is based on produced work, heart rate measured at the end of the test, age-adjusted maximum heart rate, and gender, to calculate an estimate of  $VO_{2\max}$ . Data on recent body weight and frequency of exercise were drawn from the club files.

## **Procedure**

After permission was granted for the study from the director of the fitness club and the head of the community education program, subjects were initially approached through a short letter. Measurements commenced on a later date. All procedures were carried out by the usual instructors, in order to minimize intrusion and consequent expectancy effects. The instructors

had been briefed on proper questionnaire administration procedures, but remained blind to the precise purpose of the study. At all times, however, one researcher was standing by, out of sight, to ensure that procedures were followed uneventfully.

Subjects in the exercise condition gathered in the fitness club, in groups of 6 to 10, and were asked to complete a demographic information sheet and the POMS and SAI. They then followed a typical 45-min aerobics session. During the short transitional stage from the main training phase to the cool-down, the program instructor and the club director measured the heart rates of a random sub-sample of subjects. Recorded values ranged from 108 to 150 beats per minute ( $M=123.8$ ). Given the time of measurement, it would appear that exercise was of moderate intensity, at its peak. However, interrupting the program at its peak or at more than one point, in order to check for heart rates, would endanger the external validity of the study and was, thus, considered unnecessary. Immediately after having completed the aerobics session, the subjects were asked to rate their perceived exertion and fill-in the POMS, SAI, and PACES. Identical procedures were followed at the replication sessions, not less than fifteen days later. The subjects in the exercise condition completed the trait questionnaires at their houses.

The subjects in the control condition had been told that the short-term effects of such classes were the actual focus of this investigation. They were asked to complete the POMS and SAI before and immediately after a 45-min class. The TAI was also filled-in, but only after class.

The subjects who took part in the within-subjects control condition were asked to sit, relax and choose something to read from a wide variety of magazines and newspapers. Factors, such as location, music, temperature, social environment and the presence of their aerobics instructor were kept identical compared to the exercise session. The POMS and SAI were completed again before and after this procedure, which also lasted for approximately 45-min.

## RESULTS

The internal consistency of all questionnaires was assessed by means of Cronbach's alpha and was judged as satisfying established psychometric requirements. The descriptive statistics for all the dependent variables appear in Table 1.

Analyses of variance (ANOVAs) across the four samples and sub-samples for all dependent variables under baseline conditions reached significance only in the cases of Vigor and SAI, but *post-hoc* analyses by means of *Scheffe* tests showed that no two groups were different at the .05 level. Moreover, the differences between the RPE and PACES mean scores to the main and the replication exercise sessions were not significant.

The differential effect of treatments was investigated by one-way analyses of covariance (ANCOVAs) for the posttest levels of all dependent variables, using the respective pretest values as covariates. The results indicated significant main effects of type of treatment for Tension ( $p<.001$ ), Depression ( $p<.001$ ), Anger ( $p<.001$ ), Vigor ( $p<.01$ ), Confusion ( $p<.001$ ), Total Mood Disturbance ( $p<.001$ ) and SAI ( $p<.001$ ), while the effect on Fatigue was not

TABLE 1. Means and Standard Deviations for the Treatment and the Control Conditions

