

Virtual Training — Keeping It Real

Dr. Jeff G. Wilkinson

An improvised explosive device is detonated near an Iraqi marketplace. A U.S. Army unit patrolling the vicinity is the obvious target. A young Iraqi boy and three women are killed instantly in the explosion. Dozens of Iraqi citizens are injured. A shopkeeper's wife saw something suspicious. CPT Clipp quickly goes to the market to meet with the shopkeeper and his wife. He greets them in Arabic, then asks the woman to tell him what she saw.

The new C3IT-D, when fielded Armywide, will better prepare Soldiers cognitively and psychologically for cultural and language interaction when they deploy into a foreign theater of operations. Here, SGT Jonathan Ellis, Alpha Battery, 2nd Battalion, 32nd Field Artillery Regiment, 4th Brigade Combat Team, 1st Infantry Division, pulls security during a patrol in the Mansour district of Baghdad, Iraq, on July 31, 2007. (U.S. Army photo by SGT Tierney Nowland.)

The shopkeeper is outraged. "You speak to me, not to her!" he shouts. Clipp quickly apologizes, rethinks his approach and then carefully works with the shopkeeper to get the information he needs from the man's wife. A short time later, a suspect is detained. After many questions about the man's activities that morning, Clipp asks the man, "Did you have a push cart at the market this morning?" The man replies, "I did not have a pottery cart." Clipp did not mention a pottery cart. The detainee just made a big mistake and Clipp knows that he has his man.

What you just witnessed is not a real event, but rather a training scenario based on a real event. Soldiers need training in culturally appropriate behavior, bilateral engagement and in the art/science of tactical questioning. Enter human-oriented training. Currently, live Iraqi role players provide realism for home station and combat training center human-oriented training.

This vignette, however, is not part of a live scenario. It comes from the Cultural & Cognitive Combat Immersive Trainer-Demonstration (C3IT-D) prototype tested at Fort Benning, GA. Clipp is a real Soldier but all of the other participants are life-sized computer-

generated virtual humans created by the University of Southern California's (USC's) Institute for Creative Technologies (ICT). The realistic environment, complex characters and technologies integrated to create this prototype were the result of collaboration by the ICT; the U.S. Army Research, Development and Engineering Command (RDECOM) Simulation and Training Technology Center (STTC); and U.S. Army Infantry Center.

In 1997, the National Research Council Report *Modeling and Simulation [M&S]: Linking Entertainment and Defense* identified opportunities for leveraging DOD and entertainment research. In 1999, the ICT was chartered as a University Affiliated Research Center (UARC) to conduct research in M&S technologies by leveraging the entertainment industry's, DOD's and academia's research and innovation. RDECOM STTC serves as

the Executive Agent for this UARC and manages the research contract for the Army.

ICT's mission is to "build a partnership among the entertainment industry, the Army and academia, with the goal of creating synthetic experiences so compelling that participants react as if they are real. The result is engaging, new immersive technologies for learning, training and operational environments."

The ICT has evolved since it opened in 1999. Opportunities to leverage ICT research have expanded beyond immersive training technologies into operational capabilities. Research in the areas of artificial intelligence (AI), realistic graphics and immersive audio have significant potential to enhance multimodal display systems, decision support systems and user interfaces in next generation command

and control systems. They also enable virtual reality immersion therapy to treat Post-Traumatic Stress Disorder. With this in mind, ICT's mission is to "build a partnership among the entertainment industry, the Army and academia, with the goal of creating synthetic experiences so compelling that participants react as if they are real. The result is engaging, new immersive technologies for learning, training and operational environments."

