# BRIEF REPORT

JOURNAL OF SPORT & EXERCISE PSYCHOLOGY, 2001, **23**, 156-160


# Enhancing Athletic Performance Through the Administration of Peppermint Odor

**Bryan Raudenbush, Nathan Corley, and William Eppich**
Wheeling Jesuit University

Previous research has indicated that odorant presentations can have both positive and negative effects on psychological perceptions of athletic task performance. The present study extends past research by assessing how the administration of peppermint odor affects actual athletic task performance. Forty athletes undertook a series of physical tasks under conditions of no-odor or peppermint odor. The peppermint odor condition resulted in increases in running speed, hand grip strength, and number of push-ups, but had no effect on skill related tasks such as basketball free-throw shots. The implications are particularly salient in regard to enhancing athletic performance using a nonpharmacological aid and as an adjunct to athletic training and physical therapy.

Key words: athletic training, athletic outcomes, physical ability

A series of studies has recently begun to emerge centering on the ability of odors to influence mood. Knasko (1992) found that participants report fewer health symptoms in the presence of lemon odor, but report a less pleasant mood in the presence of dimethyl sulfide. Rottman (1989) found that the presence of jasmine in a testing room enhanced performance on cognitive tasks and led to subjects indicating more motivation and interest in the task. Finally, in a series of studies, Warm and colleagues (Dember, Warm, & Parasuraman, 1996; Jones, Ruhl, Warm, & Dember, 1999; Warm, Dember, & Parasuraman, 1991) indicate that performance and vigilance on a tedious task are enhanced by peppermint odor.

These odors have a direct psychological impact on mood state due to differences in their hedonic qualities, such that good smelling odors are more pleasant and thus tend to enhance mood. Physiologically, the mechanism for such effects is not completely understood, although there is evidence that these odors have significant and widespread effects on the central nervous system (Kobal & Hummel, 1989; Lorig & Schwartz, 1988; Van Toller, 1988). These researchers noted substantial changes in EEG activity when various odors were administered. One explanation for the changes noted in EEG activity relates to attentional differences; EEG patterns change predictably when participants actively attend to the presentation of a stimulus. However, further research has provided evidence that these

B. Raudenbush and N. Corley are with the Dept. of Psychology, and W. Eppich is with the Dept. of Physical Therapy, at Wheeling Jesuit University, Wheeling, WV 26003.

EEG differences occurred even if the participants were unaware that an odor was being administered (Lorig, Huffman, DeMartino, & DeMarco, 1991). Even during sleep, the presentation of peppermint odor results in a greater incidence of high frequency EEG bursts (similar to awake EEGs), increased heart rate, and inhibition of EMG activity (Badia, Wesensten, Lammers, Culpepper, & Harsh, 1990).

Mood, physiological arousal, and athletic performance are highly related in various sport contexts (Morgan, O'Connor, Ellickson, & Bradley, 1988; Newby & Simpson, 1994, 1996; Reilly, 1977; Totterdell, 1999). In light of this, Raudenbush, Meyer, and Eppich (in press) attempted to determine whether the changes in mood and physiology brought about by the administration of odors would have any effect on athletic performance. They had athletes undergo a modified 15-minute treadmill exercise stress test under each of four odorant conditions—peppermint, jasmine, dimethyl sulfide, or a non-odored control condition—delivered via a nasal cannula. Peppermint odor significantly reduced perceived physical workload, temporal workload, effort, and frustration. Self-evaluated performance was also greater in the peppermint condition, as participants rated their level of vigor higher and their level of fatigue lower. In the dimethyl sulfide condition the athletes indicated more fatigue and increased physical workload.

Expanding on the results of Raudenbush et al. (in press), the present study sought to assess whether the addition of peppermint odor (chosen due to previous work showing positive effects on psychological aspects of athletic performance) would affect end-result physical performance. It was believed that the addition of a hedonically pleasant, stimulating peppermint odor to a physical task would significantly improve performance, primarily by increasing the athletes' mood and motivation so they would strive harder for a better performance.

## Method

### *Participants and Procedures*

Participants were 40 young adult volunteers, 20 men and 20 women, with a mean age of 20 years. They were selected from a variety of intercollegiate sports teams whose training regimen required extensive running (e.g., track, soccer, basketball). Participants received financial compensation after completing the experiment.

