Adaptive Training for Submarine Navigation and Piloting

EXHIBIT FACT SHEET

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The Adaptive Training for Submarine Navigation and Piloting (AT-SNAP) advances state-of-the-art training by developing and integrating tailored instructional approaches into submarine tactical systems.

In FY11, the Naval Air Warfare Center Training Systems Division (NAWCTSD) created a prototype system to test the ability of tailored, automated performance monitoring and feedback algorithms to improve a periscope operator's skill in estimating target angle on the bow (AOB) as compared to training that was not tailored or adapted based on a trainee's performance. Data was collected from a total of 176 participants including 81 Submarine Officer Basic Course (SOBC) students from Naval Submarine School Groton. Each participant's average absolute discrepancy from the correct angle on the bow, in degrees, was computed for both pre-test and post-test calls. These averages were then used to compute a learning gain score for each individual indicating the possible percentage points they could have gained from pre to post-assessment. The average gain score for the non-adaptive group was 12.8% with a standard deviation of 33.94%. In the adaptive group, the average gain score was 24.33% with a standard deviation of 25.27%. The mean differences were statistically significant, t (157)

= -2.55, p = .011, two-tailed, equal variances not assumed. Note that there were significant differences between the adaptive and non-adaptive group variances (Levine's test for equality of variance, F = 6.31, p = .013).

Additionally, statistically significant differences were found between the adaptive and non-adaptive groups for the average amount of time taken to complete an AOB call during the post-test scenarios. For the adaptive group, it took an average of 13.71 seconds (SD = 35 seconds) to complete a call at post-test while participants in the non-adaptive group took an average of 15.29 seconds (SD = 41 seconds) to make an AOB call. The difference between the means of the adaptive and non-adaptive groups was statistically significant, t (175) = 2.75, p =.007, two-tailed, equal variances assumed. Taken together, these results provide support for AT as an effective approach to training. Specifically, these results show that participants given AT had a higher gain rate and made quicker AOB calls than those given training that was not tailored to their individual performance.

In FY12, NAWCTSD is assessing the incremental effectiveness of different adaptation approaches (e.g., micro and Two-Step) and different adaptation variables (e.g., scenario difficulty adaptation and feedback content adaptation) within a submarine periscope operation task. The micro-adaptive approach utilizes assessment of continual on-task performance as the basis for adaptation. Instruction may be adapted on different aspects of performance such as response errors or response latencies during training. The two-step approach combines the Aptitude Treatment Interaction (ATI) (instruction is adapted based on student aptitudes or abilities that can be matched with certain types of instructional techniques or content) and micro-adaptive approaches so that adaptation is based both on a student's pre-task aptitudes and their on-task performance. This hybrid approach is based on the idea that pre-task aptitudes are less predictive of future performance than on-task performance. Prior to training, when on-task performance levels are unknown, an ATI approach would place the student in the appropriate difficulty level or determine instructional conditions such as sequencing and format based on their aptitudes. During training when on-task performance data has been collected, a micro-adaptive approach would then be used to assess student performance in real time to allow the system to adapt to the learner's current training needs.

NAWCTSD's research in adaptive training is being used to develop two training products for submarine tactical systems: Adaptive Training for Periscope Operators (PoAT) and Passive Narrowband Adaptive Training (NbAT). The PoAT product is a rule-based software application that generates periscope images with an integrated periscope simulator and adapts the difficulty of questions asked and the feedback that trainees receive to the performance of the trainee in estimating contact angle on the bow.

The NbAT product links an adaptive training game to an onboard acoustic database to train sonar operators in narrowband signal recognition and analysis using actual shipboard sonar system tools. The product aims to develop training that is adaptive and engaging (game-like), as well as carefully targeting skills required of today's sonar operators. To enhance playability and encourage use, features typical to video games were developed, including progress indicators, a scoring system, and clever animations.

For further information on this exhibit, or on business opportunities with the Office of Naval Research, Warfighter Performance Department please feel free to check our website at http://www.onr.navy.mil/Home/Science-Technology/Departments/Code-34.aspx or contact us by mail at: Office of Naval Research, One Liberty Center, Warfighter Performance Department ONR34, 875 N. Randolph St., Arlington VA, 22203.