

EFFECTS OF FLOTATION RESTRICTED ENVIRONMENTAL
STIMULATION ON INTERCOLLEGIATE
TENNIS PERFORMANCE^{1, 2, 3}

PATRICK J. McALENEY, ARREED BARABASZ, AND MARIANNE BARABASZ

Washington State University

Summary.—The study investigated the effects of flotation Restricted Environmental Stimulation (REST) with an imagery message on the competitive performance of intercollegiate tennis players (10 men, 10 women). Pre- and posttreatment athletic performance was measured during intercollegiate competition. Posttreatment results indicated that subjects exposed to flotation REST with an imagery message performed significantly better than subjects exposed to imagery only on a measure of first service accuracy. Findings suggest that flotation REST can be used to enhance the performance of a well learned skill by athletes of high ability.

Flotation Restricted Environmental Stimulation (REST) has produced promising preliminary enhancement of sports performance (Hutchison, 1984, pp. 13-14; Lee & Hewitt, 1987; Stanley, Mahoney, & Reppert, 1987; Suedfeld & Bruno, in preparation; Wagaman & Barabasz, 1990). The technique involves floating on a dense magnesium sulfate solution in a sound-attenuated, light-free tank. Unfortunately, the studies to date are limited in scope and scientific rigor. Only three studies presented data beyond anecdotal or case study reports (Lee & Hewitt, 1987; Suedfeld & Bruno, in preparation; Wagaman & Barabasz, 1990).

Lee and Hewitt (1987) examined the use of the flotation tank for the improvement of gymnastic performance and the reduction of physical symptoms. Female gymnasts of novice and intermediate skill were randomly assigned to one of three treatment conditions: REST and visualization, non-REST and visualization, or control. In each condition subjects were exposed to audiotaped messages which included initial relaxation, visualization of routines, and "wake-up." Subjects floated for 40 min. once a week for 6 wk. Subjects in the REST condition performed significantly better than subjects in the nonREST visualization only and control conditions.

The two other studies of flotation REST and athletic performance (Wagaman & Barabasz, 1990; Suedfeld & Bruno, in preparation) examined effects of flotation REST on basketball players' performance. Suedfeld and Bruno (in preparation) examined the use of visual imagery combined with

¹The authors thank Rebecca Dyer, Dan Peterson, Ken Azbill, Pallavi Nishith, and Prof. Dennis Warner, Ph.D. for their help.

²This paper is based on a Ph.D. dissertation by the first author.

³Reprints may be obtained from Prof. Arreed Barabasz, Ph.D., Director, Hypnosis and REST Laboratory, Washington State University, Pullman, WA 99164-2131.

flotation REST, an "Alpha Chair," and a normal room and chair, on the free-throw performance of occasional or nonbasketball players. Free throw (foul shot) accuracy improved by 50% the day after a 1-hr. flotation REST session with guided imagery. The two nonREST imagery-only groups showed no improvement. It was suggested that REST may induce an optimal arousal state for the task and/or it may enable subjects to return to such a level 24 hr. after treatment. Also suggested was the notion that imagery may be more vivid or accurate in a REST environment or that REST may make the imagery more accessible later. A synergistic interaction between imagery and optimal arousal was hypothesized to explain the results. Unfortunately, the study employed only a single REST session. The specificity of effects are in doubt since a single flotation session could be expected to be perceived as more novel than the control condition. Further, the results produced by non-expert occasional recreational players tell us nothing about the effects of REST on dedicated athletes of high ability.

During the 1988-89 season, Wagaman and Barabasz (1990) examined the basketball performance of players of high ability from two large north-western university intercollegiate varsity basketball teams. Subjects were randomly assigned to treatment groups, including REST (six flotation sessions) with visual imagery and relaxation with visual imagery (six sessions). Subjects were tested on performance and self-report measures before and after treatment. Analysis showed that the two groups were equivalent at the pretest but differed after treatment on basic athletic performance measures. Wagaman and Barabasz's (1990) results were viewed as consistent with the concurrent findings of Suedfeld and Bruno (in preparation). The study also suggested that two REST sessions per week were the most effective for performance enhancement.

