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Memory System Engagement as a Potential Neurocognitive Mechanism Underlying the Effectiveness of Self-Regulated Practice

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PURPOSE: Previous research indicates that self-controlled practice can be a more effective mode of practice than externally-controlled practice. This effect may be due, in part, to increased memory system engagement during self-controlled practice relative to externally-controlled practice. The proposed study seeks to investigate this notion using electroencephalographic (EEG) measures of memory system engagement, specifically theta power, alpha 2 power, and theta coherence between frontal and parietal regions. **METHODS:** Thirty-two novice participants were divided into two groups (self-controlled and yoked) to learn the cognitive-motor skill of golf putting over the course of three days. EEG measures representative of working memory engagement (theta power) and long-term memory engagement (alpha 2 power) were collected throughout the experiment. It was broadly hypothesized that the self-controlled practice group would show elevated working memory engagement and a refinement of long-term memory throughout practice as well as increased performance improvement on a 24hr-delayed retention test compared to the yoked group. **RESULTS:** Upon accounting for expected covariates, the self-controlled group achieved a significant improvement from baseline to retention in terms of the number of on-target putts ($p = 0.029$, $d = 0.409$) while the yoked group showed no such difference. Additionally, EEG results revealed that theta power in the left hemisphere remained elevated in the seconds prior to the putt, while the yoked group showed notable decreases (second 1 > second 4, $p < 0.001$, $d = 0.774$). Additionally, alpha 2 power was significantly larger in the first visit than in the second visit for the self-controlled group ($p = 0.005$, $d = 1.233$). These results suggest that the self-controlled group tended to exhibit more memory system engagement during practice than the yoked group which may have contributed to increased levels of performance improvement. **CONCLUSIONS:** These results provide early support for the notion that elevated engagement of the memory system is a potential mechanism by which self-controlled practice has a positive effect on learning over externally-imposed practice.

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