Exercising with an iPod, Friend, or Neither: Which is Better for Psychological Benefits?

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***Objective*: To examine the role of music and social contact on exercise benefits. *Methods*: Two hundred twenty-nine (n=229) students were randomly assigned to one of 6 conditions: biking alone with iPod or friend in a laboratory, walking alone with iPod or friend outdoors, or biking or walking alone in control conditions. All participants completed 20 minutes of exercise at 70% of their maximum target heart rate. *Results*: Exercising in control conditions indoors resulted in a more relaxed and calm response. Exercising outdoors was more enjoyable and resulted in less tension and stress. *Conclusions*: Exercise environment impacts psychological benefits of exercise.**

***Key words*: exercise, mood, stress, music, social contact**

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Research over several decades clearly indicates that regular physical exercise decreases the odds of developing certain types of cancer, cardiovascular disease, obesity, osteoporosis, diabetes, and a variety of other life-threatening illnesses.[1-4] In fact, it has been estimated that approximately 30% of all cancer deaths are related to insufficient physical exercise.[5] Therefore, individuals who exercise regularly are less likely to develop these and other illnesses.[4]

Researchers have also consistently found that individuals experience many psychological benefits from exercising too.[6-9] These psychological benefits include a decrease in anxiety, stress, and depression and an increase in self-confidence and positive mood.[6,9-10]

Previous studies have found that exercise environment impacts the psychological benefits of exercise.[6-10] This becomes important because in order to encourage people to secure regular physical exercise for their mental and physical health and well-being, clinicians and the public should be attentive to the environment where exercise occurs to maximize the positive effects on participants.[8,9]

In the present study, the influence of music and social contact among individuals while exercising was of particular interest as possible important environmental conditions that could influence the psychological benefits of exercise. Previous research demonstrates that music has beneficial effects for individu-

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als during exercise.[11-13] For instance, it has been reported that performing bench stepping exercise while listening to music produces more positive mood states than bench stepping without music.[14] Another study required individuals participating in a cardiac rehabilitation program to complete a music therapy survey.[13] The results demonstrated that during an exercise session, patients experienced more pleasure when listening to music, which served as a positive distraction for patients during exercise. Therefore, these researchers concluded that cardiac rehabilitation patients who listen to music while exercising will exercise for longer periods of time and be more likely to complete their exercise goals.

In another study examining the role of music and exercise, researchers attempted to determine whether exercise was affected by upbeat music selected to increase exercise motivation.[12] Participants who listened to upbeat music cycled further than those who were assigned to no-music control conditions. Participants in the music condition perceived less exertion while cycling as well. Additionally, music has been found to elicit positive emotions in exercisers.[11] Thus, the combination of exercise, music, and positive emotions may result in an increase in psychological functioning among exercisers. Because music and exercise produce positive effects independently, music and exercise combined may produce greater psychological benefits.[15]

Researchers have also recently examined the psychological effects of exercising with a partner, which also may improve the psychological benefits of exercing.[17] Participants in one study were asked to exercise on a stationary bike for 30 minutes with or without an exercise partner.[17] Results indicated that exercising with a partner produced a greater sense of calmness among both males and females. However, only males exercising with a partner experienced an increased self-reported capacity to cope with stress. The researchers reported that social support was responsible for eliciting a calmness effect in males by reducing stress. Therefore, individuals who exercise with a partner may likely experience enhanced positive psychological benefits.

Social interaction while exercising has been shown to make exercise more enjoyable as well. Females in particular have reported benefiting from social interaction while exercising. One study examined participants who were given the choice to bring a friend or come alone to an exercise program and found that 62% of females and only 26% of males chose to bring a friend to the exercise session.[18] Of those participants, women reported more often than males that exercising with a friend would encourage them to engage in more exercise activity. Therefore, women are not only more likely to bring partners to exercise with if given the choice, but they are also more likely to report benefits from socializing with their partners during exercise.