In the testing phase the participants were asked to perform four tasks: (a) dynamometer hand grip with the dominant hand; (b) 400-m dash, timed; (c) push-ups to exhaustion, no time limit; and (d) 20 basketball free-throw shots. They performed the protocol twice, each time under a different odor condition. Condition 1 called for placing an odorized (two drops of peppermint oil, Aldrich Co.) adhesive strip under the participant's nose. Condition 2 was identical except that the adhesive strip was odor-free. The athletes performed the procedure under both conditions, separated by at least 2 days; the order of conditions was randomly assigned.

## Results

The data were subjected to a correlated measures *t*-test for each physical task to determine significance. Means, standard deviations, and effect sizes for the measures are shown in Table 1.

**Table 1 Means, Standard Deviations, and Effect Sizes for Tasks Under Different Odor Conditions**

| Task | No odor | Peppermint odor | Effect size (*d*) |
|---|---|---|---|
| 400-m Dash | 81.40 ± 9.66 | 79.58 ± 10.31 | 0.47 |
| Free Throws | 8.90 ± 5.20 | 9.20 ± 4.13 | 0.09 |
| Hand Grip | 4.07 ± 0.78 | 4.30 ± 1.11 | 0.29 |
| Push-ups | 29.45 ± 12.35 | 31.18 ± 10.63 | 0.32 |

A significant difference was found between the odorized and non-odorized condition for push-ups, $t(39) = 2.02$, $p = .051$; and 400-m run, $t(39) = -2.94$, $p = .005$. Differences for the hand grip approached significance, $t(39) = 1.833$, $p = .074$. No significant differences were noted for the free-throw task, $t(39) = 0.60$, $p = .551$.

## Discussion

Extending previous findings noting that peppermint odor can enhance the psychological aspects of athletic performance (Raudenbush et al., in press), the results of the present study indicate that actual physical performance can be enhanced as well. Participants did more push-ups, ran faster, and showed a trend toward stronger grip strength in the peppermint odor condition than in the non-odorized control condition.

It is interesting to note that while there were differences for push-ups, running speed, and grip strength, there were no significant differences in basketball free-throws. Previous research suggests that the application of a pleasant odorant increases one's mood (Raudenbush et al., in press; Rottman, 1989); therefore, since mood and motivation are closely related, the increase in mood may also bring about an increase in motivation. With an increase in motivation, athletes are likely to exert more effort, which in the present study led to their running faster, doing more push-ups, and having greater dynamometer grip strength. Basketball free-throw shooting ability differs from the other methods of assessment, however, in that it is more skill related. If an athlete does not have the skill to make the free-throw, increasing the level of motivation will merely result in a more motivated athlete who still does not have the skill to make the free-throw. Thus it is not surprising that the number of free-throws completed did not change in the odorant condition.

Although the present study was the first to assess the effects of odorants on actual measures of athletic performance, the effects of peppermint are potentially substantial. In an age when athletic competitions can be won or lost by mere hundredths of a second, athletes are continually looking for new ways to excel in their sport. While the mean difference between the no-odor and the peppermint-odor conditions was quite small, effect-size measures for the statistically significant tests approached the moderate range. In addition, the use of peppermint as an ergogenic aid appears to be associated with larger effect sizes than other aids such as

caffeine (Spriett, 1995) and nasal dilators (Connel & Fregosi, 1993; Griffin, Hunter, Ferguson, & Sillers, 1997), and appears comparable to aids such as relaxation and imagery (Meyers & Schleser, 1980; Predebon & Docker, 1992; Wrisberg & Anshel, 1989) and "psyching up" (Caudill, Weinberg, & Jackson, 1983; Weinberg, Gould, & Jackson, 1980, 1981).

The application of peppermint odor before or during athletic competitions may enhance an athlete's mood and motivation and subsequent performance. While further research is needed, the administration of peppermint odor could serve as an important adjunct to an athlete's normal training regimen and could also help the athlete maintain a positive mood during physical therapy.

## References


Badia, P., Wesensten, N., Lammers, W., Culpepper, J., & Harsh, J. (1990). Responsiveness to olfactory stimuli presented during sleep. *Physiology & Behavior*, **48**, 87-90.

Caudill, D., Weinberg, R., & Jackson, A. (1983). Psyching-up and track athletes: A preliminary investigation. *Journal of Sport Psychology*, **5**, 231-235.

