The Effects of Time-Incremented Running on Mood State of College Athletes

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The hypothesis that time-incremented running is a factor affecting mood state was tested on 41 members of men’s and women’s college track teams. Mood Thermometers (Tuckman, 1988) measured the difference in tension, anger, depression, fatigue, and confusion immediately before and right after running sessions of 0, 15, 30, or 45 min. Completely randomized 2 × 4 (Sex × Length of Running Time) analyses of variance indicated a significant decrease in running groups as compared to the no-run group in women in terms of depression, tension, and confusion. Men did not show significant improvements in any of these areas and, in fact, showed significantly greater confusion following a running session of 45 min.

Research in the latter half of this century has provided increasing documentation regarding the beneficial effects of regular exercise on physical health. For example, Donoghue (1977) reviewed studies concerning exercise in relation to employment and noted a decrease in sickness, absenteeism, and errors on the job with an increase in regular exercise. More recent research attempted to identify potential psychological benefits that also may be related to regular exercise. As noted by Kirkcaldy and Shephard (1990) and Hinkle (1992), numerous problems arise in attempting to evaluate the effects of exercise on psychological mood ranging from the definition of exercise to selection of scales of measurement and potential impact of participant variables. Both reviews conclude, however, that despite the technical problems, sound evidence now exists indicating that regular physical activity is also beneficial to psychological health.

Many early studies used pathologically depressed or anxious participants and attempted to generalize the results to the normal population (Kirkcaldy & Shephard, 1990; McGowan, Pierce, & Jordan, 1991). Subsequent studies were expanded to assess the extent of improved psychological mood on various subgroups of the normal population. The accumulation of ongoing research should help fitness experts design and implement programs of exercise that will provide both physical and psychological benefits to participants with minimal risk. Hinkle (1992) provided a review of the current aerobic running research for both adult and child populations and noted the positive implications of exercise both as a treatment tool and as a contribution to psychological fitness.

Although there seems to be little doubt that exercise is beneficial for mental health, the mechanism by which this is accomplished remains unclear and may ultimately defy parsimonious solution. For example, Kirkcaldy and Shephard (1990) noted that exercise may be a factor contributing to increased levels of the mood-altering neurotransmitters, enkephalin and beta-endorphins. These neurotransmitters may be responsible to some extent for a decrease in pain sensation and autonomic reaction to stress as well as an increase in a sense of self-efficacy. In contrast, Estivill (1995) hypothesized that “participants achieved a pleasantly altered state of consciousness and respite from depression and stress . . .” (p. 341) similar to spiritual practices and that aerobic exercise provided a sense of virtuousness that tied into the traditional “work-ethic religion” (p. 348). On the other hand, the extent that one experiences improved positive affect during exercise may be related to the
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cohesiveness of the group in which an individual participates (Courneya, 1995). Still another potentially powerful element in evaluation of improved mood state is the implication that there is a strong placebo or expectancy effect that enhances the perceived improvement in one’s sense of well-being (Deshardnais, Jobin, Côté, Lèvesque, & Godin, 1993). Considering this wide array of hypotheses, it may be reasonable to assume the effects that exercise exerts on mental health may be very complex and involve several pathways.

Studies of exercise and mood state can be divided into two major areas. Some researchers have examined psychological effects of regular exercise over an extended period of time. Other researchers have studied the acute effects of a single bout or session of exercise. Within each category, some studies have compared nonaerobic exercise with aerobic activity; other studies have compared aerobic activity with control groups involved in nonexercise activities; a few studies have used aerobic exercise, nonaerobic activity, and nonexercise groups. To clarify, aerobic involvement is defined as exercising at an intensity of 60 to 90% of maximal heart rate (HR; estimated maximal HR = 220 – age) or exercising at an intensity of 50 to 85% of VO\textsubscript{2max} (maximum oxygen consumption in 1 min). One simple way to calculate an estimate of VO\textsubscript{2max} is: HR reserve = 220 – age – resting heart rate; 50 to 85% × HR reserve + resting heart rate = desired target VO\textsubscript{2max} intensity (American College of Sports Medicine, 1995).