The purpose of the current study is to further explore and examine the psychological effects of listening to music and social interactions while exercising. To our knowledge, this is the first study to examine the influence of music and social exercise in an experimental design. College-aged women and men were asked to exercise for 20 minutes on a stationary bike (in Experiment I) or walking outdoors (in Experiment II) while maintaining an average heart rate of approximately 140 beats per minute. In 2 experiments, participants were assigned to one of several conditions. In some conditions, participants were asked to bring an iPod containing music of their choice, which they listened to while exercising. In other conditions, participants were required to bring a friend and were encouraged to interact socially with them while exercising. Participants exercised either in a laboratory setting (Experiment I) or outdoors (Experiment II). They were asked to complete a series of questionnaires that assessed their mood states and stress both before and after exercising. Because previous studies have demonstrated the positive psychological and physiological effects of exercising while listening to music and interacting socially, we hypothesized that participants in both the iPod and social interaction conditions would experience an increase in positive mood states after exercising compared with those who exercised alone or without music.

METHOD - EXPERIMENT I

Participants

Participants in Experiment I included 128 undergraduate college students at Santa Clara University, a Jesuit Catholic liberal arts college located in the San

Francisco Bay Area. Fifty-nine (n=59) participants were male, 69 were female. Participants ranged in age from 17 to 23 years (M=18.64, SD=1.30). Students obtained research participation credit for their general psychology class.

Measures

***Activation-deactivation adjective check list* (AD-ACL).**[19,20] The AD-ACL is a brief, frequently used self-report checklist designed to measure momentary mood states associated with exercise. Sample items include "calm...tense...relaxed... vigorous...sleepy," which are rated on a 4-point Likert scale with scores totaled for measuring energy, tiredness, calmness, and tension. Scores on these dimensions ranged from 1 to 25 in this study with standard deviations ranging from 8.49 for tension scores to 11.94 for calmness scores. The AD-ACL has adequate test-retest reliability (r = 0.80 and higher in most studies) and construct as well as content validity and has been used in a number of investigations involving exercise.[19,20]

***Perceived Exertion Scale* (PES).** The PES was used to evaluate the participants' perceived level of exertion where 6 = very light exertion and 20 = very hard exertion. The PES is often used in exercise research and has adequate test-retest reliability and construct validity.[21]

***Paces Activity Enjoyment Scale* (PACES).**[22] The PACES scale includes18 bipolar items on which individuals rate themselves on a 7-point Likert scale. The scale measures the amount of enjoyment individuals perceive themselves to have experienced during an exercise activity. Sample scale items include "I find it energizing/I find it tiring" and "I enjoy it/I hate it." Scores ranged from 11 to 134 with a mean of 94.02 and standard deviation of 16.44 for this study. PACES has excellent internal consistency (r = 0.93), stability, and construct as well as content validity.[22]

Several author-developed Likert scales. Several 10-point Likert scales developed by the authors measured each participant's current level of perceived stress, how close participants exercising with another felt to their partner during exercise, and how fast or slow the music was for participants listening to their iPods during exercise. The value of 1 indicated low stress, low closeness, and slow music whereas a value of 10 indicated high stress, much closeness to their exercise partner during exercise, and fast or peppy music.

Procedure

To inform participants about the procedures of the study and obtain informed consent, participants attended a brief orientation session prior to their laboratory session. All participants learned about the study, had their questions answered, and signed consent forms in accordance with ethical guidelines and university human subject committee requirements and policies. Participants were asked to refrain from exercising before their scheduled laboratory session. On the day prior to their scheduled laboratory session, participants received an e-mail to remind them of the experiment and confirm their appointment. These e-mails were identical to minimize potential experimenter influence. The participants were told to wear comfortable and exercise-appropriate clothing.

At the orientation session, participants were randomly assigned to one of three 20-minute experimental conditions. All participants experienced the same exercise task in terms of intensity of exercise. Group 1 participants exercised alone while listening to their iPod. Group 2 participants exercised with a friend whom they brought to the laboratory. Group 3 participants exercised alone without an iPod or friend. Participants who exercised with a friend rated how comfortable they were with their friend on a 10-point scale at the end of the exercise session. In the first condition, participants rode a Monark Ergomedic stationary bike alone while listening to their iPod. In the second condition, 2 Monark Ergomedic stationary exercise bikes were set up side by side at a slight inward angle allowing for interaction between the participant and friend.

