

The effects of exercise on mood changes: the moderating effect of depressed mood

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Background. The present study examined the extent to which pre-exercise depressed mood moderated the influence of exercise on changes in other mood dimensions. The study was conducted in an ecologically valid setting using participants with previous experience of aerobic dance exercise. We hypothesized that (a) exercise will be associated with improved mood regardless of depressed mood, (b) the effect of exercise on mood changes would be significantly greater among individuals that reported symptoms of depressed mood before exercise, and (c) that pre-exercise depressed mood will be associated with a mood profile comprising high anger, confusion, fatigue, and tension, with low vigor.

Methods. Participants were 80 (M=27.90 years, SD=4.32 years) exercisers who had attended an exercise class on a regular basis for the previous three months. Participants completed the Profile of Mood States-A 15 minutes before exercise and then immediately after an aerobic dance exercise class. To examine the proposed moderating influence of depressed mood, participants were grouped into either a no-depression group, or a depressed mood group using pre-exercise depression scores. The exercise intervention was an aerobic dance session where participants followed the moves of the instructor. The session lasted for 60 minutes including a warm-up, main session, and cool-down.

Results. Repeated measures MANOVA (time x depression/no-depression group) results indicated that anger, confusion, fatigue, tension, and vigor reduced significantly. Thus supporting the notion that exercise reduces negative mood. Results indicated that the reduction in anger, confusion, fatigue, and ten-

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sion, and increase in vigor was significantly greater in the depressed mood group, hence consistent with theoretical predictions. Results demonstrated that pre-exercise depressed mood was associated with a negative mood profile as hypothesized.

Conclusions. Findings lend support to the notion that exercise is associated with improved mood. However, findings show that this effect was significantly greater among individuals reporting symptoms of depressed mood before exercise.

KEY WORDS Depression - Mental health - Exercise, physiology - Mood disorders.

There has been an increase in research to examine the influence of exercise on changes in mood.¹⁻⁷ Using the Profile of Mood States (POMS),⁸ the general trend in research findings indicates that exercise has a mood enhancing effect. This mood-enhancing effect is typified by increased vigor and reduced anger, confusion, depression, fatigue, and tension.^{2,3,6} A limitation to the generalizability of these findings is that they have not been unequivocally supported. To date, research has tended to focus on the type of exercise (running, yoga, swimming, aerobic dance^{3,4}), and the intensity of exercise^{4,8,9} (*i.e.* the percentage of the maximum heart rate, or whether the exercise was aerobic

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or anaerobic in nature). The present study examined the extent to which mood changes following exercise are influenced by the presence or absence of depressed mood before exercise. Specifically, we focus on the influence of exercise on changes in other moods in depressed and non-depressed exercisers. The rationale for examining mood in this way is based on a recent conceptual model on the nature of mood.^{10,11} The present study extends proposals made in Lane and Terry's^{10,11} conceptual model by examining mood changes in an exercise setting.

The present study tests three hypotheses. First, we hypothesize that aerobic dance exercise will be associated with improved mood. Second, we hypothesize that aerobic dance exercise will have a significantly greater mood enhancing effect among individuals reporting symptoms of depressed mood before the exercise class starts. Third, we hypothesize that pre-exercise depressed mood will be associated with a negative profile comprising increased anger, confusion, fatigue, tension, and reduced vigor.^{10,11}

Our hypotheses are grounded in attempts to resolve issues regarding the equivocality of findings on the influence of exercise on mood.^{1-3,9,12,13} Kennedy and Newton¹² found that running at a relatively high intensity had a greater effect on fatigue and anger than running at a relatively low intensity. By contrast, Berger *et al.*¹³ found that swimming shorter distances are preferable to long distances when mood enhancement is a goal. Dyer and Crouch¹⁴ found that while a bout of exercise improved the mood of those who exercised regularly through running, the mood states of those who did not run regularly did not change significantly.

Equivocal research findings for mood changes following exercise might be influenced by methodological issues. Research to examine the effect of exercise on mood changes has typically used experimental conditions or *quasi* experimental conditions.^{3,9} In such research, the type of exercise is prescribed by the researcher. Also, in experimental research the sample recruited was for research purposes. Thus, participants do not necessarily take part in the exercise used as the intervention to examine mood changes for personal benefits such as enjoyment or health related reasons.

