

## **The Acute Effects of Humor and Exercise on Mood and Anxiety**

Attila Szabo

The Nottingham Trent University, Nottingham, United Kingdom

The hypothesis that 20-minutes of humor would result in affective benefits that are comparable to those of a 20-minute bout of aerobic exercise was scrutinized by using a within-participants research design. Thirty-nine university students were tested, at weekly intervals, three times: running/jogging at self-selected pace, watching a humorous stand-up comedy, and watching a documentary video. Mood and state anxiety were determined 5-minutes before and after each treatment by using the Subjective Exercise Experience Scale (McAuley & Courneya, 1994) and the Spielberger State Anxiety Inventory (Spielberger, Gorsuch, & Luchene, 1970). Both humor and exercise had an equally positive effect on psychological distress and positive well-being. However, humor exerted greater anxiety-lowering effect than exercise. Based on these results, it is tentatively concluded that humor could induce positive psychological changes that are at least comparable if not superior to the effects of exercise.

**KEYWORDS:** *Anxiety, exercise, health, humor, mood*

The stress- and illness-moderating role of humor is often publicized in the mass media. The scientific community also dedicates increasing attention to the beneficial effects of humor on health. For example, the professional organization *Association for Applied and Therapeutic Humor* (AATH—formerly the *American Association for Therapeutic Humor*) was founded in 1988 to promote health and well-being through humor intervention. The association's website includes about 100 references to works linking humor with health and wellness (AATH, 2001).

The connection between humor and its therapeutic effect is unclear and complex. Monro (1988) presented an analysis of three theories of humor including the *Superiority*, *Incongruity*, and *Relief* theories. The emphasis was on what humor could provide to people to make them feel better. Some key features of humor include artificial empowering resulting in feelings of superiority (*Superiority Theory*), a means of dealing with frustration or injustice through resorting to divergent logic and contradiction (*Incongruity Theory*), and catharsis by removing social restraint through the expression of the inexpressible (*Relief Theory*). These psychological outcomes could, directly or indirectly, contribute to lower tension and anxiety as well as to more positive mood states.

---

Address correspondence to Attila Szabo, Ph.D., School of Science, The Nottingham Trent University, Clifton Lane, Nottingham, UK NG11 8NS. Phone: 44 (0) 115 848-3362. Fax: 44 (0) 115 848-6680. Email: attila.szabo@ntu.ac.uk.

Author Note: The author wishes to thank the reviewers for their valuable comments that had a positive impact on the final version of this manuscript.

Response to humor is manifested both physiologically and psychologically. An extensive electrical activity in the brain, engaging the whole cerebral cortex, has been observed in response to humor, which takes place before laughter (Doskoch, 1996). Then laughter, a general, but not universal, consequence of the appreciated humor is a form of "inner jogging" activity because it triggers a number of sympathetic responses similar to physical exercise (e.g., increases in heart rate, blood pressure, or breathing rate) without significant muscular activity (Sobel & Ornstein, 2002). On the psychological side, it was reported that humor improves mood and reduces state anxiety (Houston, McKee, Carroll & Marsh, 1998; Mannell & McMahon, 1982; Martin, Kuiper, Olinger & Dance, 1993; Moran, 1995; Newman & Stone, 1996; White & Winzelberg, 1992). It may be assumed, therefore, that humor has positive psychological effects. However, the magnitude or the significance of these effects is unknown.

To date, there is limited data on the psychological effects of humor in contrast to other interventions. White and Winzelberg (1992) showed that state anxiety decreased equally in three treatment conditions: control (geographical video watching), humor (*Candid Camera* and *Comic Relief* videos), and progressive relaxation. More recently, Snowball and Szabo (1999) reported that three forms of exercise (rowing, cycling, and running), humor (stand-up comedy), and video watching (geographical scenes) were equally effective in improving participants' mood state and state anxiety. However, these results were based on only 15 participants taking part in a *within-participants* experiment. Considering the number of treatments and the number of repeated measures in the study reported by Snowball and Szabo (1999), a lack of power may have masked possibly significant treatment differences. Consequently, the comparison of the psychological benefits of humor and exercise is still unclear. However, such a comparison is warranted in light of the widely publicized mental benefits of physical activity in contrast to the meager knowledge about the benefits of other accessible leisure activities, such as humor.