Prior to exercising, participants completed the AD-ACL and answered questions regarding their height and weight. Participants in all conditions were instructed to mount an exercise bike and adjust the seat to their level of comfort. A Polar heart rate monitor was then attached below their chest. In addition, the participants wore a heart monitor watch and were instructed to keep their heart rate at 140 beats per minute (ie, 70% of

their maximum heart rate). Heart rate monitors were observed by the research assistant during the exercise experience, and corrective feedback was given to the participants if their heart rates were too low or too fast. Participants were then instructed to bike for 20 minutes at a moderate speed. Participants in condition 1 were instructed to listen to any type of music on their iPod whereas participants in condition 2 were told that they could chat with their friend during exercise while the research assistants sat quietly out of view of the participants.

After the exercise session, the research assistant instructed the participants to complete the AD-ACL, PACES, PES, and author scales measuring stress, comfort with friend, and music tempo.

RESULTS

Data Analysis

Analysis of variance (ANOVA) and analysis of covariance (ANCOVA) with Tukey's HSD (Honestly Significant Difference) test used when appropriate for postdoc analysis when significance was found in the ANOVA or ANCOVA were used in the data analysis on dependent measures (ie, mood, stress, enjoyment, and exertion scores) by independent variable experimental conditions (indoor exercise with an iPod, a friend, or alone). The data were encoded and entered into a SPSS-13 software package by a research assistant coauthor.

Does indoor exercise improve mood, stress, and enjoyment?

Means and standard deviations for the AD-ACL (ie, energy, tiredness, tension, and calmness) and for the PACES scores and stress by experimental condition are shown in Table 1. As expected, participants demonstrated positive mood benefits after exercise as measured by the AD-ACL. For example, the mean energy score for participants increased from a baseline score of 12 to a postexercise score of 15 ($P<.05$) whereas the mean score for tiredness decreased from a baseline score of 12 to a postexercise score of 9 ($P<.05$). A series of paired t-tests were conducted on energy [$t(126) = 8.19$, $P<.001$], tiredness [$t(126) = 7.43$, $P<.001$], and calmness [$t(126) = 6.62$, $P<.001$], which were found to be significant, but not with tension scores [$t(126) = 0.97$, n.s.]. Thus, mood improvements were found following exercise compared to before the exercise experience.

Does indoor exercise with an iPod, friend, or alone result in differential mood, stress, and enjoyment effects?

AD-ACL postexercise mood scores were evaluated using a series of 2-way analysis of covariance (ANCOVA) where preexercise mood scores were used as a covariate in the analysis of each postexercise mood measure. ANCOVA was also used to examine postexercise perceived stress scores using the 10-point author-developed Likert scale using the preexercise perceived stress score as a covariate. Analysis of variance (ANOVA) was used to evaluate enjoyment scores as measured by the PACES scale because the assessment of exercise enjoyment was obtained immediately after the exercise experience only.

There was a significant condition main effect for calmness [$F(2, 126) = 5.59$, $P<.01$] and perceived stress [$F(2, 127) = 3.96$, $P<.05$]. Post hoc analysis using Tukey's HSD (Honestly Significant Difference) test revealed that control participants experienced higher levels of calmness and lower levels of perceived stress after exercising relative to the 2 experimental groups ($P's<.05$). There were no other significant main effects or interactions on other mood or the enjoyment measure.

Does music tempo influence mood, stress, and enjoyment during indoor exercise?

The influence of music tempo on mood as measured by the AD-ACL and perceived stress was evaluated using a series of 2-way analysis of covariance (ANCOVA) where preexercise mood or stress scores were again used as a covariate on the analysis of each postexercise mood and stress measure. ANOVA was used to evaluate postexercise enjoyment scores. A median split procedure was conducted for music tempo in order to examine the relationships between fast versus slower music tempo and mood and enjoyment outcomes. Because the control condition as well as the participants exercising with a friend did not exercise with music, those participants were excluded from these analyses.

