NMSG, HFM and SAS Workshop on Human Behaviour Modelling for Military Training Application Effect of Pre-Event Skills Training on Virtual Environment Performance

Emilie A. Reitz
General Dynamics Information Technology
116B Lake View Parkway
Suffolk, VA 23435-2697
USA
Tel : +1 757-203-5570
emilie.reitz.ctr@hr.js.mil

Kevin P. Seavey
Alion Science and Technology
116B Lake View Parkway
Suffolk, VA 23435-2697
USA
Tel: +1757-203-6204
kevin.seavey.ctr@hr.js.mil

ABSTRACT

With the growing understanding that virtual training can play a key role in force development, there is still a need to better understand the interaction between military skills training, virtual exercises to reinforce those skills, and live field training. There is now a body of research on virtual world performance as effective preparation for live military execution (Roman & Brown, 2009; De Leo, Sechrist, Radici, & Mastaglio, 2010). But what about utilizing virtual environments as a human behavior enhancement to bridge between training and execution? During the development of the Future Immersive Training Environment Joint Capability Technology Development (FITE JCTD), tests were administered that showed that FITE's virtual training improved soldiers' mental models (Ross & Kobus, 2011). An opportunity to explore this type of improvement came in Bold Quest 2011 (BQ11), a coalition combat identification event. Building on the FITE experience, two days of virtual scenarios were provided to four squads. Three of these squads received training prior to the virtual scenarios to increase their situational awareness; the fourth did not. Our hypothesis was that pre-event training targeted to enhance situational awareness will greatly enhance the ability of individuals in a virtual environment to pick up and appropriately respond to environmental cues within a scenario, and yield increased gains in mental model improvement than virtual training alone. This unclassified paper will discuss initial results of analysis on this interplay between live and virtual environments, broad requirements for supporting training individual and group decision making in the virtual environment.

With the growing understanding that virtual training can play a key role in force development, there is still a need to better understand the interaction between military skills training, virtual exercises to reinforce those skills, and live field training. There is now a body of research on virtual world performance as effective preparation for live military execution (Roman & Brown, 2009; De Leo, Sechrist, Radici, & Mastaglio, 2010). But there is room for research on using a virtual environment to improve decision-making as an effective bridge to live force on force training.

During the Future Immersive Training Environment Joint Capability Technology Demonstration (FITE JCTD), tests were administered which showed that FITE's virtual training improved soldiers' mental models (Ross & Kobus, 2011). These improvements were based on training that had previously been executed in a classroom or field environment. During Bold Quest 2011, a coalition combat identification event, we had an opportunity to explore this improvement in decision making, as infantry squads progressed from skills training to a virtual environment to a live training site. Building on the FITE experience, two days of virtual scenarios were provided to four infantry squads. Three of these squads received pre-event training to increase their situational awareness; the fourth did not. Afterwards, the squads conducted force-on-force Combat Identification (CID) exercises. Our hypothesis was that pre-event training to improve situational awareness will enhance the ability of individuals in a virtual environment to pick up and appropriately respond to environmental cues within a scenario, and yield increased gains in mental model development than virtual training alone. We were unable to disprove the null hypothesis for this specific section of the training given at Bold Quest 2011, in terms of mental model development, but did see unexpected gains in knowledge transfer of explicit knowledge. This paper will discuss initial results of analysis on this interplay between skills training and virtual environments, as well as broad requirements for training on individual and group decision making in the virtual environment.

Bold Quest 2011 (BQ11) was a Joint Staff Deputy Director J8-sponsored event focused on improving Coalition Combat Identification. It was conducted at Camp Atterbury Joint Maneuver Training Center (CAJMTC) and Muscatatuck Urban Training Center (MUTC) in Indiana from 6 to 23 September 2011. While past Bold Quest events have been focused on developing and testing material solutions to improve CID, Joint Staff Deputy Director J7 for Joint and Coalition Warfighting (JCW) supported an initiative during BQ11 to apply non-material human-effectiveness focused solutions to improve CID. This effort employed a sequence of mutually supportive training initiatives to create enhanced situational awareness and provide a basis for improved decision-making. A foundational element of this training was the Advanced Situational Awareness Training (ASAT) course, which focused on building small unit combat observation, profiling and decision-making skills. ASAT is a training course, similar to the U.S. Marine Corps' Combat Hunter course. Both ASAT and Combat Hunter focus on teaching trainees how to read and react appropriately to changes in the baseline of their environments, in multiple domains, to include human behavior (Spiker & Williams, 2010; Spiker, Johnston, Williams & Lethin, 2010). The version of ASAT conducted during BQ11 consisted of three days of classroom training and two days of observational range practice at MUTC.