Indeed, several literature reviews reveal that aerobic exercise reduces state anxiety and that this effect is accompanied by positive changes in mood (Berger & Motl, 2000; LaFontaine, et al., 1992; McDonald & Hodgdon, 1991; O'Connor, Raglin & Martinsen, 2000; Petruzzello, Landers, Hatfield, Kubitz & Salazar, 1991; Scully, Kremer, Meade, Graham & Dudgeon, 1998). The practical implication of such a consensus is that exercise is prescribed not only for physical but also for mental health (Biddle, Fox, & Boutcher, 2000; Morgan, 1997). From the health and leisure perspectives, however, the psychological benefits of exercise may only be enjoyed by a small segment of the general population that is physically able and mentally willing to engage in exercise. An important question then is whether other easily accessible and inexpensive leisure activities, including humor, could result in affective benefits comparable to that of exercise.

Although more than 1000 articles have been published on the relationship between exercise and psychological health in the past 26 years (based on SPORT Discus 1975-2001/12 electronic database searches), only a few

studies have compared the psychological benefits of exercise to that of other treatments. These *other treatments* primarily served as control rather than as rival treatments. Overall, the results of these studies suggest that a physically inactive episode, such as music appreciation (Szabo, Mesko, Caputo & Gill, 1998), video watching of geographical sceneries (Snowball & Szabo, 1999; Szabo et al., 1993), or humor (Snowball & Szabo, 1999), is as effective as exercise in improving mood and decreasing state anxiety. The plausible theoretical explanation for the above may rest with Morgan's (1985) *distraction hypothesis*, which predicts that a temporary attentional switch from stress, ongoing concerns, or challenges results in psychological benefits. Nevertheless, distraction from negative events may not be necessary, because psychological benefits could occur with pleasurable and/or personally satisfying experiences (Sandlund & Norlander, 2000). Therefore, simply feeling good could also account for the changes observed in mood and anxiety. Consequently, research evidence, theory, and applied research's interest all warrant the further and *direct* comparison of the psychological benefits of exercise to physically undemanding leisure activities, such as humor.

Considering that many individuals engage in leisure time running or jogging to deal with daily stress, the aim of this study was to examine whether a 20-minute humorous episode can yield similar psychological effects to that achievable through a 20-minute bout of running. In the course of the study two important issues were taken into consideration: 1) While the state anxiety was measured with the "general" *Spielberger State Anxiety Inventory* (Spielberger, Gorsuch & Luchene, 1970), mood measures were taken with an *exercise specific* instrument, the *Subjective Exercise Experience Scale* (McAuley & Courneya, 1994). This instrument was selected to assess whether psychological changes triggered by exercise could also be observed following exposure to humor. 2) The ecological validity of the research, by testing participants in their natural setting rather than in the laboratory, was a point of concern. While Snowball and Szabo (1999) revealed that humor has similar effects to exercise in reducing state anxiety and improving psychological mood, in their study a 70% maximal heart rate reserve (MHRR) exercise workload was used that may far exceed the effort associated with recreational or self-selected physical activities. Indeed, in the Snowball and Szabo (1999) study only trained males were tested in a laboratory setting. In contrast to their study, in the current investigation both genders were tested, in the field, by using shorter (20 versus 30 minutes) interventions and a self-selected exercise-intensity protocol that were postulated to better mimic recreational running or jogging.

## Method

### *Participants*

Thirty-nine consenting male ( $n = 22$ ) and female ( $n = 17$ ) second year sport science students, studying at a large University, were tested in three conditions that were scheduled at weekly intervals for three consecutive

weeks. All participants had a British-Caucasian cultural background. All of them were healthy nonsmokers and able to exercise, as determined with the Physical Activity Readiness Questionnaire (PAR-Q—British Columbia Ministry of Health). They were aged between 20 and 23 years. While the participants were free to deny consent to participation at any time, they were informed that the experience of taking part in this research would be discussed and evaluated collectively and that would help them in devising and carrying out their third year research project. This method could be perceived as partially eliminating the concern of self-selection for the benefits of one or more treatment(s). The method also proved to be efficient in maximizing participation as none of the students withdrew from the study.

### Materials

State anxiety was measured with the *Spielberger State Anxiety Inventory* (SSAI; Spielberger et al., 1970) before and after each experimental condition. This questionnaire is a widely used and well-validated instrument with good internal consistency ranging between (Cronbach  $\alpha$ ) .83 to .92. However, the appropriateness of using the SSAI in exercise studies, especially during the exercise, has been recently questioned (Ekkekakis, Hall & Petruzzello, 1999), because of a possible confound between state anxiety itself and effort-triggered tension or activation during exercise.

