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A Comparison of Two Neurofeedback Strategies on Golf Putting Performance

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Purpose: Neurofeedback training is becoming increasingly more popular in sports (Babiloni et al., 2008; Beauchamp et al., 2012; Berka, et al., 2010; Crews, 2016; Del Percio, et al., 2011). Since the mental side of golf is recognized as a strong component of the game, it might be a logical way to improve scores. The first question of interest is whether brain training actually improves performance in golf putting among a wide range of skill. Secondly which neurofeedback training technique is optimal to improve golf performance? One concept that has emerged to explain changes in neural processing is hemispheric differentiation, suggesting that one hemisphere of the brain is active (right side) while the other hemisphere is quiet (left side) immediately prior to initiating motion (Landers et al, 1984; Crews & Landers, 1993). A second concept is synchrony or coherence during the final second prior to motion (Crews, 2016). Two brain training devices have been used in golf to train these concepts. Focus Band attempts to quiet the left side of the brain (mushin state) and increase (right side alpha activity) quiet eye performance within the context of a routine (WO 2013040642 A1, 2013). Opti Brain attempts to synchronize the brain (synergy) during the final 1s before motion (U.S. Patent No. 8990054, 2015). No published data is available on Focus Band training. One published study for Opti Brain (Crews, 2016) suggests a 16% increase in successful 12 ft putts following 15 training trials. It was the purpose of this investigation to compare these two brain training approaches among skilled and less skilled golfers and determine the effect on golf putting scores.

Methods: Eleven individuals (male = 7, female = 4) volunteered to participate in this study. The average age was 59.00 $\pm$ 10.67 (range 29-66) years and the average index was 17.63 $\pm$ 10.56 (range 1.4-34). Total years playing golf was 31.00 $\pm$ 17.01 (range 2-50) and their average low score was 80.18 $\pm$ 11.47 (range 67-102). Golfers putt 10, 12ft straight putts on an outdoor putting green as their baseline measures. They putt to one hole using the Focus Band and a different hole using Opti Train. The hole used for the training rotated to equate the surfaces. Quality of feel (1-10, 10 is high), zone scoring (3=in the hole, 2 = within 10cm and 1= within 20 cm, 0 beyond 20 cm) and total putts made were recorded for each putt. Golfers were randomly assigned to Focus Band or Opti Brain device as their first condition to reduce the possibility of order effects. Golfers rested between conditions for 5 min. Golfers were introduced to device and trained for 3-5 min total without putts before the training condition. They then had 5 practice putts with device. This was followed by 15 training trials with one of the two headsets. Lastly, they completed 10, 12 ft posttest trials following each set of training trials. In addition to performance measures, each neurofeedback training system provided output measures relevant to the brain signals they were training. Thus, Focus Band provided a measure of mushin and quiet eye and Opti Brain provided a measure of synergy. These values were recorded during pretest, training and posttest trials. It would be important to see changes in brain patterns in addition to changes in performance if the performance differences were related to the training intervention.

Results: A 2 X 2 (Condition X Time) repeated measures Analysis of Variance was used to analyze the differences between the two neurofeedback techniques. Results indicated no differences in quality, zone score, or putts made as a result of mushin and quiet eye training. The average pretest zone score was 13.52 $\pm$ 3.88 and the posttest zone score was 12.85 $\pm$ 4.13 ($F(1,10) = .20$), $p=.66$, np2=.020. However, the mushin brain measure increased from the pretest (58.58 $\pm$ 30.70) to the posttest (73.95 $\pm$ 31.92) and this change was significant ($F(1,10) = 25.00$, $p = .02$, np2=.893). No other significant differences were found for the Focus Band training.

Results indicated a significant increase ($F(1,10) = 7.02$, $p=.02$, np2=.412) in zone score performance as a result of synchrony training. The average prestest zone score was 11.33 $\pm$ 5.73 and the average posttest zone score was 15.06 $\pm$ 3.04. In addition, the synergy brain measure increased significantly, $F(1,10)=4.89$, $p = .05$, np2=.329, from 67.94 $\pm$ 3.94 percent to 72.67 $\pm$ 4.18 percent. No other significant differences were found for Opti Brain training.

Both programs significantly increased the brain measure they were training, but only Opti significantly changed performance. Although nonsignificant, Focus Band increased the number of 12 ft putts made by 7% (2.46$\pm$1.64 to 2.64 $\pm$ 1.63) from the pretest to the posttest (15 training putts) and Opti increased the number of puttt apps made by 55% (1.64+1.29 to 2.55 $\pm$ 1.57).

Discussion: It appears from the results of this study that training synchrony in the brain during the final second before motion is more effective for improving golf putting performance than training the mushin/ quiet eye state during the preshot routine of golfers. Limitations to this study include small sample size, one training session of 15 trials, and a wide range of skill golfers. However, it was of interest that performance results improved significantly for one neurofeedback technique compared to another. Additional research is necessary to test various neurofeedback techniques with a variety of golf shots. It would also be important to include pressure situations to test the effectiveness of this mental training approach.

Practical Application/Clinical Relevance: Combining skill training with neurofeedback training among golfers of all skill levels may enhance golf putting performance. To improve putting performance, creating synchrony in the brain during the final second before motion may be more effective than lowering left hemisphere activity (mushin) and increasing right hemisphere alpha activity (quiet eye) as one completes their routine.

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