After participating in ASAT training, specific units moved to an immersive virtual training environment prior to live events at MUTC. BQ11 Individual Worn Virtual Reality (IWVR) capabilities were based on training technologies demonstrated during Spiral 1 of the FITE JCTD (Muller, 2010). They consisted of ExpeditionDI as the wearable virtual system and Virtual Battlespace 2 (VBS2) as the scenario generator. Deputy Director J8 sponsored JCW's development of a very high fidelity VBS2 terrain database of the central portion of the MUTC site. MUTC is an extremely complex urban training environment and, therefore, the virtual environment had to be comparably rich and complex. Much care was taken to create the look and feel of the actual MUTC simulated marketplace area, to include accurate size and spacing of buildings and photo-realistic textures on walls, windows and floors. Figures 1 and 2 below provide a comparative look at the live and virtual MUTC terrain. This level of fidelity greatly increased the units' sense of "presence" as they operated in the virtual environment; and that additional fidelity was expected to facilitate the transfer of knowledge between the virtual and live events. The IWVR systems were set up in

CAJMTC's Joint Simulation Training and Exercise Center (JSTEC) complex. Exercise control and technical support for the virtual scenarios were provided by a small, integrated team from JCW and CAJMTC.

To facilitate training transfer between virtual and live environments, three scenarios were developed that represented an increasingly complex CID environment as the units moved from virtual to live. Two of the scenarios were executed in the virtual environment; the third was conducted as a live force on force CID exercise in the actual MUTC simulated marketplace area. Scenarios were tailored by subject matter experts to support BQ11 CID objectives, and reinforced ASAT skills in building situational awareness and practicing target identification. Each scenario provided opportunities to further develop enhanced decision making skills that trainees had begun to exhibit at the end of the two days of ASAT range training. To support transfer of those skills from the virtual to the live environment, the live scenario re-used the same physical and human terrain, intelligence background and Rules of Engagement that had been used in the virtual environment. Unfortunately, the virtual characters bore little visual resemblance to the role-players the trainees would later interact with, and lacked much of the cultural context required in a complex environment.

Figure 1. MUTC simulated Marketplace Training area

Figure 2. MUTC simulated Marketplace terrain replication, running in VBS2.

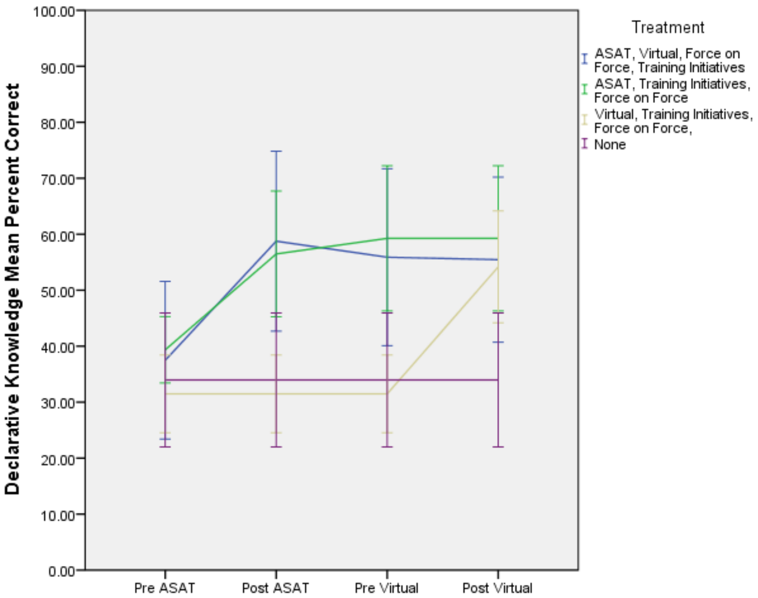

Figure 3. Graph illustrating the changes to trainees' declarative knowledge during the ASAT and virtual environment portions of the training initiatives. Error bars represent 1 standard deviation.

