The Effectiveness of EEG Biofeedback, Relaxation, and Imagery Training on Golf Putting Performance

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A variety of cognitive (imagery) and psychophysiological (relaxation, biofeedback) techniques have been used to enhance sport performance (Williams, 1989; Landers et al., 1981). Presently, no studies exist comparing the efficacy of these techniques to improve sport performance. While imagery is typically a cognitive mediator of performance, relaxation training may include both cognitive cues and feedback from physiological responses [e.g., breathing, heart tare (HR)]. Biofeedback training uses feedback from one's physiological responses to identify appropriate cognitive cues to facilitate performance. The purpose of the present investigation was to determine the efficacy of these three techniques to enhance sport performance. An electroencephalographic (EEG) measure known as slow potential shift (SPS) was used in the biofeedback condition. This signal represents "readiness to respond" and is recorded as a shift in the baseline of the EEG signal. The protocol of Elbert et al. (1980) was followed to increase SPS in the left hemisphere. Subjects trained relaxation and imagery skills by participating in an audio/videotape program designed specifically for golf. All training sessions were approximately one and one-half hour in length. Male (N=7) and female (N = 9) intermediate level golfers reported to the laboratory on four separate occasions to complete the three training sessions plus a control reading condition. The four conditions were counterbalanced to control for order effects. HR and state anxiety (Speilberger's State scale) were recorded prior to and following each training session to measure the effectiveness of the training condition. In addition, an imagery rating score and the maximal SPS were recorded. To assess sport performance, subjects completed 40, 12 ft putts prior to and following each training session. Putts made, cm error from the hole, and perception of self-confidence, concentration, and quality of the stroke were recorded after each putt. ANOVA results indicated a significant pre-post x condition (2 X 4) interaction for putts made. The most putts were made after biofeedback training ($\underline{M}$ = 15.8) and lastly, relaxation training showed a decrement from the putts made prior to training while biofeedback and imagery training improved putting performance. HRs, STAI scores, imagery ratings, and SPS measures verified the effectiveness of the training programs. It appeared that relaxation training inhibited putting performance while biofeedback produced the greatest improvements and the best putting performance.

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