	Treatment Group (n=49)		Control Group (n=35)		Replication Sub-Sample (n=28)		Control Sub-Sample (n=26)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Tension								
M	4.53	2.16	6.42	5.76	5.64	2.36	5.19	4.00
SD	4.33	2.98	4.12	4.97	5.27	3.28	4.44	3.91
Depression								
M	2.71	0.88	3.51	3.88	3.32	1.39	3.11	2.42
SD	3.84	2.20	4.49	5.74	4.59	2.68	3.77	2.90
Anger								
M	2.20	0.41	2.94	2.79	2.75	1.00	3.42	3.00
SD	3.42	1.00	4.82	4.08	5.65	2.04	5.09	4.56
Vigor								
M	14.65	16.63	14.88	14.88	11.50	14.68	12.65	12.19
SD	4.28	4.33	5.74	5.63	4.97	6.36	5.30	5.66
Fatigue								
M	2.49	3.22	4.39	4.76	3.57	2.57	2.54	2.35
SD	3.08	3.69	4.35	4.44	3.95	3.08	2.50	3.15
Confusion								
M	3.39	1.53	4.33	4.39	2.93	1.75	3.15	2.38
SD	2.62	2.05	3.59	3.68	3.07	2.24	2.51	2.28
Total								
M	100.67	91.57	106.73	106.70	106.71	94.39	104.77	101.96
SD	14.93	10.69	19.87	23.27	20.74	14.48	16.71	15.70
SAI								
M	36.27	31.04	40.57	39.91	42.91	34.91	40.92	39.65
SD	10.05	7.79	11.35	11.70	10.60	10.59	10.52	9.81
RPE								
M		11.65				11.96		
SD		3.68				2.36		
PACES								
M		113.34				111.68		
SD		13.01				12.18		

significant. *Scheffe* tests showed that the differences were in all cases between one or both of the exercise samples and one or both of the control samples; no difference was found between the two exercise samples or between the two control samples. Furthermore, multiple paired *t*-tests between pretest and posttest means of all dependent variables for each sample showed that while the differences after both exercise sessions were statistically significant in all variables except Fatigue, the only significant differences found in the control groups were in Tension ( $p < .05$ ) and Confusion ( $p < .05$ ) in the press-reading control sub-sample; no variable was significantly altered after the course in the main control group.

For the within-subjects design, the scores of the 26 women from the control sub-sample in both the exercise and the press-reading control sessions were considered for analysis, using a 2 (Type of Treatment: exercise, control) by 2 (Phase of Measurement: pre, post) repeated-measures design. The results of the doubly multivariate analyses of variance (MANOVAs)

showed that the main effect of the Type of Treatment was significant for Tension ( $p < .05$ ), Anger ( $p < .05$ ), Vigor ( $p < .01$ ), Confusion ( $p < .05$ ), Total Mood Disturbance ( $p < .01$ ), and SAI ( $p < .01$ ); the main effect of the Phase of Measurement was significant for Tension ( $p < .01$ ), Depression ( $p < .001$ ), Anger ( $p < .05$ ), Confusion ( $p < .001$ ), Total Mood Disturbance ( $p < .001$ ), and SAI ( $p < .05$ ); finally, the effect of the interaction of the two factors was significant for Vigor ( $p < .01$ ), Confusion ( $p < .05$ ), Total Mood Disturbance ( $p < .01$ ), and SAI ( $p < .05$ ).

The role of psychological and biological variables was investigated in the main exercise sample by means of *Pearson* product-moment correlations and ANCOVAs among low and high levels of each variable, following median splits, and using pretest levels as covariates. The findings can be epitomized in the following:

- RPE is negatively associated with post-exercise Vigor ( $r = .48, p < .001$ ) and enjoyment ( $r = .40, p < .01$ ) and positively associated with Fatigue ( $r = .44, p < .01$ ), Total Mood Disturbance ( $r = .35, p < .05$ ), and SAI ( $r = .34, p < .05$ ). Similarly, post-exercise Fatigue is positively associated with Tension ( $r = .54, p < .001$ ), Confusion ( $r = .50, p < .001$ ), Total Mood Disturbance ( $r = .72, p < .001$ ), and SAI ( $r = .49, p < .001$ ).
- Post exercise enjoyment covaries with reduced Tension ( $r = -.41, p < .01$ ), Depression ( $r = -.34, p < .05$ ), Total Mood Disturbance ( $r = -.61, p < .001$ ) and SAI ( $r = -.56, p < .001$ ), as well as with increased Vigor ( $r = .69, p < .001$ ).
- Social Desirability does not seem to affect any of the dependent variables to a considerable extent, either under baseline or post-exercise conditions. SDS correlated highly only with TAI ( $r = -.41, p < .01$ ).
- Few biological and trait variables had certain main effects on dependent variables, as shown by one-way ANCOVAs. However, by examining the effects through separate four-way ANCOVAs for the biological (VO<sub>2</sub> max, body weight, training experience, age) and psychological (TAI, BRS, Internal factor of EOLOC, RPE) variables, the variation was distributed across independent variables and interactions, so that no main effect or interaction was significant, except RPE. Perceived exertion seemed in most cases far more important than any trait variable and its effect reached statistical significance in the cases of Vigor, Fatigue, Total Mood Disturbance, SAI, and PACES.