Research has found that individuals vary in the extent to which they feel that exercise can be used as a strategy to bring about improved mood.¹⁵ For exam-

ple, Thayer *et al.*¹⁵ found that 44% of a sample from the general population reported that exercise was the most frequently used and most effective strategy to regulate mood. This finding has been reported as evidence demonstrating the mood-enhancing effect of exercise.¹⁶ However, an alternative way of interpreting the results of Thayer *et al.*¹⁵ is that they also show that 56% of the sample did not use exercise to regulate mood. It is suggested that individuals who use exercise for mood-enhancement have experienced positive mood following exercise, and *viceversa*. Experimental research showing mood-enhancing effects from exercise might be a function of the sample comprising participants who use that type of exercise to regulate mood. A process that is reversed for non-significant findings.

It is suggested that research should control for the amount of previous experience that participants have had in taking part in the exercise session used as an intervention to examine mood changes. Logically, individuals who exercise on a regular basis believe that the benefits of exercise outweigh the effort made to complete the exercise session.

In the present study, we focus on mood changes following exercise in depressed and non-depressed exercisers having accounted for previous experience. Lane and Terry^{10,11} proposed that depressed mood is associated with increased anger, confusion, fatigue, and tension, with reduced vigor. Given the widespread usage of the term depression, some explanation of it is needed. Lane and Terry^{10,11} talk about depressed mood rather than clinical depression. Mood is a continuous construct on which clinical mood disturbance is at one end, and depressed mood is somewhere in the middle.¹⁷

Lane and Terry^{10,11} proposed that depression is the most important mood dimension because of the demotivating nature of the depression construct. Depressed mood has been characterized by themes of sadness, worthlessness, and self-blame.^{18,19} Lane and Terry argued that researchers should use a scale that assesses relatively independent markers of depression and divide the sample into a "depressed mood" and "no-depression" group. Lane and Terry¹¹ proposed that symptoms of depressed mood, however small, have a powerful impact on other mood dimensions.

Consistent with theoretical proposals, research has demonstrated that the depressed mood is associated with

significantly higher anger, confusion, fatigue, and tension, with lower vigor scores before competitive sport.²⁰⁻²³ Depressed mood is proposed to derive from the process of attributing failure to achieve important goals to internal factors such as lack of ability.^{18,19} According to Lane and Terry,¹¹ anticipated thoughts of failure to attain performance goals lead to depressed mood in the pre-competition period. To date, the conceptual model^{10,11} of the influence of depressed mood on other mood dimensions has not been tested in an exercise setting.

In the present study, we extend examination of Lane and Terry's conceptual model through investigating the influence of exercise on mood changes in depressed and non-depressed exercisers. We propose that exercise will have a significantly greater mood-enhancing effect in the depressed mood group. Previous research has supported the notion that exercise is an effective method of reducing depressed mood.^{2,3,5,9} In the present study, it is suggested that the depressed mood group will perceive completing an exercise class to be a greater achievement than the no-depression group, and this will be evidenced through greater changes in mood. The rationale for this proposal is based on the notion that a mechanism through which exercise leads to improved mood is through exercise fostering a sense of achievement.

At least two different factors are proposed to influence the extent to which exercise fosters a sense of achievement in the present study. The first factor is that participants should see achievement in terms of completing the exercise session. It is important to recognize the notion of relative achievement in the context of an aerobic dance exercise setting, which is the type of exercise used in the present study. The activity of aerobic dance requires the individual to follow the movements of the instructor. Thus movement patterns that are performed are largely determined by the instructor, and therefore the pace of the exercise is relatively external of the individual. This contrasts with exercise sessions such as circuit training where the number of repetitions performed at each station is individually determined. In exercise types that are internally paced, it is easier for the individual to set performance goals, and judge achievement through goal attainment. Consistent with previous research in sport,²⁰⁻²³ it is suggested that depressed individuals would fail to attain their performance goals, and that this would lead to increased negative mood. Thus for exercise to lead to improved mood in the depressed

mood group, the exercise experience should be free of interpersonal competition.

A second factor that contributes to exercise fostering a sense of achievement is the participants previous experience of the exercise session. The relative difficulty of aerobic dance is reduced if the individual has sufficient experience with the instructor. Given sufficient experience, it is likely that he/she could follow the moves of the instructor. Previous experience of successfully completing the exercise session is especially important for individuals who report depressed mood before exercise. Low coping ability associated with depressed mood is suggested to magnify the perceived difficulty of the task. Thus depressed individuals will tend to perceive the task of completing the aerobic dance exercise session is more difficult than usual. It is suggested that completing the exercise session when feeling depressed will produce a greater sense of achievement, and consequently this will be associated with improved mood.

Collectively, the extent to which pre-exercise depressed mood influences changes in other mood dimensions is unknown. The present study investigated the influence of exercise on changes in other moods in depressed and non-depressed exercisers.

