Training and Assessment of Decision-Making Skills in Virtual Environments

This research showed a linkage between decision-making and situation awareness

Preparing small unit leaders (platoon, squad, and team) for future warfare presents many challenges to trainers. Leaders must be capable of taking effective independent actions across an increasingly diverse range of military missions including humanitarian assistance, peacekeeping, and low or high intensity conflict.

Many missions will take place in urban settings. Conducting the requisite training at existing real world urban training sites can be very expensive and inefficient in terms of the specific leader skills needed for such operations. The small unit leader operating in an urban environment has a cognitively challenging job.

Components of Training Effective Decision-Making Skills

Critical to unit success is the leader's ability to recognize environmental cues and relevant situational factors, maintain situational awareness (SA), apply appropriate strategies, and make effective real-time decisions. Adequate preparation for such missions would require exposing the soldier to multiple scenarios, providing sufficient practice, and timely feedback, so he can effectively assimilate the many lessons learned.

Clearly, following such an approach in the real world would be very costly. One solution is to conduct a portion of this training in virtual environments through the use of individual combatant simulators.

Using Virtual Environments to Train Decision-Making Skills

A virtual environment, which can be used for training and education, is taking shape at the Land Warrior Test Bed (LWTB) at Fort Benning, Georgia. Here, an individual soldier or small unit leader can explore innovative approaches for conducting urban operations and mission rehearsal activities in virtual settings. Through the use of individual combatant simulators (Figure 1), soldiers can immerse themselves in virtual representations (data bases) of urban training sites and conduct limited missions (e.g., clear a building). Virtual environments offer soldiers the opportunity to rehearse missions to familiarize themselves with the procedural aspects of specific tasks as well as offering a chance to examine new tactics and techniques. These simulators allow the soldiers to play out scenarios and determine the impact of various courses of action on the likely success of a mission.

Figure 1. LWTB individual combatant simulator system.

Using Virtual Environments for Decision-Making/ Situational Awareness Research and Training

Research. The LWTB provides an ideal setting for the development of SA measurement instruments that can be used by trainers and researchers in simulation and field environments. The virtual environment allows for greater control of both extraneous and experimental variables than is possible in a real world training site. Under the controlled setting of the LWTB, new SA measurement instruments tailored specifically for dismounted infantry operations can be examined and refined. This type of setting also provides, for the first time, a unique opportunity to conduct basic and applied research linking SA to deci-

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sion-making in simulated dismounted infantry environments.

Training. Simulations can play a key role in training decision-making skills and possibly refining individual SA capabilities as well. Simulations accelerate proficiency by exposing the small unit leader to the kinds of situations he is likely to confront in the real world. More importantly, a simulation can be controlled. The characteristics of the decision problem portrayed in a mission scenario can be shaped to address specific teaching points based on trainer input. Time constraints, specific situational cues and cue patterns from various sources (e.g., audio communications, civilian/enemy presence) can be incorporated in the scenarios.

Increasing exposure to varied scenarios, combined with structured feedback, should enhance the leader's ability to accurately characterize situations and lead to greater situational understanding. This, in turn, should lead to improved decision-making capability.

Research Objectives

ARI was able to leverage the many positive features offered by the LWTB under a single comprehensive research effort having both basic and applied objectives. The primary objectives were to:

1. Determine the effectiveness of using a virtual environment to train real world decision-making skills.

2. Determine the feasibility of using a virtual environment as a test bed for developing SA measurement instruments.

3. Empirically assess the role of SA in decision-making in simulated dismounted infantry environments.

Design Overview

Experienced (captains) and inexperienced (second lieutenants) officers were put in an immersive virtual environment (using the LWTB's individual combatant simulator systems) and given four scenarios to execute. Scenarios included built-in decision points that required the officer to take specific actions at each point.

Each officer played the role of an infantry platoon leader and conducted four virtual urban missions. Confederates played the roles of the company commander, platoon sergeant, and squad leaders. Computer generated forces were used to fill squad/team member positions.

An observer/controller offered guidance during the scenario, provided feedback following the completion of each scenario, and assessed the officer's leader/decision-making capability and level of situation awareness. During the actual mission, objective decision point and SA data were obtained. After each mission, officers and role players completed paper-and-pencil instruments addressing leader/decision-making skills and additional SA knowledge areas.

Major Findings

"I was forced to make quick and accurate decisions…very realistic."

"This will give leaders the opportunity to learn and develop without jerking soldiers around. Platoon leaders would [arrive at their new units] more informed and…confident".

Objective assessment of decision-making skills. Errors for each decision-point were recorded and summed for each scenario (trial). A percentage was calculated based on the total number of possible decision-making errors for a given trial.