Psychological mood states were assessed with the *Subjective Exercise Experience Scale* (SEES; McAuley & Courneya, 1994), which is a 12-item rating scale. The SEES is rated on a 7-point scale ranging from one to seven where one stands *for not at all*, four stands for *moderately*, and seven implies *very much so*. The SEES gauges three mood states, via three 4-item subscales, which are: 1) positive well-being, 2) psychological distress, and 3) physical fatigue. The internal consistencies reported for the three subscales of the SEES ranged between (Cronbach  $\alpha$ ) .84 to .92 (McAuley & Courneya, 1994).

Together these two questionnaires yielded a total of four dependent measures: one measure of state anxiety and three measures of mood.

### Procedure

Participants were informed that they would engage in different activities, chosen by the experimenter from a list of a large number of possible physically active and passive alternatives, in the coming weeks. During the course of the study the students were asked to be dressed for exercise at all times. They did not know what activities they would perform, until the test session has started. This method was used in an attempt to eliminate bias due to expectation. Three test sessions, consisting of exercise, humor, and neutral video watching, were scheduled at 1-week intervals. The order of the three test sessions was determined by lot. Testing took place in the early afternoon in a co-acting social environment, where all students participated at the same time. During testing all participants performed the same task without inter-

acting with each other. The experimental locations were a running track (exercise condition) and a large classroom auditorium reserved exclusively for the study. In all three sessions, participants completed the SSAI and the SEES five minutes before as well as five minutes after the corresponding 20-minute intervention. The 5-minute intervals, between filling the questionnaires and treatment, were spent in quiet rest.

During the first session (week 1), participants ran (or jogged) at a self-selected pace for 20 minutes on the running track. This method was preferred because most exercisers self-select the intensity of their exercise in the field. A recent literature analysis also suggested that self-selected exercise intensity might produce affective changes that are comparable to experimenter-imposed exercise intensities (Ekkekakis & Petruzzello, 1999). Finally, the ecological validity of running in a co-acting environment at a self-set place is stronger than that of running alone in the laboratory at an experimenter-imposed workload, which may be comfortable for some but stressful for other participants.

The second (week 2) and third (week 3) sessions, apart from the treatment, were identical to session one. In session two (week 2), the students watched a 20-minute giant screen projection of a famous (Lee Evans) stand-up comedian's performance. This humor was selected on the basis of pilot projects with similar student samples that appraised the humor as both funny and appropriate for them in the sense that they could relate to the content. In the third session (week 3), the students watched a 20-minute documentary about the evolution of life on Earth in the same auditorium. As in previous research (Snowball & Szabo, 1999; Szabo et al., 1993), it was assumed that this type of documentary has little or no effect on mood and anxiety. As mentioned earlier, the participants were blind to the intervention before every test session. Upon completion of the study, students were debriefed and their questions were answered.

### *Data Analyses*

Due to the key interest in the magnitude of psychological changes evoked by humor and exercise, the percent (%) change scores were calculated using the method described by Fillingim, Roth and Cook (1992). These scores reflect the treatment-induced differences. The formula used was: *Percent (%) change score* =  $[(\text{Post-treatment score} - \text{Pre-treatment score}) / \text{Pre-treatment score}] \times 100$ . The data were analyzed with a multivariate repeated measures analysis of variance (MANOVA). The results of the MANOVA were followed up with univariate tests, which were further examined with Bonferroni corrected paired *t*-tests.

### *Results*

The MANOVA of the percent change scores yielded a significant treatment main effect (Wilk's  $\Lambda = .572$ ,  $F(8,146) = 5.88$ ,  $p < .001$ ). Uni-

variate follow up tests, using Greenhouse-Geisser correction, revealed significant differences between the three conditions in all the four dependent measures; state anxiety ( $F(1.5, 58.3) = 5.32, p < .01$ ), positive well-being ( $F(1.3, 48.2) = 7.43, p < .005$ ), psychological distress ( $F(1.8, 69.8) = 10.0, p < .001$ ), and physical fatigue ( $F(1.6, 61.0) = 5.60, p < .01$ ). The mean percent changes in the four dependent measures in the three treatment conditions are presented in Figure 1.