Results of studies conducted over extended periods of time have often been contradictory. For example, in a 1986 study Hughes, Casal, and Leon used treadmill walking, which raised mean HR of participants to 55% of maximum, followed by stair climbing, which raised mean HR of participants to 82% of maximum, and found no improvement in anger, tension, confusion, depression, fatigue, or total mood disturbance over a period of 12 weeks. In another study that provided for aerobic exercise at a level of 60 to 70% maximum HR, Williams and Getty (1986) compared the effects of 10 weeks of jogging or aerobic dance against 10 weeks of nonaerobic recreational games. When compared to the recreational games group, the aerobic groups showed increased improvement in physical fitness and had less anger, but they did not reflect significant improvement in mood states.

In contrast, Simons and Birkimer (1988) conducted an 8-week study and found that all of their exercise groups (jog, walk-jog, brisk walk, and mild walk), regardless of aerobic level, showed significant improvement in mood state, whereas their sedentary control group did not. In addition, rate of improvement was not dependent on initial physical fitness. Rate of improvement was most pronounced in those whose pretesting indicated the most psychological disturbance. They also found no correlation between cognitive variables relating to physical status, beliefs about exercise, enjoyment of exercise, or satisfaction with exercise.

In another contrasting example, Moses, Steptoe, Mathews, and Edwards (1989) proposed that positive mood affect is achieved simply by physical activity without the need for aerobic fitness. They conducted a program that included a 10-week walk-jog or discontinuous exercise at three levels of target HR. In direct conflict with Williams and Getty (1986), who found no improvement using 60 to 70% maximum HR, significant positive psychological improvement was found by Moses et al. (1989), but only for the moderate (60% of maximal HR) group. This result indicated the presence of an aerobic component to mood improvement and supported their hypothesis that vigorous physical activity was more important than improvement in aerobic fitness (which would be achieved by regular exercise at a higher rate of a person’s maximum VO\textsubscript{2} capacity).

A third contrasting example is found in a 6-week study comparing moods of college-age runners, aerobic dancers, and weight lifters conducted by Dyer and Crouch (1988). Dyer and Crouch concluded that exercise may help cope with stress. Their research found in a comparison from early to midsemester, aerobic dancers and runners had a significantly more positive mood profile than nonexercisers and a somewhat more positive profile than weight lifters. In addition, runners increased in vigor and decreased in confusion, whereas weight lifters experienced the opposite effect.

In an effort to identify the components that contribute to improved mood, many researchers examined the effects of a single bout of exercise. As with long-term studies, these studies are also plagued with methodological problems, as well as some contradictory results. Yeung (1996) compiled an excellent review of the current literature on single-session studies. Of the 23 studies he reviewed and classified as “experimental design” (which required a control group composed of randomly assigned participants), 18 showed mood improvement of the experimental group as compared to the control group on at least one measure, whereas 5 reported no change in mood state. Yeung also reviewed 18 “quasi-experimental design” studies and reported results showing improvement on at least one measure of mood state in 17 of the studies. These two blocks of studies used aerobics, swimming, fencing, running, weight training, sports,
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karate, walking, racquetball, tennis, cycling, or mixed exercises for the experimental activity. These activities were compared against quiet rest, lecture, yoga, clerical work, sugar snack, massage, eating lunch, relaxation, discussion group, reading, cognitive task, no exercise, or low-level cycling.

Likewise, Tooman (1982, as cited in Harris, 1987) found significant main effects for improved state anxiety and reduced anger, tension, depression, and confusion in both competitive and recreational runners from prerun to postrun testing. It is interesting to note that the competitive runners had more positive moods on all of the subscales measured both before and after the run.