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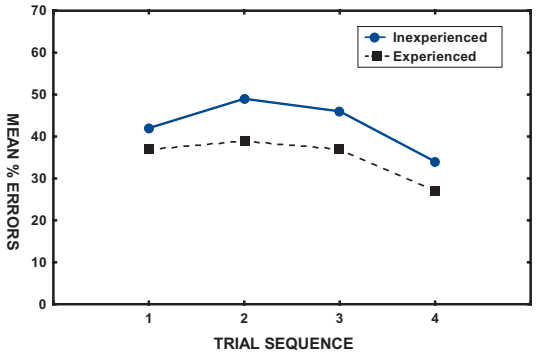
Decision- making errors (failure to act) increased from Trials 1 to 2 and then decreased over the remaining trials (Figure 2).

Figure 2. Mean percentage of decision-making errors over trials by group.



Overall, there was a tendency for the experienced group to make fewer errors over trials than the less experienced group. A comparison of error rates shows that signficantly fewer decision errors were made in Trial 4 than in Trial 1.

Situation awareness ratings. Ratings from SA instruments yielded different patterns of results. The most noteworthy findings centered around experience levels and objective items asking the subjects to identify elements on a map (Figure 3). Experienced officers more accurately located friendly/enemy elements on the map. They also showed better SA for threat situations (identifying strongest enemy locations and the element posing the highest threat to their platoon). Conversely, inexperienced officers showed better SA for friendly strength (identifying the locations of the strongest friendly elements).

Predicting decision-making accuracy from SA measures. Additional analyses were performed to determine the set of SA items/factors that best predicted decision-making accuracy. The following factors/items predicted 69% of the variance in decision-making scores. The model is shown below.

Decision Score = Focused Inside the Platoon + Self Rating + Objective SA Items

Focused Inside the Platoon

- Communicates key information to commanding officer
- Gathers follow-up information when needed
- Asks for pertinent intelligence information
- Assesses key finds and unusual events
- Discerns key information from reports received

Self-Rating

- Workload

Objective SA Items

- Locations of friendly units exposed to enemy fire/attack
- Which side has the advantage
- Which friendly elements have lost communication

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Figure 3. Example of map used to objectively assess SA knowledge.

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Conclusions

Overall, the immersive environment created by the individual combatant simulation systems provided the opportunity to simulate conditions similar to what the soldier might experience in the real world (i.e., fluid, dynamic environments requiring quick, rapid decisions). Soldiers were clearly challenged and could both see and hear the consequences of their actions unfold in real time and in subsequent message traffic received from the squad leaders, platoon sergeant, and the company commander. More importantly, this can all be accomplished in a safe training environment where soldiers can profit by learning from poor decisions made in earlier scenarios.

The research showed that a virtual environment can be used as a test bed. Valuable insights were obtained showing the possible complimentary aspects of the different SA measures and how the focus of SA changes with experience. Additionally, conducting research in the controlled setting of the LWTB permitted closer empirical examination of the linkage between decision-making and situation awareness for dismounted infantry.

Items from the SA measures contributed significantly to the prediction of decision-making accuracy. Many are concerned with an individual's ability to assess the importance of various pieces of information from much larger pools of information, such as discerning critical cues. These activities form the cornerstone of the training approach used in this research. While we have only begun to tap the capabilities of this technology, the overall pattern of results indicates that virtual immersive environments offer a potential cost effective means for conducting real world decision-skills training.

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"Did you know that. . ."

Soldiers at Work

54.2% of all officers and 40.8% of enlisted personnel (PV2-CSM) reported they work 12 or more hours on a "typical/average duty day" (including all activities required for duty, i.e., PT, etc.)?

87.8% of all officers and 88.5% of enlisted personnel (PV2-CSM) reported they usually do their "daily Army work with the company (or other similar unit)" to which they are assigned?

84.4% of all officers and 81.1% of enlisted personnel (PV2-CSM) reported they are currently working in either their "primary or secondary branch/MOS"?

19.8% of all officers and 36.8% of enlisted personnel (PV2-CSM) reported they have been away from their duty station for "military duties (including deployments, assignments, training, TDY)" for less than 1 week during the last 12 months?

21.1% of all officers and 15.7% of enlisted personnel (PV2-CSM) reported they have been away from their duty station for "military duties (including deployments, assignments, training, TDY)" for 1-4 weeks during the last 12 months?

24.3% of all officers and 23.2% of enlisted personnel (PV2-CSM) reported they have been away from their duty station for "military duties (including deployments, assignments, training, TDY)" for 13 or more weeks during the last 12 months?