Significant differences in the magnitude of the percent changes in mood and anxiety, between the three conditions, were examined with Bonferroni corrected  $\alpha = .004$  ( $\alpha = .05/12$  tests = .004) paired  $t$ -tests. For state anxiety, statistically significant differences emerged between the humor and the exercise session ( $t(38) = 3.36, p < .002$ ) as well as between the humor and the documentary video session ( $t(38) = -3.14, p < .003$ ), but not between the exercise and the video session. For the other three dependent measures, positive well-being, psychological distress, and physical fatigue, the only statistically significant differences emerged between the humor and the

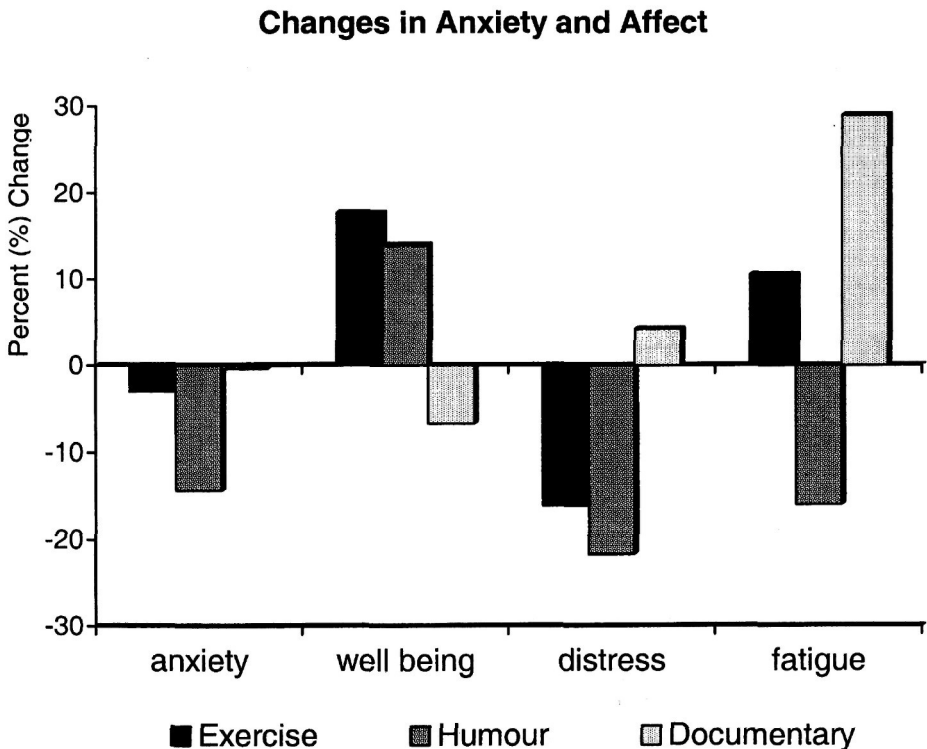


Figure 1. Mean percent (%) changes from pre- (line at 0) to post-treatment in four dependent measures (state anxiety, positive well-being, psychological distress, and physical fatigue) as measured in three experimental situations.

documentary video session; ( $t(38) = 6.03, p < .001$  for well-being,  $t(38) = -4.59, p < .001$  for distress, and  $t(38) = -3.64, p < .001$  for fatigue).

### Discussion

The results of this exploratory study demonstrate that: 1) humor has positive effects on state anxiety and mood, and 2) these effects are comparable or possibly even stronger than those of a similar duration bout of exercise. The reason why the effects of humor may be stronger than that of exercise, albeit in this inquiry statistical differences were seen in state anxiety only, could be explained by two facts. The first is that mood was measured with an instrument *specifically* designed to gauge exercise-related changes in mood, or the SEES (McAuley & Courneya, 1994). Hence, any real effects of humor may be expected to be stronger when a more general or humor-specific instrument is used. Indeed, Biddle (2000) thought that using the SEES, when the impact of other treatments is compared to exercise, may lead to questionable results. Consequently, one shortcoming of the current research was the lack of employment of a general mood state-gauging instrument in addition to the SEES. On the other hand, these results agree with previous findings (Snowball & Szabo, 1999; Szabo et al., 1998), which have shown that the three mood measures obtained with the SEES are *not specific* to exercise.