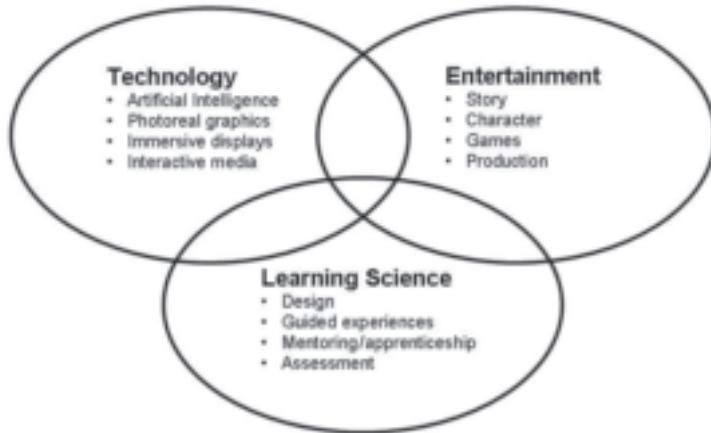
Research in AI, graphics and sound alone is not sufficient to create compelling and memorable experiences. Another key element to immersion is provided by well-crafted stories and characters, which draw the viewer into the scenario, setting the conditions for memorable experiences. Through its collaboration with Hollywood and the game industry, ICT is conducting research to extend state-of-the-art story development, immersive games for training, rapid scenario generation and system production. Realistic environments and well-crafted scenarios are necessary

A Soldier tests the C3IT-D trainer at Fort Benning. (Photo by Jarrell Pair, USC/ICT.)



ICT: A Nexus for Innovation

Can we make learning useful and unforgettable?



to create truly useful experiences but alone are insufficient. Whether one is focused on training a task or learning a concept, it is crucial to present the right set of developmental experiences. This is where the learning sciences make a contribution to this nexus of innovation — through design, guidance, mentoring and assessment. ICT's multidisciplinary approach to research in immersive learning technologies is depicted in the figure above. The end goal is effective learning that is useful and unforgettable.

The ICT research portfolio spans these areas through an interdisciplinary research program that includes the following major thrusts.

Virtual Humans

Most military simulations focus on high-fidelity models and simulators of vehicles, aircraft and units. But mission success also requires human interaction, whether it is within a team, engagement with locals or working with nongovernmental organizations. To train these human-oriented tasks, the objective is to create interactive simulations of people — virtual humans. A significant portion of ICT's research in AI is focused on

solving the challenges to developing virtual humans that:

- Fully perceive their environment (including real humans).
- Interact using the full repertoire of human interaction:
 - Robust verbal language.
 - Nonverbal communication (gestures, facial expressions, etc.).
- Manipulate and interact with the environment.
- Model emotions and their effect on behavior.
- Can introspect and model other's beliefs, desires and intentions.
- Learn.

While the C3IT-D prototype described above is a glimpse into how a fully capable virtual human can be used in a training system, individual technologies are already being transitioned to Army programs. For instance, RDECOM STTC and ICT are currently working with Program Manager (PM) Constructive Simulation to integrate natural language and emotion models into the Intelligence and Electronic Warfare Tactical Proficiency Trainer. This successful technology transition resulted in a \$34 million program cost avoidance.

Realistic Graphics

A typical animated film or game requires expensive and time-consuming artistic effort. The ICT graphics lab is performing research that will enable simulations that are photorealistic, rapidly reconfigurable and available in real-time.

A challenge to providing photorealistic animated images is the need for realistic lighting within a simulation. The graphics lab has created techniques to rapidly capture and manipulate image data, which includes the reflectance properties of an object or person. These techniques enable rendering, in a computer-generated environment, of photo-real images of objects or people that react appropriately to the lighting conditions in the simulation (streetlights, explosions, etc.). These photo-real images can be calculated automatically and produce consistent and realistic appearance. The results of this research have been exploited in movies such as *Spider Man II*, *Superman Returns* and *King Kong*. A new challenge being addressed by ICT is to create highly realistic real-time animations of virtual humans. This capability will enable mission-rehearsal-level training of human-oriented tasks.

Social and Cultural Representation

Simulations need to account for the operational environment's social, cultural and political complexities. This goes beyond developing the hard-coded methods that occur each time a new area of operations is introduced. The ICT is researching methods to represent cultural knowledge in simulated characters as swappable culture modules. Critical to this effort are the answers to some very basic questions: What does such a culture module contain? How does the system use it? Can culture modules be authored? The idea of a swappable culture module that modifies the behavior of simulated characters cannot be fully

exploited without also addressing the need for representing these characteristics within the environment. Key to the development of rapid scenario generation tools is developing a fundamental understanding of how to represent the social, cultural and political context of the terrain, and do it in a modular and easy-to-author manner. Advances in this research will enable simulation-based training in geo-specific terrain that has been augmented with social, cultural and political information.