In another single-bout study, Roth (1989) compared mood level changes between very active and markedly inactive college-age participants using a bicycle ergometer for testing while maintaining the participants’ aerobic level of exertion via heart rate checks and appropriate workload adjustments. In apparent contradiction to Tooman’s (1982, as cited in Harris, 1987) observations, Roth found that neither prior activity level nor sex yielded better mood states prior to the exercise test and that the active and inactive participants of both sexes experienced acute reductions in anxiety and tension following a single bout of exercise. At the same time, Roth’s quiet resting control group failed to improve, demonstrating that exercising appears to be more effective than a time-out for reducing anxiety. When considering the contradictions between these studies, it should be noted that Tooman had no inactive control group or sedentary participants and that Roth, on the other hand, compared active to inactive participants, which included no competitive-level athletes. The use of different types of participants may have contributed to the difference in conclusions that were drawn.

Addressing the effects of one 45-min session of vigorous HR-monitored aerobic exercise on mood disturbance of volunteers, Barabasz (1991) found significant improvement in total mood disturbance of the aerobic group, as compared to the control group which quietly viewed a 45-min aerobics videotape. Similar results were obtained by McGowan et al. (1991) who tested college-age participants in a 75-min activity class which included aerobic-level measures. Running and weight lifting participants reported a significant reduction in mood disturbance, whereas the karate and lecture class participants did not.

Both Choi, Van Horn, Picker, and Roberts (1993) and Maroulakis and Zervas (1993) examined the effects of one session of an aerobic class on adult women from college age to 55 years using self-measured pulse to maintain 60 to 80% maximal HR. Maroulakis and Zervas noted mood improvement regardless of morning or afternoon sessions and additionally found some of the improved state to persist 24 hr after the exercise was performed. Choi et al. (1993) found increased positive mood, decreased negative mood, and decreased fatigue in both high- and low-exercise frequency volunteers.

In a study using both competitive amateur male athletes and inactive men riding a cycle ergometer, Steptoe, Kearsley, and Walters (1993) found no differences between two groups, one of which was controlled to exercise at 50% of VO\textsubscript{2max} and the other at 70% of VO\textsubscript{2max}. Both groups showed increases in mental vigor and exhilaration responses when tested 1 min after exercising. In addition, some of the increase in exhilaration was still evident in a posttest conducted 30 min after exercise.

It is apparent from the available research that both running and other forms of aerobic exercise have similar effects on self-reported improvement of mood state. Studies on the long-term effects are not consistent in reporting improved mood state; in contrast, research studying the effects of a single bout of exercise has suggested that a positive mood improvement can result (Yeung, 1996). It appears, however, that little research has been conducted that attempts to determine the length of time, in one session of physical activity, that is required to show a positive improvement. It is also interesting to note that in two unpublished studies (Stephens, 1988; Morris & Salmon, 1988; both as cited in Choi et al., 1993) it was found that the positive association between physical activity and mood state is stronger in women than in men. This comparison was not addressed in other research cited.

The purpose of this study is to examine the effects of a single bout of running of different lengths of time on anger, fatigue, tension, confusion, and depression in competitive-level athletes. It is hypothesized that as the length of running time increases, the degree of mood improvement will increase for both men and women.

**Method**

**Participants**

Twenty men and 21 women aged 18 to 23 from a university track team (who generally run from 19 to 37 km per week) volunteered to participate. One male participant suffered minor injuries during his run and was excluded from test results. All participating track members raced long-distance events. Some of the volunteers were also enrolled in undergraduate psychology courses and received course credit for participating in the experiment. Participants were treated
in accordance with the “Ethical Principles of Psychologists and Code of Conduct” (American Psychological Association, 1992).

Materials

Mood state was measured with self-reporting Mood Thermometers (Tuckman, 1988) to quantify tension, confusion, anger, fatigue, and depression. The instrument involves a combination of Thurstone scaling and magnitude estimation and was originally designed as a simple, more direct measure of mood to be used with adolescents. To disguise the intent of the measurement, additional scales were devised and added for confidence, physical state, hunger, and thirst.