Materials and methods

Participants

Eighty volunteers participated in this study (age: $M=27.90$ years, $SD=4.32$ years, male=37; female=43). All participants had some experience of aerobic dance sessions, ranging from 3 months to 2 years ($M=1.0$ years; $SD=1.35$ years). To ensure relatively homogeneity in terms of previous experience of the exercise session used in the present study, an inclusion criterion was set so that participants had to have attended the exercise class at least once per week for the previous three months. Thus participants were familiar with the exercise routine and the exercise instructor.

Two different steps were taken to ensure that previous experience of the exercise session related to the session used as the intervention to assess mood changes. The first is the aerobics class chosen as the intervention took place at the same time of day and the same day each week. Second, the same music was used to accompany each aerobics session as Karageorghis and Terry²⁴ argued music might mediate the influence of exercise on mood changes.

Exercise intervention

The aerobic dance session lasted for 60 minutes including a warm-up, main session, and cool-down. The session involved an instructor performing to the class from the front. Participants followed the moves of the instructor. The warm-up comprised exercises designed to raise heart rate such as dance steps and walking. This was followed by a stretching routine. The main session involved rhythmic movements such as stepping, lunges, knee lifts, bicep-curls in addition to basis dance steps. It was designed to raise heart rate so that individuals exercised between 50 to 70% of their heart rate maximum. An accepted limitation of the present study was that no physiological markers of exercise intensity were taken. It also included a section designed to increase abdominal muscle strength. The cool-down included a series of stretching and rhythmic breathing exercises.

Measure of mood

Mood was assessed using the 24-item profile of mood states-adolescents (POMS-A²⁵). The POMS-A was chosen as the measure of mood for four reasons. First, it was validated on samples of athletes whereas other mood scales, such as the original POMS⁸ were developed for use with student or psychiatric populations. Second, it was validated for use with a British population, hence an appropriate group to the sample used in the present study. The original POMS⁸ has a North American orientation with items such as "Blue" and "Bushed" which are expressions not commonly used in Britain. Third, brevity was an important consideration as mood was assessed shortly before and after an exercise class. The completion time of a psychometric questionnaire is a function of the number of items and the difficulty of items.^{25,26} As the POMS-A has been validated so that individuals as young as 11 years old can understand the items, adults should have little difficulty.

Fourth, the POMS-A has been subjected to a rigorous validation process. Terry *et al.*²⁵ reported confirmatory factor analysis of the POMS-A which supported the factorial validity of a 24-item six-factor model using both independent and multisample analyses. They also reported correlations of POMS-A scores with previously validated inventories, which were consistent with theoretical predictions and thus provided evidence of criterion validity. Recent research has sup-

ported the predictive validity of this measure among adult athletes, to the extent that POMS-A scores significantly predicted athletic performance.²¹⁻²³

The POMS-A inventory assesses six mood constructs: anger, confusion, depression, fatigue, tension, and vigor. Examples of anger items include "furious" and "bad-tempered", confusion items include "muddled" and "uncertain", depression items include "unhappy" and "downhearted", fatigue items include "worn out" and "tired", tension items include "panicky" and "worried", and vigor items include "alert" and "energetic". Items are rated on a 5-point scale anchored by 0 ("not at all") to 4 ("extremely").

Scores on the POMS-A were converted to T-scores using tables of normative data from adult athletes.²⁰ Transforming raw scores to T-scores is desirable to facilitate comparisons with an appropriate reference group.²⁶

Depressed mood and no-depression groups

To examine the effect of depression mood on mood changes, participants were grouped into either a no-depression group (N=28) or a depressed mood group (N=52; M=65.31, SD=10.33) using pre-exercise depression scores. Depression on the POMS-A is assessed through asking participants how they feel "right now" in relation to the four items "depressed", "downhearted", "unhappy", and "miserable". Lane and Terry²⁵ argued that depressed mood should be split into a no-depression group and depressed mood group on the basis of scores on the POMS-A (Terry *et al.*²⁵). Thus the no-depression group comprised individuals who reported zero for each item and the depressed mood group comprised individuals who reported 1 or more.

As the purpose of the present study was to test mood changes in an ecologically valid setting, no mood manipulation strategies were employed. Participants were divided into two naturally occurring groups on the basis of pre-exercise depressed mood scores. Previous research using the POMS-A has found that a score of zero is the mode for symptoms of depressed mood.²⁰ As the participants were drawn from the general population rather than a clinical population, it is reasonable to expect scores of depressed mood to be at the low end of a scale which ranges from 0 to 16.^{7,27} An accepted limitation is that participants were not screened for individuals currently undergoing treatment for clinical depression.

TABLE I.—A comparison of mood over time between depressed mood and no-depressed mood group.