A significant main effect for energy emerged [$F(1, 50) = 16.83$, $P<.001$]. Post hoc analysis using the Tukey's HSD (Honestly Significant Difference) test revealed that participants showed higher energy when listening to music with a fast (rather than slow) tempo while exercising ($P<.05$). There were no other significant main

Table 1
Means and Standard Deviations of AD-ACL, Stress, and PACES Scores: Experiment I

		iPod				Friend				Control			
		Male		Female		Male		Female		Male		Female	
	N	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Preenergy	128	13.95	2.95	11.16	3.09	12.50	3.81	11.62	3.57	10.86	3.24	11.07	3.45
Postenergy	127	16.20	3.13	14.29	3.17	15.31	3.38	16.04	3.08	13.31	3.68	13.92	4.54
Pretiredness	128	9.80	4.32	12.96	3.46	12.12	4.41	12.16	4.23	13.90	4.38	11.05	4.62
Posttiredness	127	8.75	3.71	8.56	2.55	8.68	3.23	8.87	2.57	11.68	4.34	8.57	3.41
Pretension	128	9.04	0.55	7.80	0.45	7.68	0.63	8.62	0.52	10.04	3.81	9.42	3.61
Posttension	127	8.90	2.38	8.93	2.27	9.43	2.65	9.20	3.47	9.04	3.37	8.14	2.38
Precalmness	128	11.19	3.31	11.35	2.49	12.76	2.34	12.16	3.19	12.09	2.72	12.07	2.67
Postcalmness**	127	10.00	2.91	8.29	2.86	10.00	2.94	8.33	3.45	5.68	1.80	6.07	2.09
Prestress	128	6.69	1.69	6.16	1.52	6.93	1.80	5.77	1.93	5.56	2.09	5.28	2.23
Poststress*	128	7.57	1.53	6.43	1.72	6.87	1.74	6.47	1.99	5.68	1.80	6.07	2.09
PACES	128	99.09	13.38	86.93	24.03	94.06	16.55	94.95	16.51	87.86	12.83	90.00	19.44

** P < .01, * P < .05

effects or interactions on other mood, stress, or the enjoyment measure.

Does reported comfort level with a friend impact mood, stress, and enjoyment during indoor exercise?

The influence of comfort with their friend on mood as measured by the AD-ACL and perceived stress was evaluated using a series of 2-way analysis of covariance (ANCOVA). ANOVA was used to evaluate postexercise enjoyment scores. A median split procedure was conducted for self-reported comfort with their friend with whom they exercised in order to examine the relationship between their perceived closeness and mood and enjoyment outcomes. Because the control condition as well as the participants exercising with music did not exercise with a friend, those participants were excluded from these analyses.

A significant main effect for enjoyment as measured by PACES emerged [F (1, 41) = 5.63, P<.05]. Post hoc analysis using the Tukey's HSD (Honestly Significant Difference) test revealed that participants experienced more enjoyment when they exercised with a friend they felt more comfortable with (P<.05). However, there were no significant main effects or interactions for the mood measures (ie, energy, tiredness, tension, or calmness) as well as for perceived stress.

Does indoor exercise with an iPod, a friend, or alone influence perceived exertion?

No significant main effects or interactions surfaced while examining PES scores measuring perceived exercise exertion using ANOVA (all P's>05). Mean PES scores for the participants were 12.10 (SD=2.90).

METHOD - EXPERIMENT II

Participants

Participants in Experiment II included 101 undergraduate college students from the same university as in Experiment I. Forty participants were male whereas 61 were female. Participants ranged in age from 18 to 23 years (M=18.84, SD=.24). Students again obtained research participation credit for their general psychology class.

Measures

The measures for Experiment II were identical to the measures of Experiment I.