Procedure

Testing was conducted on 2 separate days, one for the women’s team and one for the men’s team. Within each team, participants were randomly assigned to one of four groups consisting of the following levels: Group 1 sat for 45 min; Group 2 sat for 30 min and then ran for 15 min; Group 3 sat for 15 min and ran for 30 min; and Group 4 ran for 45 min. During the sitting session, participants were allowed to study, read, or converse. The runners were advised to run at their normal team practice pace. All but one of the participants ran with members of the group to which they were assigned.

The mood thermometer questionnaire was administered immediately before and right after the 45-min sit/run sessions and took approximately 5 min to complete. Participants also were asked to provide their target HR at a level of 75% VO$_{2\text{max}}$. In addition, they were asked to take their pulse and provide a HR measured for potential changes affected by the sit/run session. To preserve the anonymity of the participants, the completed pre- and postsession questionnaires were paired by reported birth dates. The amount of increase or decrease for each mood category and for confidence was then calculated for each participant by subtracting the postsession score from the participant’s presession score.

Results

Target heart rates at 75% VO$_{2\text{max}}$ for all participants ranged from 156 to 170 beats per min. End-of-session, mean heart rates for each group are delineated in Table 1. Only a small number of the participants reached their 75% target heart range by completion of the run. Most of the 30- and 45-min runners finished in target ranges of 60 to 70%, whereas the 15-min runners finished under 50%. An analysis of variance (ANOVA) on heart rates indicated significant increases for time of run, $F = 49.27$, $p < .001$. Means for Groups 1 through 4 were 55.80, 117.65, 143.40, and 143.25, respectively. The results of Newman-Keuls post hoc tests confirmed significant ($p < .05$) HR increase between Groups 1 and 2, Groups 1 and 3, Groups 1 and 4, Groups 2 and 3, and Groups 2 and 4. There was no significant difference in HR between Groups 3 and 4. In addition, no significant effects were found for sex, and no significant interaction was found.

A between-subjects factorial ANOVA was used to analyze the scale difference in pre- to posttesting for each mood category using a 2 × 4 (Sex × Length of Running Time) design. With regard to depression, a significant difference was found showing decreased depression in the running groups, $F(3, 32) = 4.10$, $p < .014$; means for Groups 1 through 4 were −1.50, −16.13, −21.25, and −18.29 (the negative sign indicates a reduction of symptoms), respectively. Newman-Keuls post hoc analyses confirmed the significant ($p < .05$) decrease between Groups 1 and 2, Groups 1 and 3, and Groups 1 and 4. However, as noted below, this main effect was primarily due to improvements for the women’s groups.

A significant interaction for depression was found between sex and group as shown in Figure 1, $F(3, 32) = 3.24$, $p = .05$; improvement level for women was greater than for men. When comparing groups within sex, the Newman-Keuls analyses found no significant difference in depression for men between groups; a significant ($p < .05$) difference was found for women comparing Groups 1 and 2, Groups 1 and 3, and Groups 1 and 4.

With regard to tension, a significant interaction between sex and group was found, $F(3, 32) = 3.86$,
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FIGURE 1
Decrease in depression on a mood scale for each length of running time.

Note: The vertical lines indicate ±1 SE.

$p = .018$, (see Figure 2). Tension level improved for women but became worse for men. Newman-Keuls analyses comparing groups within each sex revealed a significant increase in confusion for men between Groups 3 and 4 and significant decrease in confusion for women between Groups 1 and 4, 2 and 4, and 3 and 4. These results indicated that for women, running 45 min resulted in a larger reduction in confusion than sitting or running 15 or 30 min. However, running 30 min did not reflect an improvement over running 15 min.

A Pearson product-moment correlation was performed comparing HR increases to reduction in depressive symptoms as length of running time increased. The results, $r(37) = -.44$, $p < .01$, confirmed that as aerobic level increased, the reduction in symptoms was more pronounced.