To date, no study has tested the effects of flotation REST and visual imagery with comprehensive performance measures in a competitive environment, and no study has focused on tennis. The purpose of the present study was to test the effects of REST and visual imagery on the competitive performance of expert intercollegiate tennis players. Indeed, little can be said about the effectiveness of REST on athletic performance if data are not obtained in actual competition.

METHOD

Subjects

Members of a varsity tennis team (10 men, 10 women; ages 18 to 22 yr.) from a PAC-10 university volunteered for this study. To control for possible confounds due to sex differences, groups were balanced according to sex. Within the sex constraint, subjects were randomly assigned to one of two treatment groups, (1) flotation REST with imagery messages and (2) an

imagery-message-only condition. Subjects in both groups understood that imagery training was widely used and had been shown to be an effective technique for enhancement of performance.

Apparatus

A Flotarium brand flotation tank was employed for the REST treatment subjects. It is constructed of fiberglass, is lightproof and sound-attenuated. Intercommunication and ventilation systems are integral to the construction of the Flotarium tank. Subjects floated supine on a solution of water and Epsom salts (magnesium sulfate) at a density of 1.30 gm per cubic centimeter (Lilly, 1977). The solution was maintained at approximately 34.2° centigrade ($\pm .2^{\circ}\text{C}$) (Lilly, 1977).

Subjects in the imagery-only condition were exposed to treatment in a REST chamber, a sound-attenuated room (3 m \times 1.7 m \times 2.4 m). Entry to the chamber is provided by an elaborate double door. The experimental demand characteristics of the chamber are at least as great as those of the flotation tank. To eliminate potential REST effects for the imagery-only control condition, the room was fully lighted and normal sounds were provided by an open intercom hidden in a ceiling vent. Subjects moved about the room or sat in a comfortable chair.

Materials

The performance enhancement/visual-imagery message was similar to that used in the Wagaman and Barabasz (1990) study. It was devised under the guidance of a professional tennis instructor and was eight minutes in length. It included images of five or six alternative skills during which the subjects visualized themselves making optimal shots (Feltz & Landers, 1983). This relatively short message length was selected so that subjects would have adequate time to process the content of the message in the REST environment. In the Wagaman and Barabasz (1990) study, the message was approximately 20 min. in length and was delivered at the 30-min. point of the 50-min. session. As a consequence, the subjects complained that they had no uninterrupted message-processing time in the REST environment.

Procedure

To familiarize subjects with experimental procedures (Suedfeld, 1980), those in the REST condition received an introduction to the tank and flotation procedures, including a 20-min. introductory float prior to their initial treatment session. Experience in our lab has shown that the introductory float is important because subjects enjoy a nonexperimental period which allows exploration of the environment. Novelty effects are greatly reduced. Subjects in the imagery-only condition received a similar orientation to their treatment condition.

Each group was exposed to six treatment sessions in the 3-wk. period

prior to the posttest (two sessions per week). Treatment periods were of 50 min. duration. At the halfway point in each session, subjects were exposed to the tape-recorded imagery message.

RESULTS

To obtain accurate performance data, subjects' tennis matches were videotaped before treatment and after completion of the six-treatment package. Players' opponents were matched for ability by the coaches at the pretreatment tournament. At posttreatment, opponents were determined by draw. At pretreatment, two of the study's players competed against each other; at posttreatment none did. Videotapes were scored by raters blind to subjects' treatment condition on three separate performance measures: first service, key shot, and points won/lost. The possible scores for service variables were winner, in-play, or error. The key shot, that shot which produced or resulted in winning or losing the game point, had possible scores of winner, forced error, or unforced error. Frequency counts were kept for each subject (e.g., first service winners) precluding the need to attempt to assign equal-interval scale values for the scores on the dependent measures. Length of time for scoring the videotapes was not standardized given the variability in actual playing time. The number of points to be scored per player was set at the first 50 points per match. Interrater reliability for all performance scores was .88.

t tests for independent samples were computed for each of the three separate performance variables. At pretreatment no significant differences were found between groups on the performance variables. At posttreatment, a significant difference was found between groups on first service winners ($t = 2.11, p < .05$); in the REST treatment group $M = 2.55$ ($SD = 2.5$). There were significantly more service winners than in the control group ($M = .67, SD = 1.4$). The results appear in Fig. 1. An omega squared showed that 15% of the variance was accounted for between the independent and dependent variables. Analyses of key shots and point won/lost data were not significant ($p > .05$).