Procedure

All procedures used to obtain participants in Experiment I were also used in

Experiment II. However, in Experiment II, participants were randomly assigned to one of three 20-minute outdoor experimental conditions. Group 1 walked briskly along a prescribed route on the university campus while listening to music of their choice on their iPod. Group 2 completed the same walk as Group 1 but brought a friend with them. Group 3 completed the same walk as the other participants without an iPod or a friend. Participants were given a map of campus, and a predetermined walking route was provided.

All participants experienced the same exercise task in terms of type and intensity of exercise. The groups differed in terms of the social environment and music experience. Before the presentation of the exercise conditions, participants completed the AD-ACL scale and reported their height and weight.

As in Experiment I, the participants wore a Polar heart monitor watch and were instructed to keep their heart rate at 140 beats per minute (ie, 70% of their maximum heart rate). However, because participants walked around campus out of view from the research assistant, they heart rates were not monitored and corrective feedback given by the research assistants. Participants were then instructed to walk for 20 minutes at a moderate speed.

After the exercise session, the research assistant instructed the participants to immediately complete the AD-ACL again as well as PACES, PES, and the other Likert-scale measures evaluating perceived stress, comfort with friend, and music tempo.

RESULTS

Analysis of variance (ANOVA) and analysis of covariance (ANCOVA) with Tukey's HSD (Honestly Significant Difference) test used when appropriate for postdoc analysis when significance was found in the ANOVA or ANCOVA were used in the data analysis on dependent measures (ie, mood, stress, enjoyment, and exertion scores) by independent variable experimental conditions (outdoor exercise with an iPod, a friend, or alone). The data were encoded and entered into a SPSS-13 software package by a research assistant coauthor.

Does outdoor exercise improve mood, stress, and enjoyment?

Means and standard deviations for the AD-ACL (ie, energy, tiredness, tension, and calmness) and for the PACES scores and stress by experimental condition are shown in Table 2. As expected, participants demonstrated positive mood benefits after exercise as measured by the AD-ACL. For example, the mean energy score for participants increased from a baseline score of 12 to a postexercise score of 15 ($P<.05$) whereas the mean score for tiredness decreased from a baseline score of 11 to a postexercise score of 9 ($P<.05$). A series of paired t-tests were conducted on energy [$t(126) = 6.67$, $P<.001$], tiredness [$t(126) = 6.85$, $P<.001$] and calmness [$t(126) = 6.67$, $P<.001$] that were found to be significant. However, tension scores were not found to be significant in these analyses [$t(126) = 1.26$, n.s.]. Thus, significant mood improvements following exercise compared to before the exercise experience were found on 3 of the 4 mood measures.

Does outdoor exercise with an iPod, friend, or alone result in differential mood, stress, and enjoyment effects?

As in the first experiment, a series of 2-way analysis of covariance (ANCOVA) tests were conducted on mood measures using the preexercise mood measures as a covariate. ANCOVA was also used to examine postexercise perceived stress scores using the preexercise perceived stress score as a covariate. ANOVA was used to evaluate enjoyment scores as measured by the PACES scale because, as mentioned earlier, the assessment of exercise enjoyment was obtained immediately after the exercise experience only.

A significant condition main effect for tiredness emerged [$F(2, 100) = 3.03$, $P<.05$]. Post hoc analysis using Tukey's HSD (Honestly Significant Difference Test) revealed that exercising outdoors with a friend resulted in higher tired scores after exercising compared to exercising outdoors with music using an iPod or exercising outdoors without a friend or music ($P<.05$). There were no other significant main effects or interactions for any of the other mood, stress, or enjoyment measures.

Does music tempo influence mood, stress, and enjoyment during outdoor exercise?