No significant differences were found on any level for anger or fatigue. In addition, no significance was found on any level for confidence, a measure not designed to assess mood improvement. The confidence measure was used to evaluate potential participant expectation of improved mood state due to running.

FIGURE 2
Decrease in tension for women, but increase for men on a mood scale for each length of running time.

Note: The vertical lines indicate ±1 SE.

FIGURE 3
Decrease in confusion for women, but increase for men on a mood scale for each length of running time.

Note: The vertical lines indicate ±1 SE.

Discussion

As expected, depression, at least for women, showed a significant improvement for the running groups, but results did not reflect the anticipated increase in mood improvement that would correlate with an increase in length of running time. These
results indicated that women experience an improvement in depressive state after only 15 min of running and prior to reaching aerobic levels. However, the significant correlation between increased HR and greater reduction of depressive symptoms support the hypothesis that as aerobic levels increase, the benefits of reduced depressive symptoms become more pronounced.

For the remaining measures—tension, confusion, anger, and fatigue—significant improvement in mood state as running time increased was not apparent when scores for men and women were combined. However, although not statistically significant, women showed decreased tension in the 30- and 45-min categories; whereas men decreased in the 15-min category, but then showed more tension over 30 and 45 min as compared to no running (see Figure 2). Women also showed significantly less confusion, whereas men moved toward more confusion. The differences between men and women in these areas was not expected, although this phenomenon has been noted in the unpublished studies mentioned previously (Stephan, 1988; Morris & Salmon, 1988; both as cited in Choi et al., 1993). In those studies women showed a stronger correlation between physical activity and mood improvement than men did.

It should also be noted that although both teams ran during the same week in April, the men ran on Tuesday and the women ran on Thursday. Temperatures and cloud cover on both days were similar, but the women also experienced the addition of light rain and some wind. One would normally expect the addition of rain and wind to adversely affect mood state for both men and women. In this case, then, if based solely on the weather, men would be expected to perform better. Admittedly, however, testing the men and women on different days of the week could possibly have affected the results and may even have counteracted any effects caused by the weather.

A review of Figures 1, 2, and 3 reveals that men experienced improved postrun mood states for both the sitting and running groups with the exception of Group 4’s response to tension and confusion. It was informally observed that the men seemed less eager to run the longer time trials and were pleased to be assigned to the sitting group. On the other hand, the women seemed to prefer running over sitting in a control group. The men’s control group interacted socially, which may have contributed to their consistent mood improvement. The women’s control group did very little socializing and also did not reflect improvement in mood state. These informally observed sex differences in attitudes and expectations very likely had some influence on the direction and magnitude of mood change in this study. In addition, it may also hold that the men interpreted the experience of tension and confusion differently than the women and so reported these measures as more severe instead of less.

The ANOVA for confidence was used to evaluate the possibility of conformity by the participants to expected changes in mood state. No significant difference was expected or found on this measure indicating participants were selectively responding to the scales. It is still possible that some Hawthorne effects influenced participants’ answers on postrun testing. Expected positive effects of running have been accepted as common knowledge, especially by runners. Disguising the measurements being used, although helpful, is difficult to achieve. The small number within each group also makes it difficult to generalize these results to a larger population.

Further exploration of the amount of time needed to achieve positive increase in psychological mood as well as the response differences between men and women is certainly appropriate. Research regarding the possible cumulative effects of exercise from one workout to the next would also be helpful, noting that Maroulakis and Zervas (1993) found positive residuals 24 hr later, whereas Tooman (1982, as cited in Harris, 1987) found increased anxiety after 48 hr without regular exercise. Increased knowledge in both areas will supply fitness experts with the tools needed to design effective exercise programs with regard to both session duration and frequency. For those individuals seeking a means to improve periods of mild depression, results of this study support other research in the field: aerobic-level running does appear to decrease depressive symptoms, at least for women, thus improving one’s state of mind.

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