The second reason why the impact of humor could be expected to be stronger than that of exercise is related to an initial delimitation (and hence limitation) of this study of testing sport science students only. These participants may have expectations related to the mood benefits of exercise that may be channeled into their mood-ratings following a bout of exercise. However, experimental research failed to disclose evidence for the mood-moderating role of expectancy in joggers (Berger, Owen, Motl & Parks, 1998). Accordingly, what may be perceived as limitations in this study, in favor of humor's impact of psychological well-being, remains speculative at this time and needs to be tested directly in future research. In summary, apart from state anxiety, the mood benefits of humor and exercise appear to be equally positive.

Although state anxiety was lower five minutes after humor than five minutes after the exercise session (14% vs. 3%), these results need to be looked at cautiously because in exercise settings the SSAI is now believed to gauge perceived activation and effort-associated tension (Ekkekakis et al., 1999) rather than state anxiety per se. In spite of this hypothesis, there are numerous studies that have demonstrated that a 20-minute bout of acute aerobic exercise has anxiolytic properties (Petrusello et al., 1991; Petrusello & Landers, 1994; Raglin & Wilson, 1996). Hence, while the employment of the SSAI may not be considered a serious limitation at this time, the possibility that the differences in state anxiety after humor and exercise may be due to physiological confounds should be kept in perspective.

The results obtained with physical fatigue were not statistically different between the humor and exercise session (albeit the changes were in the

opposite direction, refer to Figure 1). Such results could be expected since self-selected exercise implies different levels of chosen effort, which then also results in large individual variability in the perception of fatigue. Further, the interpretation of fatigue after exercise may interfere with other exercise-induced feelings such as tranquility and revitalization (Gauvin & Rejeski, 1993) in the post-exercise period. Clearly a confound between mental and physical fatigue is apparent in this study, because the changes in this measure were the largest after the *effortless* documentary video watching. It appears, then, that the documentary video was not *neutral* but rather boring that could have induced negative mood as also manifested by the decrease in positive well-being and slight increase in psychological distress. While, these results are unlikely to affect in any way the results seen in response to humor and exercise, a really neutral control session was lacking in this research.

The current results corroborate and strengthen past research that has demonstrated the positive impact of humor (Houston, McKee, Carroll & Marsh, 1998; Mannell & McMahon, 1982; Martin et al., 1993; Newman & Stone, 1996; White & Winzelberg, 1992) and of acute aerobic exercise (Berger & Motl, 2000; LaFontaine, et al., 1992; McDonald & Hodgdon, 1991; O'Connor et al., 2000; Petruzzello et al., 1991; Scully et al., 1998). Perhaps the most important contribution of this exploratory research is to show that two distinct leisure activities such as humor and exercise yield similar psychological effects. It is noteworthy to emphasize that unlike most previous studies that were carried out in the laboratory, this study was a field experiment in which the treatments were presented in a social co-acting (but not interacting) situation. Social activities have been positively related to well-being (Okun, Stock, Haring & Witter, 1984; Turner, Rejeski & Brawley, 1997). Further, both treatment effects and external validity may be greater in a social setting than in the laboratory. Treatment effects may increase through social justification and/or amplification of one's response via the observation of the co-acting peers' responses. For example, Butcher and Whissell (1984) reported that the amount of laughter increases with group size. External validity may also be greater in a natural environment because in the laboratory the treatment-anticipatory period, in which the participant is most often alone, could induce anxiety (Szabo et al., 1993).

There are at least two explanations accounting for the comparable effects of humor and exercise on mood and anxiety observed in this inquiry. The first could be based on Morgan's (1985) *distraction hypothesis*, which proposes that any pleasant 'time-out' activity could yield psychological benefits. Indeed, the participants may have perceived both humor and exercise intervention as pleasant, in contrast to the documentary video, and responded accordingly with positive changes in mood and anxiety. Alternatively, the similarity between the physiological response to exercise and humor-related laughter, that prompted Sobel and Ornstein (2002) to call laughter "inner jogging," could be the foundation of the similar psychological effects.