The influence of music tempo on mood as measured by the AD-ACL and perceived stress was evaluated using a series of 2-way analysis of covariance (ANCOVA) where preexercise mood and

Table 2
Means and Standard Deviations of AD-ACL, Stress, and PACES Scores: Experiment II

		iPod				Friend				Control			
		Male		Female		Male		Female		Male		Female	
	N	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Preenergy	101	10.40	2.99	10.85	2.66	14.63	3.23	11.64	3.16	11.57	3.69	11.95	4.48
Postenergy	101	14.60	3.18	16.2	2.99	13.90	3.80	15.58	3.58	14.28	4.14	13.95	3.46
Pretiredness	101	11.60	5.36	13.04	3.95	7.90	3.08	11.94	4.06	10.64	4.63	11.28	4.35
Posttiredness*	101	8.40	3.58	8.90	2.68	9.18	2.99	9.26	3.57	7.58	2.62	8.21	3.55
Pretension	100	8.13	1.99	9.10	2.57	8.54	2.69	7.78	3.01	7.50	2.44	8.09	2.60
Posttension	100	8.13	2.66	7.70	1.83	7.27	2.45	7.89	2.15	8.42	2.34	7.76	2.07
Precalmness	101	12.53	3.35	12.52	2.99	11.27	3.00	11.05	2.99	13.21	2.75	11.76	2.75
Postcalmness	101	9.73	3.01	9.23	2.77	11.18	3.65	8.57	2.94	9.78	2.48	9.73	3.63
Prestress	101	7.10	1.56	6.30	1.77	7.36	1.56	5.52	2.16	6.92	1.43	5.80	1.50
Poststress	101	7.66	1.17	6.54	1.93	7.72	1.55	6.84	2.19	7.42	1.39	6.66	1.65
PACES	101	95.26	7.73	102.1	4.02	90.72	9.46	95.94	12.73	97.07	16.71	96.00	15.21

*** P<.05**

perceived stress scores were again used as a covariate on the analysis of each postexercise mood or perceived stress measure. ANOVA was used to evaluate enjoyment scores as measured by the PACES scale. A median split procedure was conducted for music tempo in order to examine the relationships between fast versus slower music tempo and mood and enjoyment outcomes. Because the control condition did not exercise with music, nor did those who exercised with a friend, those participants were excluded from these analyses.

A significant main effect for tiredness emerged [F (1, 32) = 4.87, P<.05]. Post hoc analysis using the Tukey's HSD (Honestly Significant Difference) test revealed that participants were less tired when listening to music with a fast (rather than slow) tempo while exercising (P<.05). There were no significant main effects or interactions for enjoyment, other mood measures, or perceived stress.

Does reported comfort level with a friend impact mood, stress, and enjoyment during outdoor exercise?

The influence of comfort with their friend on mood as measured by the AD-ACL and perceived stress was evaluated using a series of 2-way analysis of covariance (ANCOVA). ANOVA was used to evaluate enjoyment scores as measured by the PACES scale. A median split procedure was conducted for self-reported comfort with their friend whom they exercised with in order to examine the relationship between their perceived closeness and mood and enjoyment outcomes.

A significant main effect for perceived stress was found [F (1, 32) = 4.99, P<.05] as well as a significant interaction for energy [F (1, 32) = 5.95, P<.05]. Post hoc analysis using the Tukey's HSD (Honestly Significant Difference) test revealed that participants experienced more stress when they exercised with a friend they felt more comfortable with (P<.05). There were no significant main effects or interactions for the other mood measures.

Does outdoor exercise with an iPod, a friend, or alone influence perceived exertion?

No significant main effects or interactions surfaced while examining PES scores measuring perceived exercise exertion using ANOVA (all P's>.05). Mean PES scores for the group were 10.22 (SD=3.10).

Does indoor or outdoor exercise result in improved mood, stress, or enjoyment?

Finally, a series of 2-way analysis of variance (ANOVA) were conducted on mood, stress, and enjoyment scores based on outdoor versus indoor exercise (comparing Experiment I to Experiment II).

A significant main effect for tension [$F(1, 126) = 7.96$, $P<.01$] and stress [$F(1, 228) = 4.99$, $P<.05$] was found. Post hoc analyses using Tukey's HSD (Honestly Significant Difference) test revealed that participants reported higher tension and more stress while exercising in the lab compared to exercising outdoors ($P<.05$).

