Part-Task Trainers for Complex Cognitive Skills: Evaluation of the User Interface*

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Military preparedness has become more dependent upon effective human-computer interaction. Interactive computer systems are playing major roles in training the military. Simulation of the total system, as physically realistic as budgets allow, has been the military's approach to training. Several factors now lead to consideration of part-task trainers (PTTs) for single, complicated tasks. One factor is difficulty of maintaining simultaneous delivery of the weapons system and the complete simulator. A second factor is the difficulty of keeping up with modifications of the weapons system. Another is the need for on-the-job refresher training in distant fields of operation where the simulator is not available. Because part-task trainers are in a sense, modules, they increase the maintainability and adaptability of the total training system and the acceptability of partial simulation when operational systems are very complex.

The Naval Air (NAVAIR) Systems Command has developed a part-task trainer for a new airborne weapon, the Stand-off Land Attack Missile (SLAM). The SLAM PTT is an evolving system based on a PTT developed for the Systems/Weapons Integration Program for the A-6E aircraft. It is a desk-sized system with partial simulation capability, consisting of three computers and two touch-screen monitors.

The designers' intentions for the system are: to maintain a simultaneous delivery of the weapons and training; to adapt the system to weapon changes in a timely manner; to provide a portable trainer for shipboard refresher

training; to provide flexibility in scenario creation; to provide the ability to save multiple scenarios; to be "user friendly"; to be expandable; and to provide missile and operational procedures familiarization as well as proficiency training in launch and control techniques.

The configuration of traditional shore-based aircraft simulators may not include the new weapon in time for the initial training, or the weapon might be deployed to the fleet before the aircrews are scheduled for shore-based simulator training. Because the SLAM PTT is developed from commercially available equipment, it has the ability to adapt quickly to new weapons in time for the initial training.

The trainer is being developed in response to a need for training operators of weapons deployed on Navy aircraft. These operators are experienced pilots or bombardier/navigators whose aircraft are being equipped with new weapons or new interfaces to existing weapons. Because the users are already expert aviators, they have no delusions about the complexity of their environment and should be able to accept a trainer that covers only tasks new to total system operation.

The SLAM weapon system is a new airborne missile, but it is also a derivative of the existing weapons systems. In addition to its direct Harpoon heritage, the SLAM includes a Walleye infrared seeker. The particular challenge posed by deployment of the SLAM is that the system includes a man-in-the-loop capability for aim-point update after launch of the missile, with few operational missiles purchased by the Navy for practice or training. In other words, an operator's first shot must be a hit, but he will have little or no opportunity to practice. Therefore, the ultimate goal of the trainer is to provide effective instruction to ensure accuracy of the operator's first shot.

The research reported here is an evaluation of the user interface of the SLAM PTT. The objective of this evaluation is to provide enhancements to the user interface so that it supports the effectiveness of the training. The evaluation consisted of participating in acceptance testing and a "hands on" demonstration, interviewing users, and observing the system in use. An evaluator questionnaire was developed incorporating items from number of sources: Austin (1988); Davis (1989); Hamel & Clark (1986); Shneiderman (1987); and Smith & Mosier (1986).

During the "hands on" demonstration, the evaluator observed that the text in the tutorial was difficult to read because of the type of contrast used between the text and background. A second concern of the evaluator was that the details described in the body of the text were not highlighted on the accompanying

graphics display. Highlighted details would focus the user's attention to the objective of the text. Ideas are being generated for voice input and output. Voice driven commands may alleviate some of the monotony of the interaction with the touch screen. A voice narrator would enable the trainer to communicate through the unused auditory modality

Another concern stemming from the demonstration was the amount of text the user was required to read. This was reinforced by user complaints of the screens containing too much information. In addition to the amount of text required to read, the number of screens without user interactivity is excessive. Smith & Mosier (1986) recommend user interactivity every two to three screens.

The observation of the PTT user testing revealed several user interface problems. An issue involving the touchscreen concerned calibration problems or "fat finger" problems. Several times the user touched the right answer but was given feedback indicating a wrong answer. Third, the "scroll up," "scroll down," "page up," and "page down," functions were confusing. The user thought they meant the opposite of what they actually performed. The designer intends to change the wording so that the labels coincide with the actual functions. The user was also confused when a certain input was required for continuation of a lesson. The designer has made arrangements to use highlighting as a means of indicating critical user guidance information.

A final problem identified during user testing concerns the lack of feedback for correct answers. When the user touched the correct answer, the PTT accepted that answer and immediately progressed to the next question with no pause. The user might have correctly guessed the item, or merely preferred additional feedback. In any case, the user ought to have time to reflect on why the answer was correct.

Acceptance of the system is partially dependent upon the users' first interaction with it which, in this case, is the system set-up. First, when calibrating the touchscreen, the coordinates were given for each place the user touched. The numbers are meaningless and confusing. It was recommended that the meaninglessness be noted in the users manual since they could not be eliminated. Because of the need to secure classified information, the system has to be broken down and set-up every time it is used. The set-up of the PTT is cause for some concern. It entails many steps and the feedback information on the screens is confusing. The complexity of the set-up may have been instrumental in the users' apprehension to report actual hardware malfunctions. Members of one squadron used their own ingenuity to write a one page document for set-up and for troubleshooting. At the time of this report a quick-

reference guide for set-up procedures was delivered to two squadrons on board an aircraft carrier. The authors evaluated the quick-reference card and made recommendations to the designer regarding clarification of actions required in the set-up.

Initial interviews indicate that the users felt the trainer was a good procedural trainer. However, they felt it was weak in development of decision making skills. In particular they were disappointed in its inability to allow alternate paths to reach the same goal as aviators actually do in the aircraft. Another issue related to flexibility concerned navigation through the computer system. The system is designed so that only an instructor or squadron leader (superusers) can navigate through the system and control the sequence. Although for many of the users the information is a review, the question and answer module requires 100% accuracy rather than allowing users to skip areas already mastered. To overcome this obstacle, all users were being identified as superusers to allow more flexibility in navigation through the trainer. We recommend that the experienced user be given sequence control.

The interview also investigated users' expectations of the system. Users commented that they were expecting a full-scale simulator with all the "bells and whistles." These authors feel that the designers' intent may not be appropriately transferred through the trainer. We recommend that they report to the users their intention along with the potential advantages of a PTT over a full-scale simulator.

One of the common themes voiced by users during the interview was the need for freeplay. The designer is in the process of developing a scenario-based training module. Once freeplay is in place records of performance will enable evaluators to identify where the trainer is effective as well as where common errors lie. Such knowledge could be used in redesign of the training. The recommended enhancements could be incorporated as front-end requirements for future iterations of the trainer.

Navy test aviators have had 4 successful SLAM hits out of 4 shots launched. Such success is promising compared to the results of first shots with similar missiles. Evaluators will continue to collect hit/miss data as the ultimate criterion measure of the SLAM PTT.

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