While this study shows that there are positive psychological benefits gained from humor and exercise, there are several limitations of the current study that need to be addressed in future research. For example, the self-



selected exercise workload needs to be measured along with the rated perceived exertion in the exercise condition. In the humor condition, the amount, frequency and magnitude of laughter need to be assessed. The duration of the effects is another emerging issue that needs to be investigated to see whether humor could be prescribed as an alternative behavioral intervention to exercise. For example, are the effects of humor lasting as long as the effects of exercise, or even longer? Humor content and sense of humor as well as physical fitness may be covariates that need to be taken in consideration. Using both situation-specific and more general instruments in gauging mood could lead to clearer results. Finally, the presentation of the treatments in several different orders (in several waves using not only sport science students) along with a *truly* neutral control session could strengthen the findings.

Some criticism of the extant literature in the area of exercise-affect relationship ought to be discussed as well. First, it appears that the predicted beneficial effects of exercise on mental health may be in exaggerated focus. Clearly, not all people benefit psychologically from an acute bout of exercise. Further, other physically passive treatments could yield similar effects to exercise. The studying of combined effects, especially in those responding equally to exercise and humor, appears to be warranted in future research. The benefits of regular exercise in improving health and fitness that concomitantly may be expected to improve mental health are not disputed. Still, when the focus is on mental health, from an applied research perspective, it appears that other leisure activities, such as humor, could produce comparable or even superior immediate effects. This is an important point because many people wish not or *cannot* engage in exercise.

### Conclusion

Using a within-participant design, this field experiment demonstrated that 20 minutes of humor and 20 minutes of running or jogging, at a self-selected pace, have positive effects on the participants' mood and state anxiety. The study also revealed that the changes in psychological distress and positive well-being after humor and exercise were similar, however the anxiety-lowering effects of humor were greater than that of exercise. These preliminary results deserve systematic research attention in future inquiries due to their practical importance in the area of leisure and health.

### References

- AATH. (2001). *Purpose of the Association for Applied and Therapeutic Humor*. Retrieved May 10, 2002, from [http://www.aath.org/home\\_1.html](http://www.aath.org/home_1.html)
- Berger, B. G., & Motl, R. W. (2000). Exercise and mood: A selective review and synthesis of research employing the Profile of Mood States. *Journal of Applied Sport Psychology*, 12, 69-92.
- Berger, B. G., Owen, D. R., Motl, R. W., & Parks, L. (1998). Relationship between expectancy of psychological benefits and mood alteration in joggers. *International Journal of Sport Psychology*, 29, 1-16.

- Biddle, S. J. H. (2000). Emotion, mood and physical activity. In S. J. H. Biddle, K. R. Fox, & S. H. Boutcher (Eds.), *Physical activity and psychological well-being* (pp. 63-87). London: Routledge.
- Biddle, S. J. H., Fox, K. R. & Boutcher, S. H. (Eds.) (2000), *Physical activity and psychological well-being*. London: Routledge.
- British Columbia Ministry of Health (1978). *Physical Activity Readiness Questionnaire (PAR-Q) Validation Report*.
- Butcher, J., & Whissell, C. (1984). Laughter as a function of audience size, sex of the audience, and segments of the short film "Duck Soup". *Perceptual and Motor Skills*, 59, 949-950.
- Doskoch, P. (1996, July-August). Happily ever laughter. *Psychology Today*, 29(4), 32-34.
- Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (1999). Measuring state anxiety in the context of acute exercise using the State Anxiety Inventory: an attempt to resolve the brouhaha. *Journal of Sport and Exercise Psychology*, 21, 205-229.
- Ekkekakis, P., & Petruzzello, S. J. (1999). Acute aerobic exercise and affect: Current status, problems and prospects regarding dose-response. *Sports Medicine*, 28, 337-374.
- Fillingim, R. B., Roth, D. L., & Cook E. W. (1992). The effects of aerobic exercise on cardiovascular, facial EMG, and self-report responses to emotional imagery. *Psychosomatic Medicine*, 54, 109-120.
- Gauvin, L., & Rejeski, W. J. (1993). The Exercise-Induced Feeling inventory: development and initial validation. *Journal of Sport and Exercise Psychology*, 15, 403-423.
- Houston, D. M., McKee, K. J., Carroll, L., & Marsh, H. (1998). Using humour to promote psychological well-being in residential homes for older people. *Aging and Mental Health*, 2(4), 328-332.
- LaFontaine, P. T., DiLorenzo, T. M., Frensch, P. A., Stucky-Ropp, R. C., Bargman, E. P., & MacDonald, D. G. (1992). Aerobic exercise and mood: A brief review, 1985-1990. *Sports Medicine*, 13, 160-170.
- Mannell, R. C., & McMahon, L. (1982). Humor as play: its relationship to psychological well-being during the course of the day. *Leisure Science*, 5, 143-155.
- Martin, R. A., Kuiper, N. A., Olinger L. J., & Dance, K. A. (1993). Humor, coping with stress, self-concept, and psychological well-being. *Humor*, 6, 89-104.
- McAuley, E. & Courneya, K. S. (1994). The Subjective Exercise Experience Scale (SEES): Development and preliminary validation. *Journal of Sport and Exercise Psychology*, 16, 163-177.
- McDonald, D. G. & Hodgdon, J. A. (1991). *Psychological effects of aerobic fitness training*. New York: Springer-Verlag.
- Monro, D. H. (1988). Theories of humor. In Behrens, L. & Rosen, L. J. (Eds.), *Writing and reading across the curriculum* (pp. 349-355), (3<sup>rd</sup> ed.). Glenview, IL: Scott, Foresman and Co.
- Moran, C. C. (1995). Short-term mood change, perceived funniness, and the effect of humor stimuli. *Behavioral Medicine*, 20, 32-38.
- Morgan, W. P. (1985). Affective beneficence of vigorous physical activity. *Medicine and Science in Sports & Exercise*, 17, 94-100.
- Morgan, W.P. (Ed.) (1997). *Physical activity and mental health*. Washington DC: Taylor & Francis.
- Newman, G. A. & Stone, A. A. (1996). Does humor moderate the effects of experimentally-induced stress? *Annals of Behavioral Medicine*, 18, 101-109.
- O'Connor, P. J., Raglin, J. S., & Martinsen, E. W. (2000). Physical activity, anxiety and anxiety disorders. *International Journal of Sport Psychology*, 31, 136-155.
- Okun, M. A., Stock, W. A., Haring, M. J., & Witter, R. A. (1984). The social activity/subjective well-being relation: A quantitative synthesis. *Research on Aging*, 6, 45-65.
- Petruzzello, S. J., & Landers, D. M. (1994). Varying the duration of acute exercise: implications for changes in affect. *Anxiety, Stress, and Coping*, 6, 301-310.