## DISCUSSION

This study has been an attempt to examine the psychological effectiveness of acute aerobic exercise in a naturalistic setting, while maintaining a high degree of methodological constraint.

The results indicate that for women who choose to exercise, a bout of aerobic exercise is indeed very effective in reducing stress and improving mood. On the other hand, it seems that voluntary participation in other activities aimed at self-improvement, such as post-school education, which may allow for energetic attendance but of a non-physical nature, are not at all effective in that respect. It also seems that occupying oneself with "distracting" pass-time activities of a passive nature can be expected to have only limited effects on mood enhancement, contrary to the "distraction" or "time-out" hypothesis (Morgan & O'Connor, 1988).

The present study made an effort to address the issue of data contamination by social desirability and acquiescence, as well as to control for expectancy by utilizing a placebo control group. However, although response sets do not seem to influence the data to a significant extent, it would appear that the Hawthorn effect remains a serious threat to the internal validity of the findings, since the psychological benefits of exercise is a concept popularized through the media, whereas no such effects are to be expected from educational or passive pass-time activities. The successful control for expectancy is perhaps one of the most challenging methodological issues for future research on the topic.

Moreover, the present study examined the role of a limited number of variables in exercise-induced mood enhancement. Apparently, the scope of this inquiry was of an exploratory nature and lacked a sound theoretical basis. However, the attempt was instrumental in showing that either individuals possessing a variety of psychological and biological make-ups may experience the psychological benefits of acute aerobic exercise or that the search for the antecedents of the positive affective reactions to vigorous exercise has still a long way to go. Either way, it seems like a potentially fruitful direction for future research, given its strong association with the major issue of exercise adherence. The only variable definitely identified herein to play a decisive regulatory role in post-exercise levels of mood and enjoyment is the subjective exercise intensity. Identifying the limits wherein aerobic exercise retains its psychologically beneficial potential and sensitizing program instructors in applying such guidelines would be an advancement of tremendous practical value.

In conclusion, two more general suggestions seem in order: (a) Methodological considerations to date have focussed almost exclusively on research designs, while another major problem lies in the inconsistency between current level of theorizing in the area of affect and commonly employed measures. The operationalization of mood and affect must reflect our conceptual definitions (Gauvin & Brawley, 1993). Otherwise, we run the risk of utilizing psychometric instruments which lack construct validity in an exercise setting (Rejeski, Hardy & Shaw, 1991). (b) The persisting lack of a broader theoretical framework for the role of Exercise Psychology may hinder or misdirect the development of the field or dramatically restrict its scope to the level of mere description. It is the contention of these authors that Exercise Psychology must be viewed as a health-oriented field, which addresses the issue of human psychosomatic well-being, through a genuinely multi-disciplinary approach.

## REFERENCES

- Biddle, S., & Mutrie, N. (1991). *Psychology of physical activity and exercise* (pp. 3-23). London: Springer-Verlag.
- Borg, G.A.V., & Noble, B.J. (1974). Perceived exertion. *Exercise and Sport Science Reviews*, 2, 131-153.
- Bortner, R.W. (1969). A short rating scale as a potential measure of pattern A behavior. *Journal of Chronic Diseases*, 22, 87-91.
- Crowne, D.P., & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology*, 24, 349-354.