Parameters	Pre-exercise mood		Postexercise mood		Depressed mood $F_{1,78}$ (Eta ²)	Time $F_{1,78}$ (Eta ²)	Interaction $F_{1,78}$ (Eta ²)
	M	SD	M	SD			
Anger					3.26 (0.04)	24.44* (0.24)	36.72* (0.32)
No-depression	47.84	7.56	48.90	11.40			
Depressed mood	56.60	9.48	46.09	2.70			
Confusion					29.93* (0.28)	26.84* (0.26)	26.83* (0.26)
No-depression	43.81	2.26	43.81	3.14			
Depressed mood	54.09	8.61	44.62	3.89			
Fatigue					14.68* (0.16)	1.73 (0.02)	15.87* (0.17)
No-depression	50.15	9.50	53.52	11.28			
Depressed mood	63.80	11.96	57.10	9.80			
Tension					11.83** (0.13)	18.55* (0.19)	18.55* (0.19)
No-depression	39.12	4.08	39.11	4.08			
Depressed mood	50.42	14.80	40.91	3.93			
Vigour					1.00 (0.01)	9.78** (0.11)	7.45** (0.09)
No-depression	49.77	9.01	44.37	8.81			
Depressed mood	45.69	8.08	45.32	5.27			

* $p < 0.001$; ** $p < 0.01$. Depression Group Pillais_{5,73} = 0.33, $p < 0.001$, effect size = 0.34. Time Pillais_{5,73} = 0.38, $p < 0.001$, effect size = 0.38. Interaction Pillais_{5,73} = 0.44, $p < 0.001$, effect size = 0.44.

Procedure

Aerobic dance instructors and leisure centers were contacted to ascertain the viability of the study. Participants were asked if they would participate in a research program to investigate how individuals feel before and after exercise. Participants were recruited to the study when they inquired about enrolling for the exercise class.

Participants completed the POMS-A²⁵ within 15 minutes of exercise and then immediately after exercise session using the response set "How are you feeling right now?" Data were analyzed using a two factor (time x depressed mood/no-depression groups) repeated measures MANOVA. Alpha was set at $p < 0.05$. Prior to analysis, data were examined for normality. One case was shown to be a multivariate outlier using the mahalanobis distances method and was removed from the data set. This case showed a maximum score on each subscale before exercise.

Results

The Bartlett test of sphericity indicated (103.32, $p < 0.001$) that the variance within the groups were not equal suggesting using the Pillais value which is a more conservative statistic. MANOVA results are presented in Table I. As Table 1 indicates, a repeated mea-

asures factorial MANOVA of mood scores (time x depressed mood/no-depression groups) indicated a significant group x time interaction effect (Pillais_{5,73} = 0.77, $p < 0.001$; effect size = 0.44), a significant main effect for depression (Pillais_{5,73} = 0.33, $p < 0.001$; effect size = 0.34) and a significant main effect for mood changes over time (Pillais_{5,73} = 0.38, $p < 0.001$; effect size = 0.38). Significant interaction effects were found for scores of anger ($F_{1,78} = 36.73$, $p < 0.001$; $\eta^2 = 0.32$), confusion ($F_{1,78} = 26.83$, $p < 0.001$; $\eta^2 = 0.26$), fatigue ($F_{1,78} = 15.87$, $p < 0.001$; $\eta^2 = 0.17$), tension ($F_{1,78} = 18.55$, $p < 0.001$; $\eta^2 = 0.19$), and vigor ($F_{1,78} = 7.45$, $p < 0.01$; $\eta^2 = 0.09$). The differences indicated that the reduction in anger, confusion, fatigue, and tension, and increase in vigor was significantly greater in the depressed group.

The depressed mood main effect was attributed to the differences between the groups in scores of confusion ($F_{1,78} = 29.93$, $p < 0.001$; $\eta^2 = 0.28$), fatigue ($F_{1,78} = 14.68$, $p < 0.001$; $\eta^2 = 0.16$) and tension ($F_{1,78} = 11.83$, $p < 0.01$; $\eta^2 = 0.13$). The differences indicated that the depression group reported higher scores on confusion, fatigue, and tension across the two time periods (Table I).

For mood changes over time, univariate differences were evidenced for Anger ($F_{1,78} = 24.44$, $p < 0.001$; $\eta^2 = 0.24$), confusion ($F_{1,78} = 26.84$, $p < 0.001$; $\eta^2 = 0.26$), tension ($F_{1,78} = 18.55$, $p < 0.001$; $\eta^2 = 0.19$),

and vigor ($F_{178}=9.78$, $p<0.01$; $\eta^2=0.11$). Differences indicated that anger, confusion, fatigue, and tension, and vigor reduced significantly. A paired samples "t"-test indicated that depression scores reduced significantly ($T=8.36$, $p<0.001$), although further analysis indicated that depressed mood group reported significantly ($p<0.01$) higher post-exercise depression scores than the no-depression group.