- Petruzzello, S. J., Landers, D. M., Hatfield, B. D., Kubitz, K. A., & Salazar, W. (1991). A meta-analysis on the anxiety-reducing effects of acute and chronic exercise: Outcomes and mechanisms. *Sports Medicine*, 11, 143-182.
- Raglin, J. S., & Wilson, M. (1996). State anxiety following 20 minutes of bicycle exercise at selected intensities. *International Journal of Sports Medicine*, 17(6), 467-471.
- Sandlund, E. S., & Norlander, T. (2000). The effects of tai chi chuan relaxation and exercise on stress responses and well-being: An overview of research. *Journal of Stress Management*, 7, 139-149.
- Scully, D., Kremer J., Meade, M. M., Graham, R., & Dudgeon, K. (1998). Physical exercise and psychological well-being: A critical review. *British Journal of Sports Medicine*, 32, 111-120.
- Snowball, J., & Szabo, A. (1999). Anxiety, affect and exercise: Preliminary evidence lends support to the Distraction Hypothesis. *Journal of Sport Sciences*, 17, 67-68.
- Sobel, D. S., & Ornstein, R. (2002). Good humor, good health. Retrieved May 13, 2002, from <http://www.kaiserpermanente.org/toyourhealth/hottopics/sobel/humor.html>
- Spielberger, C.D., Gorsuch, R.L. & Luchene, R.E. (1970). *Manual for the state-trait anxiety inventory*. Palo Alto, CA: Consulting Psychologists.
- Szabo A., Mesko, A., Caputo, A., & Gill, É. (1998). Examination of exercise-induced feeling states in four modes of exercise. *International Journal of Sport Psychology*, 29, 376-390.
- Szabo, A., Péronnet, F., Boudreau, G., Côté, L., Gauvin, L., & Seraganian, P. (1993). Psychophysiological profiles in response to various challenges during recovery from acute aerobic exercise. *International Journal of Psychophysiology*, 14, 285-294.
- Turner, E. E., Rejeski, W. J., & Brawley, L. R. (1997). Psychological benefits of physical activity are influenced by the social environment. *Journal of Sport and Exercise Psychology*, 19, 119-130.
- White, S. and Winzelberg A. (1992). Laughter and stress. *Humor*, 5, 343-355.