- Gauvin, L., & Brawley, L.R. (1993). Alternative psychological models and methodologies for the study of exercise and affect. In P. Seraganian (Ed.), *Exercise psychology: the influence of physical exercise on psychological processes* (pp. 146-171). New York: Wiley & Sons.
- Graziano, A.M., & Raulin, M.L. (1989). *Research Methods: a process of inquiry* (pp. 225-237). New York: Harper & Row.
- Grove, J.R., & 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.
- Hughes, J.R. (1984). Psychological effects of habitual aerobic exercise: a critical review. *Preventive Medicine*, 13, 66-78.
- Jamieson, J.L., & Flood, K.R. (1993). Experimental versus observational research methodologies. In P. Seraganian (Ed.), *Exercise psychology: the influence of physical exercise on psychological processes* (pp. 218-233). New York: Wiley & Sons.
- Kendzierski, D., & DeCarlo, K.J. (1991). Physical Activity Enjoyment Scale: two validation studies. *Journal of Sport and Exercise Psychology*, 13, 50-64.
- Maroulakis, E., & Zervas, Y. (1993). Effects of aerobic exercise on mood of adult women. *Perceptual and Motor Skills*, 76, 795-801.
- McCready, M.L., & Long, B.C. (1985). Locus of control, attitudes toward physical activity, and exercise adherence. *Journal of Sport Psychology*, 7, 346-359.
- McNair, D.M., Lorr, M., & Droppleman, L.F. (1971). *Manual of the Profile of Mood States*. San Diego, CA: EDITS.
- Morgan, W.P. (1987). Reduction of state anxiety following acute physical activity. In W.P. Morgan & S.E. Goldston (Eds.), *Exercise and mental health* (pp. 105-109). Washington: Hemisphere.
- Morgan, W.P., & O'Connor, P.J. (1988). Exercise and mental health. In R.K. Dishman (Ed.), *Exercise adherence: its impact on public health* (pp. 91-121). Champaign, IL: Human Kinetics.
- Petruzzello, S.J., Landers, D.M., Hatfield, B.D., Kubitz, K.A., & Salazar, W. (1991). A meta-analysis of the anxiety-reducing effects of acute and chronic exercise: outcomes and mechanisms. *Sports Medicine*, 11, 143-182.
- Pjeaski, W.J., Hardy, C.J., & Shaw, J. (1991). Psychometric confounds of assessing state anxiety in conjunction with acute bouts of vigorous exercise. *Journal of Sport & Exercise Psychology*, 13, 65-74.
- Rippe, J.M., Wilkie, S.O., Hanley, S., Freeson, P., Zwiren, K., Kalme, D., Crawford, B., & Ward, A. (1987). Validity of estimating VO<sub>2</sub> max in women from submaximal bicycle ergometer tests using measured and age-adjusted maximal heart rate. *Journal of Cardiopulmonary Rehabilitation*, 7.
- Shacham, S. (1983). A shortened version of the Profile of Mood States. *Journal of Personality Assessment*, 47, 305-306.
- Spielberger, C.D., Gorsuch, R., & Lushene, R. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists.
- Tuson, K.M., & Sinyor, D. (1993). On the affective benefits of acute aerobic exercise: taking stock after twenty years of research. In P. Seraganian (Ed.), *Exercise psychology: the influence of physical exercise on psychological processes* (pp. 80-121). New York: Wiley & Sons.

# **ACTAS**

## ***PROCEEDINGS***

**VIII CONGRESSO MUNDIAL DE PSICOLOGIA DO DESPORTO**

***VIII WORLD CONGRESS OF SPORT PSYCHOLOGY***

**Psicologia do Desporto: uma perspectiva integrada**  
***Sport Psychology: an integrated approach***

**Lisboa/Lisbon, 22-27, Junho/June, 1993**

**International Society of Sport Psychology**  
**Sociedade Portuguesa de Psicologia Desportiva**

**Faculdade de Motricidade Humana (Universidade Técnica de Lisboa)**

**EDITORES/EDITORS:**

**Sidónio Serpa**

**José Alves**

**Vítor Ferreira**

**António Paula-Brito**