Discussion

The present study examined the influence of exercise on mood changes in depressed and non-depressed exercisers. It was theory-driven testing three hypotheses. In support of the first hypothesis that exercise influences mood regardless of depressed mood, results show a significant effect for the influence of exercise on mood changes. This result is consistent with previous research showing that exercise reduces negative mood.^{1-6,9} It is suggested that the reduction of negative mood from exercise can be attributed to at least two factors. The first relates to the nature of aerobic dance exercise. The second relates to using participants who were homogeneous in terms of taking part in the exercise session used as the intervention.

The aerobic dance exercise session was relatively free of interpersonal competition. Berger and Molt³ emphasized that if mood-enhancement is the goal, the exercise session should be free of interpersonal competition. Previous research has found that losing performance is associated with negative mood.¹ Berger and Molt³ proposed that competition tends to emphasize the end-product of winning rather than the process of taking part in the exercise for enjoyment or health related benefits. In the present study, improved mood following exercise suggests that completing an exercise class where the movements are externally paced fosters a sense of achievement.

It is suggested that improved mood following exercise might also have been a function of the sample used. The sample used in the present study were experienced exercisers having participated in the exercise session used as the intervention on a weekly basis for the previous three months. This suggests that participants were familiar with the routine of the instructor.

When individuals understand the relative difficulty of the exercise session this can facilitate feelings that the individual can cope with its demands. If participants are to learn to enjoy the exercise experience, the exer-

cise session should be free of competition and individuals should feel that they can cope with the demands of the task.

The second hypothesis tested proposed that the effect of exercise on mood changes would be significantly greater among individuals that reported symptoms of depressed mood before exercise. In support of this hypothesis, results indicated that the depressed mood group reported significantly greater mood changes. It was evident that the reduction in anger, confusion, fatigue, and tension with an increase in vigor was significantly greater in the depressed mood group.

The third hypothesis tested the influence of pre-exercise depressed mood on the intensity of other mood dimensions. Consistent with theoretical predictions for the relationship between depression and other mood dimensions, results show that the depressed mood group reported significantly higher anger, confusion, fatigue, tension, with reduced vigor. This finding concurs with the influence of depressed mood on other mood dimensions in competitive sport.^{0,23}

Findings of the present study show that exercise might be a useful method of improving mood for individuals feeling depressed mood. A limitation of this proposal is that the stability of improved mood from exercise is unknown. We suggest that there is need for further research to examine the longevity of the effects of exercise on mood. Previous research has found evidence to suggest that exercise is an effective strategy for treating clinically depressed individuals.^{2,5,6}

Previous research has found that exercise is the most effective mood regulating strategy. Findings from the present study showing that exercise had a significantly greater mood-enhancing effect in the depressed mood group could be attributed to participants using exercise as a mood-regulating strategy. It is possible that depressed individuals chose to go to an exercise class to regulate this negative mood. If individuals chose to attend an exercise session to regulate feeling of depressed mood, inferences on the severity of the depression experienced can be made. Clinical depression is proposed to be associated with a perception by the individual that he/she has no or little control of environmental factors.¹⁹ Thus in the present study, it is suggested that participants experienced a transitory depressed mood rather than clinical depression. Further, it is suggested that depressed mood in the present study was likely to have been caused by lifestyle issues

such as daily hassles.²⁸ Exercise served to direct attention from these hassles through focusing on the demands of the exercise session, thus reducing the negative focus associated with depressed mood.

The notion that participants use exercise to regulate mood can also be used to explain mood changes in the no-depression group. In the no-depression group, participants might anticipate the effects of exercise before the session and report a profile typified by low anger, confusion, fatigue, and tension. In such cases, exercise served to maintain a positive mood.

Two interrelated lines of research are suggested for future research. The first is that the mechanisms through which individuals learn to use exercise to improve mood should be investigated. This would involve an intra-individual design in which mood changes following exercise are examined over time would be assessed. Second, the influence of depressed mood on changes in mood following exercise should be investigated in a number of different types of exercise.

Conclusions

Collectively, findings support the notion that exercise is an effective predictor of mood changes, and in the present study, the mood enhancing effect of exercise is enhanced among individuals reporting symptoms of depressed mood before exercise. It is suggested that exercise is an effective strategy to bring about improved mood among participants reporting symptoms of depressed mood.

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