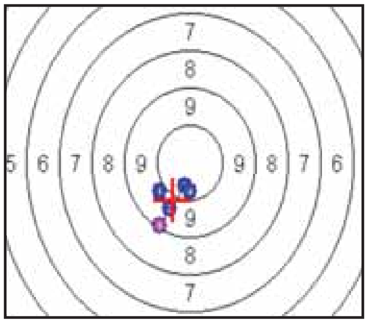
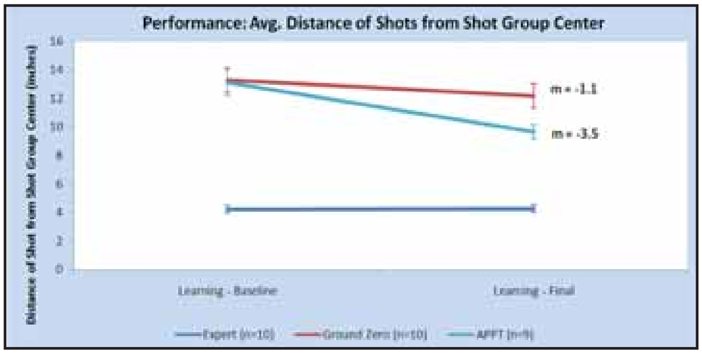
Improving the Pace and Efficiency of Rifle Marksmanship

The learning of a novel task relies heavily on conventional classroom instruction with qualitative assessment and observation. A suite of adaptive and interactive neuro-educational technology (I-NET) suites have been developed which utilize neuroscience-based evaluation techniques to accelerate skill acquisition and provide quantitative evidence of successful training. I-NET covers four major themes: 1) Integration of brain monitoring into paced instructional tutorials, 2) Identification of psychophysiological characteristics of expertise using a model population, 3) Development of sensor-based feedback to accelerate novice-to-expert transition, 4) Identification of neurocognitive factors that are predictive of skill acquisition to allow early triage and interventions. To demonstrate the application of I-NET we selected rifle marksmanship training because it is a core skill for the Army and Marine Corps and it involves both classroom instructional learning and field practice which requires instantiation of a well-defined set of sensory, motor and cognitive skills. The transition from novice to expert marksman requires practice and the speed and efficiency of acquiring the necessary motor skill is dependent on one's control of their physiology (respiration, heart rate, etc.). We applied an approach whereby the physiological patterns unique to expert marksmen were first identified and then real-time neuro-feedback was used to train novices to match the experts' physiology.



To profile expert marksmanship physiology, 10 qualified expert marksmen (off-duty military) underwent 3 trials of five shots each at a simulated 200m distance in a kneeling position with a demilitarized "airsoft" replica of the M4 with a infrared laser-based training system for target projection and shot detection. Shot precision was defined as the mean distance of each shot from the center of the shot group, where lower values reflect better precision. From a performance standpoint, the experts had similar results during both sessions. From a physiological perspective, experts displayed a deceleration in cardio respiratory function and a marked increase in EEG alpha power three to four seconds preceding each trigger pull. This pattern suggested automated task execution performed with minimal conscious mental effort. Of interest, the experts also exhibited significantly lower heart rate variability (cardio respiratory control) while simply sitting for 5-minutes with eyes opened and eyes closed.



For the novices, initial instruction was provided followed by baseline measures which included up to 8 trials of five shots. During the learning trials, half of the novices received neuro-feedback training to assist them in controlling their physiology. Feedback was provided using a B-Alert system modified with two visio-haptic motors affixed to their neck. The sensory motors were programmed to pulse concurrently with each heart beat to assist the novices learn how to control their cardio respiratory function. Once increasing EEG alpha activity was detected, the sensors stopped pulsing to indicate it was time for the novice to take the shot. The graph above shows the novices showed a 200% improvement in the shot precision rate as compared to novices when the neuro-feedback was provided.

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