Connel, D.C., & Fregosi, R.F. (1993). Influence of nasal airflow and resistance on nasal dilator muscle activities during exercise. *Journal of Applied Physiology*, **74**, 2529-2536.

Dember, W.N., Warm, J.S., & Parasuraman, R. (1996). Olfactory stimulation and sustained attention. In A. Gilbert (Ed.), *Compendium of olfactory research* (pp. 39-46). New York: Olfactory Research Fund, Ltd.

Griffin, J.W., Hunter, G., Ferguson, D., & Sillers, M.J. (1997). Physiologic effects of an external nasal dilator. *Laryngoscore*, **107**, 1235-1238.

Jones, K.S., Ruhl, R.L., Warm, J.S., & Dember, W.N. (1999). Olfaction and vigilance: The role of hedonic value. In M.W. Scerbo & M. Mouloua (Eds.), *Automation technology and human performance: Current research and trends* (pp. 193-197). London: Erlbaum.

Knasko, S.C. (1992). Ambient odor's effect on creativity, mood, and perceived health. *Chemical Senses*, **17**, 27-35.

Kobal, G., & Hummel, C. (1989). Cerebral chemosensory evoked potentials elicited by chemical stimulation of the human olfactory and respiratory nasal mucosa. *Electroencephalography and Clinical Neurophysiology*, **71**, 241-250.

Lorig, T.S., Huffman, E., DeMartino, A., & DeMarco, J. (1991). The effects of low concentration odors on EEG activity and behavior. *Journal of Psychophysiology*, **5**, 69-77.

Lorig, T.S., & Schwartz, G.E. (1988). Brain and odor. I. Alternation of human EEG by odor administration. *Psychobiology*, **16**, 281-284.

Meyers, A.W., & Schleser, R. (1980). A cognitive behavioral intervention for improving basketball performance. *Journal of Sport Psychology*, **2**, 69-73.

Morgan, W.P., O'Connor, P.J., Ellickson, K.A., & Bradley, P.W. (1988). Personality structure, mood states, and performance in elite male distance runners. *International Journal of Sport Psychology*, **19**, 247-263.

Newby, R.W., & Simpson, S. (1994). Basketball performance as a function of scores on Profile of Mood States. *Perceptual & Motor Skills*, **78**, 1142.

Newby, R.W., & Simpson, S. (1996). Correlations between mood scores and volleyball performance. *Perceptual & Motor Skills*, **83**, 1153-1154.

Predebon, J., & Docker, S.B. (1992). Free-throw shooting performance as a function of preshot routines. *Perceptual and Motor Skills*, **75**, 167-171.

Raudenbush, B., Meyer, B., & Eppich, B. (in press). The effects of odors on objective and subjective measures of athletic performance. *International Sports Journal.*

Reilly, T. (1977). Pre-start moods of cross-country runners and their relationship to performance. *International Journal of Sport Psychology*, **8**, 210-217.

Rottman, T.R. (1989). *The effects of ambient odor on the cognitive performance, mood, and activation, of low and high impulsive individuals in a naturally arousing situation.* Unpublished doctoral dissertation, Texas Christian University.

Spriett, L.L. (1995). Caffeine and performance. *International Journal of Sport Nutrition*, **5**, S84-S99.

Totterdell, P. (1999). Mood scores: Mood and performance in professional cricketers. *British Journal of Psychology*, **90**, 317-332.

Van Toller, C. (1988). Emotion and the brain. In C. Van Toller & G. Dodd (Eds.), *Perfumery: The psychology and biology of fragrance* (pp. 121-146). London: Chapman Hall.

Warm, J.S., Dember, W.N. & Parasuraman, R. (1991). Effects of olfactory stimulation on performance and stress in a visual sustained attention task. *Journal of the Society of Cosmetic Chemists*, **42**, 199-210.

Weinberg, R.S., Gould, D., & Jackson, A.V. (1980). Cognition and motor performance: Effects of psyching-up strategies on three motor tasks. *Cognitive Therapy and Research*, **4**, 239-245.

Weinberg, R.S., Gould, D., & Jackson, A.V. (1981). Relationship between the duration of the psych-up interval and strength performance. *Journal of Sport Psychology*, **3**, 166-170.

Wrisberg, C.A., & Anshel, M.H. (1989). The effect of cognitive strategies on the free throw performance of young athletes. *The Sport Psychologist*, **3**, 95-104.

*Manuscript submitted*: September 20, 2000
*Revision accepted*: March 8, 2001