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Intelligent Tutoring Systems

The ICT is exploring the integration of Intelligent Tutoring System technology into human-oriented training systems. This research is set within the Guided Experiential Learning (GEL) model of training design. Created by Dr. Richard Clark, Professor of Educational Psychology and Technology at the USC Rossier School of Education, GEL has been adopted as a supplement to Soldier

training by the U.S. Army Training and Doctrine Command (TRADOC). It emphasizes deliberate practice and the critical role of feedback and guidance. The ultimate goal is to build automated tutors and coaches that maximize the learning effectiveness of computer simulations used for training.

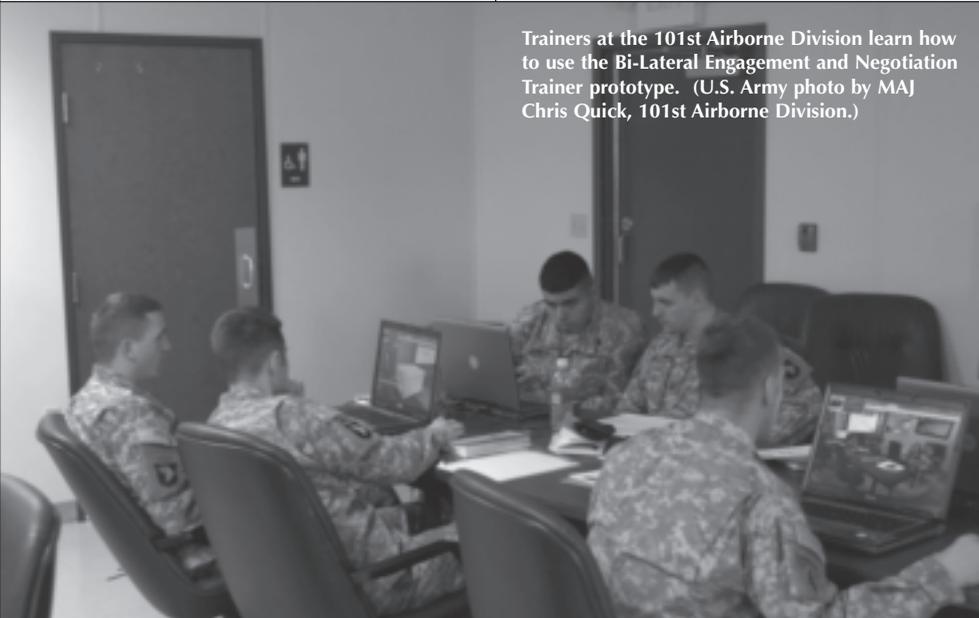
This team seeks to answer fundamental questions that face all serious games and training simulations:

- The timing of feedback — how often should a coach intervene?
- Content — is goal-based feedback superior to explanation-based?
- Reflection — what is the appropriate structure for an after-action review?

The results of this learning science research are critical to ensure that the investment in the simulation’s realism and the complex scenarios are coupled with the guidance and feedback necessary to enable effective learning.

The ICT has developed active partnerships with government laboratories, other universities, Army schools, PMs and industry to align its research with the greater community’s needs. A current example of a collaborative effort is the Learning With Adaptive Simulation and Training Army Technology Objective (ATO), which is a team effort among the ICT, RDECOM STTC, Army Research Institute, Army Research Laboratory and TRADOC. An early spin-out from this ATO is the Bi-Lateral Engagement and Negotiation Training System. This PC-based prototype incorporates many of the research technologies discussed into a GEL system. The prototype is being tested by units from the 101st Airborne Division, 10th Mountain Division, 1st Infantry Division and the School for Command Preparation.

ICT’s early vision — to bring together academia, the entertainment industry and the Army to create engaging, new immersive technologies for human-oriented learning and training — has proven to be even more important today than it was in 1999. ICT Executive Director Dr. Randy Hill welcomes the opportunity to partner with organizations to transition ICT research, or collaborate to create innovative multidisciplinary solutions to tough immersive learning technology challenges.



Trainers at the 101st Airborne Division learn how to use the Bi-Lateral Engagement and Negotiation Trainer prototype. (U.S. Army photo by MAJ Chris Quick, 101st Airborne Division.)

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