We found that the effectiveness of the virtual environment for supporting decision-making training was mixed. Those trainees who had received the ASAT training and then transitioned to virtual training (n=27) had no significant improvement in their declarative knowledge, but maintained the score level they had reached with the end of ASAT training. However, those trainees who had not received the ASAT training (n=9), had a significant improvement in their declarative knowledge, $F(3, 76)=16.866$, $p<.05$. The content in the declarative knowledge tests was not explicitly taught during the virtual training; it was instead imbedded in the environment as cues and indicators of changes in the village during the scenarios. The no-ASAT training group exhibited a 67.66% increase over their pre-virtual training test scores (Figure 3).

Trainees were also administered situational judgment tests as part of the larger experimental plan. The scores were the squared difference between the baseline subject matter expert score, and each trainee response, as described in Weekley, J.A., Ployhart, R.E., & Holtz, B.C. (2006). Under these circumstances, virtual training itself did not yield a statistically significant decrease in trainee score among those who received all training treatments, while the preceding training section did yield significance. However, during the virtual training the trainees did not suffer any significant declines in the nearness of their answers to the more expert mental model represented by the score baseline (Figure 4). The trainees who did not receive the ASAT training experienced no significant change in their situational judgment score through the execution of the virtual training.

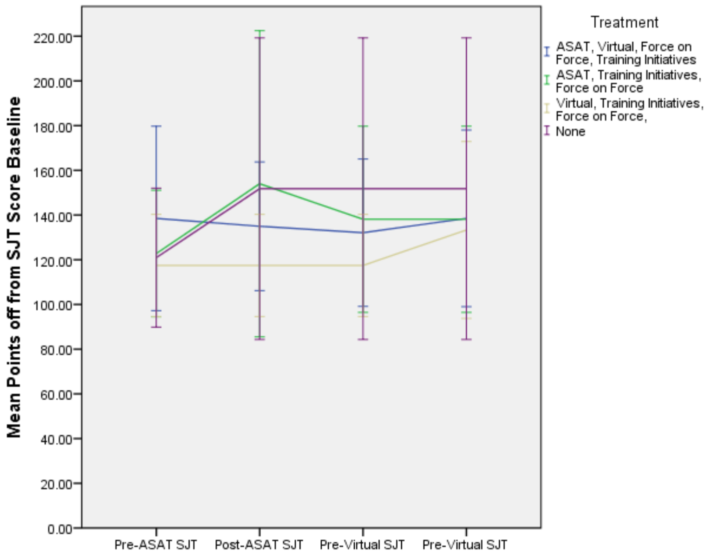

Figure 4. Graph illustrating the changes to trainees' situational judgment during the ASAT and virtual environment portions of the training initiatives. Error bars represent 1 standard deviation.

The data trends towards the utility of virtual environments for sustaining the sorts of skillsets utilized by programs like Combat Hunter and ASAT, as well as for the utility to provide a quick knowledge transfer to those who have not experienced the training, through the use of carefully crafted scenarios aligned with the skillset.

Technical difficulties during the event potentially hindered increases in trainee learning among the groups which had received the ASAT training first, as their expectations of how a scenario should flow and function were not met to the same level as live range practice. To increase realism and the performance of more skilled units within the scenarios, several initiatives are planned for the next Bold Quest event. First, we will expand our ability to generate sensory stimulation for the participants in order to increase their sense of immersion. During BQ11 there was little audio and no haptic stimulation available. We are already taking steps to improve audio input by providing higher quality, more realistic and relevant environmental background noise. Additionally, we are exploring improved haptic feedback devices to provide both positive and negative inputs, special effects and other sensory stimuli to improve realism and the ability of the IWVR system to induce a sense of lethal responsibility.

The results also support what we suspected were going to be pitfalls going into the research. Simulation systems in general today lack the ability to model human behavior to the fidelity required to fully engage the trainees on the same level they would be engaged while working face to face with a person. We therefore had to have a live exercise controller drive all interactions between trainees and virtual humans. For the more skilled trainees, in particular, this meant that we were unable to provide the realistic human interaction challenges that exist in real world operations and that are required to move past training sustainment and allow trainees to progress in their learning.

We are also planning to add richer cultural context to the virtual scenarios. The immersive environment demands training cases that emphasize the cultural environment to provide opportunities for cross-cultural perspective taking and to reinforce the importance of culturally-correct behavior. For future events we intend to put an increased focus on the cultural environment, to include requiring the squad to interact with village leaders, providing more realistic human terrain built upon social network data available in the intelligence background, and some exposure to the local language. While greater emphasis on cultural context will require more from the exercise control team, it is nevertheless required to replicate the current environment, where complex CID dilemmas persist.

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