Furthermore, a significant main effect for enjoyment was found as measured by the PACES scale [$F(1, 176) = 4.20$, $P<.05$]. Post hoc analyses using Tukey's HSD (Honestly Significant Difference) test revealed that participants reported that they enjoyed exercising outdoors more than did those exercising indoors ($P<.05$).

DISCUSSION

The purpose of this study was to further evaluate the role of music and social contact on the psychological benefits of exercise in several experimental conditions by examining mood and enjoyment benefits of exercising with an iPod or with a friend either indoors or outdoors. Overall, we found that music and social contact generally enhanced mood, enjoyment, and psychological functioning. These findings are consistent with previous research findings that exercise produces positive psychological and mood benefits,[8,9,23] and that these benefits are enhanced with music[13] and social contact.[16] However, mood improvements such as more energy and less tiredness were especially noted when listening to music with a fast tempo and exercising with a friend the participant felt most comfortable with. Furthermore, exercising alone indoors had added benefits in terms of enhanced calmness and stress reduction compared with exercising indoors with music or with a friend. Exercising outdoors relative to exercising indoors resulted in more enjoyment as well as less tension and stress. Exercising outdoors with a friend was more tiring than exercising outdoors with an iPod or alone without an iPod or friend. These results suggest that participants enjoyed exercising outdoors more than indoors and were less tense and stressed compared to those exercising indoors. Yet, among indoor exercisers, those who exercised without an iPod or a friend were most calm and less stressed.

Overall, our findings suggest that psychological improvements associated with exercise may be related to listening to music (eg, music with a faster tempo results in more enjoyment than does music with a slower tempo) and social factors (eg, exercising with a friend one feels most comfortable with results in more enjoyment than with a friend one feels less comfortable with) as well as exercising outdoors rather than indoors (eg, more enjoyment as well as less tension and stress). Exercising indoors while alone without music may be more calming and relaxing than exercising with others or outdoors. Exercising outdoors with a friend may be more tiring than exercising alone.

In conclusion, one may likely achieve different psychological benefits of exercise based on different exercise environments. Different mood and enjoyment outcomes present themselves when exercising either alone or with another person, with or without music, and indoors or outdoors. Exercisers might wish to consider participating in particular exercise environments (eg, indoors, outdoors, with or without a friend or music) when desiring particular psychological outcomes (eg, energizing versus calming). Of course, mood and personality traits may be a factor in exercise selection such that those with particular mood experiences and personality tendencies may choose different types of exercise experiences.

Previous research has clearly demonstrated that mood effects of exercise are much more likely to emerge with clinical populations or among those suffering from negative affect.[24] Therefore, any differences that may exist between participants listening to music or in the presence of a friend may differ when evaluating normal college students rather than clinical populations.

There are several important limitations of this study that must be considered. This study consisted of an evaluation of a fairly small number of healthy homogeneous undergraduate students engaged in one exercise session. The use of a larger, more diverse population or a clinical population may have resulted in different findings. Furthermore, because students engaged in only one exercise session, the benefits found were immedi-

ate and may not be long lasting. It is important to note that most of our results were found in the laboratory experience (Experiment I) rather than in the outdoor experiment (Experiment II). This could be due to higher internal validity or more control in the lab environment rather than outdoors. Participants in the laboratory also perceived their workout as being harder than did those exercising outdoors as evidenced by mean PES scores among the 2 experiments (ie, 12 in experiment I and 10 in experiment II). The campus environment is a lovely mission garden that has excellent weather year round. Findings may differ in other outdoor environments across the country and world.

Future research in this area may benefit by considering a larger, more diverse participant population. Additionally, the psychological benefits of exercise may be particularly relevant to clinical populations such as those who struggle with depression and anxiety. It may also be worth investigating the duration of time the psychological benefits might last and how long exercise should occur to obtain maximum mood, enjoyment, and stress-reducing effects. Research should also focus on exercise prescriptions specifically tailored to the fitness level and likes of the participants as well. Additional research may also examine self-selected music choice versus cadence-directed music selected by the researchers. Future research in this area is needed in order to help us better understand the relationship between psychological benefits and exercise in various exercise environments. ■

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