Since first service data were frequency counts of winners and not normally distributed, complete reliance on the robustness of the sensitive parametric analysis might be inappropriate. To provide additional stringency nonparametric analyses were also calculated. A Kruskal-Wallis analysis of variance showed no significant difference between REST and control groups at pretreatment ($He_1 = 1.4, p > .05$). At posttreatment the REST group showed significantly better first service results than the control group ($He_1 = 4.3, p < .05$).

Pretreatment to posttreatment data were analyzed using the Wilcoxon signed-ranks test. Controls showed no significant change in performance ($N_s - R = 5, T = 5, p > .05$), while the REST group showed a significant im-

provement in first service winners after exposure to the six REST sessions ($N_s - R = 8$, $T = 3$, $p < .05$).

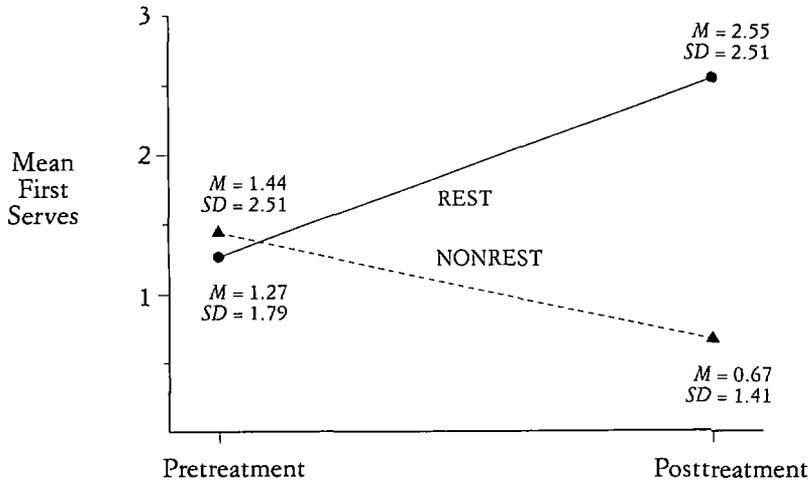


FIG. 1. First service results at pre- and posttreatment

DISCUSSION

This is the first study of the effects of REST with visual imagery on athletic performance, using outcome data obtained in actual competition. Both expert male and female athletes were employed and performance data were obtained on comprehensive competitive performance indicants. The results show that flotation REST combined with a visual-imagery message enhanced the performance of one previously well-learned key athletic skill among players of high ability. The significant first-service winner results indicate that players who are already at a high level of performance can improve the execution of this frequently repeated task.

The nonsignificant findings for the analyses of key shots are not surprising. For this variable, a variety of skills or types of shots were scored, including forehands, backhands, forehand and backhand volleys, drop shots, and overhead smashes. These shots, although highly practiced and repeated often, are inherently more variable in a game or match environment. A player has less control of the direction, speed, or spin of a ball returned by an opposing player, so these shots might be expected to be less responsive to imagery practice, no matter how favorable the learning environment. In contrast to this variability, the automatic nature of the service motion is under direct control of the server.

Also, the nonsignificance for the point won/lost measure is not surpris-

ing, since it is affected by the performance of both players, subjects, and opponents alike. In varsity athletics, there tends to be high similarity among the players, with the less skillful players not being selected for the teams so a convergence of over-all points scored is not unexpected. Despite this constraint, this measure was added to the study to provide over-all performance data. Perhaps increases in over-all points won might be observed for less highly skilled players.

It appears that REST was effective in enhancing the highly controlled skill of the service motion and was less effective for the more variable demands of the key shot. It also may be that the imagery message, which was generic in description, might be more effective if individually tailored to the needs of each player. Further research should assess the effect of individualized messages on enhancement of athletic performance.

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Accepted October 31, 1990.