Assessing Learning from a Mixed-Media, Mobile Counter-IED Trainer

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ABSTRACT

Improvised explosive devices (IEDs) cause more than half of Coalition casualties. In 2009, the Institute for Creative Technologies (ICT) developed a research prototype for a mobile counter-IED training system. This system—the Experiential Counter-IED Immersive Training Environment (ExCITE)—was described at I/ITSEC 2010. Since that time, researchers at the ICT have developed several ways of assessing learning from ExCITE. One measure is a paper-based pretest/posttest. Another is a system that tracks trainees' responses to interactive training tools and their performance during a simulated vehicle patrol. This paper describes how these measures were created and refined. This paper also presents preliminary results from our empirical studies on the effectiveness of this counter-IED training.

ABOUT THE AUTHORS

Dr. Matthew Jensen Hays is a Research Associate at the ICT. He graduated from Duke University with a B.S. in psychology. He went on to earn a Ph.D. in cognitive psychology (with a minor in human-computer interaction) from UCLA. During that time, Dr. Hays worked to develop training programs and assessments at UCLA's National Center for Research on Evaluation, Standards, and Student Testing. As a Postdoctoral Fellow at the ICT, Dr. Hays performed several empirical evaluations of the pedagogical value of various training systems. Resulting publications received Best Paper Awards at conferences in 2008 and 2009. His current work includes assessment development; applied research on counter-IED training, cross-cultural negotiation, and battalion-level command decisions; and basic research on how feedback can be delivered during learning to make training as efficient and long-lasting as possible.

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Dr. Todd Richmond is a Project Director at the ICT. He entered college as a music major (an interest he continues to pursue as a performing bassist/guitarist/vocalist in several ensembles) but graduated with a B.A. in chemistry. Dr. Richmond went on to earn a Ph.D. in chemistry from Caltech. Following a postdoctoral fellowship at UCSF, he accepted a faculty position at The Claremont Colleges. Early in his faculty career he incorporated multimedia and Web technologies into his teaching and research. He then became managing director of the USC Annenberg Center for Communication in 2000, researching trends in new media while fostering emerging technologies for collaboration and learning. Currently, at the ICT, Dr. Richmond's work includes interactive education including serious games and simulations; visualization, messaging, and media as agents of change; viral media; and building learning communities.

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IMPROVISED EXPLOSIVE DEVICES

Improvised explosive devices (IEDs) are just like any other bomb—but they are used differently. Instead of always being used to strategically target an opponent's military force, IEDs are often used to intimidate the opponent, or to convince the enemy's military leadership and civilian population that the conflict cannot be won.

IEDs are an effective tool for this task because they vary so much across so many dimensions. Some IEDs are made of recovered unexploded ordnance or mines. Others are made of simple combinations of fuel and fertilizer. IEDs can be the size of a vehicle or the size of a soda can. As a result, IEDs can be nearly anywhere and concealed in nearly anything.

This constant threat of IEDs can cause insurgents' opponents to be intimidated, which can have far-reaching consequences. When alarmed or otherwise put under pressure, trainees often forget recent training and revert to old habits (e.g., Beilock & Carr, 2001). That is, even excellent counter-IED training can become useless—unless IEDs and their use become so familiar that they cease to be intimidating.

ExCITE

The Experiential Counter-IED Interactive Training Environment (ExCITE) system is a research prototype[1] that was designed to provide critical counter-IED training, and also seal that training in by demystifying IEDs and their use. This training was initially used in the Mobile Counter-IED Interactive Trainer (MCIT; Hays, Silva, & Richmond, 2010). ExCITE serves as the "engine" for the MCIT's training. ExCITE provides content through narrative videos and static exhibits as well as a multi-player game environment for deliberate practice. In this way, MCIT and ExCITE respond to two of the "big five" FY11 Warfighter Outcomes: counter-IED and training.

We began by consulting subject-matter experts (SMEs). We interviewed these experts using a technique called cognitive task analysis (CTA; Clark & Estes, 1996). CTAs are unique among interview techniques in that they are able to extract information that has become *automated* (i.e., typically unavailable for conscious retrieval; Singer, 1968). Thus, compared to standard interview techniques, CTAs can more than double the amount of information experts provide (Chao & Salvendy, 1994).

We applied established instructional design principles to the information we gathered from the CTAs. This effort resulted in several design decisions that provide substantial pedagogical value (cf. Hays et al., 2010). The training content was delivered via powerful narrative (Malone & Lepper, 1987). Interactivity was emphasized throughout the training experience (Evans & Gibbons, 2006). Trainees were provided multiple perspectives on insurgents' tactics, techniques, and procedures (TTPs; Galinsky, Maddux, Gilin, & White, 2008). The trainees also received direct instruction that was then reinforced by simulated practice (Schmidt & Bjork, 1992; Schwartz & Bransford, 1998). This simulation was provided from a *first-person perspective* so that it would overlap as much as possible with real-world situations in which effective counter-IED training can be a matter of life and death (Morris, Bransford, & Franks, 1977). Each of these principles was designed to maximize both the durability of ExCITE training as well as trainees' ability to apply what they had learned across as many situations as possible (Anderson & Krathwohl, 2001).

With ExCITE providing the training approach and content, MCIT was originally conceived as a "mobile classroom experience." It was made mobile because the training was entirely housed in four 40-foot-long ISO Container Express boxes (CBs). The training could therefore be brought to the trainee anywhere a

[1] Disclosure note: As a research institute—not a production facility—the ICT's development work was serving as prime during design, production, and refinement of the initial system prototypes. Thereafter, a contractor (A-T Solutions) began manufacturing additional MCIT systems under a separate Limited Rate Initial Production contract.

vehicle could deliver the CBs—also part of the "training" FY11 Warfighter Outcome.

In MCIT, fireteams (groups of 3-4 trainees) progress sequentially through the four trailers. That is, a fireteam enters CB1, completes that training (described below), and then moves on to CB2—while another fireteam then enters CB1. Using separate training rooms increases throughput (12 trainees can complete MCIT in approximately 90 minutes). It also allows the content of each CB to be radically different. The first three CBs display widely varying exhibits and stage craft, Hollywood-quality storylines and videos, and interactive touch-screen quizzes. The final CB provides trainees with interactive game play of a mounted patrol through geo-specific terrain (i.e., a virtual version of a real route), in which all three fireteams take turns playing the role of Coalition Warfighters and insurgents. Each CB is detailed below.

Trailers 1-3: Mixed-Media Training

CB1 uses story telling as the primary vehicle for engaging trainees and delivering important concepts in a way that learners will retain. There are a number of overarching messages (e.g., showing trainees that IEDs have been used by insurgents for hundreds of years). These are intended to demonstrate that IEDs are nothing new—that there is no need to be intimidated by them. This concept is reinforced by instruction about the basic components of an IED. Rather than watching a PowerPoint lecture, trainees instead are immediately confronted with a high-impact montage of IEDs. Next, they are introduced via narrative video storylines to an insurgent leader who describes his tactics and detonates an IED, causing casualties in a passing convoy. Consistent with the video content, nearby exhibits feature IED components and their uses.

By dimming the lights near the first video screen and brightening the lights near the next one (partway through the trailer), MCIT is able to advance trainees without a proctor. The next video is from the perspective of an enlisted Coalition Warfighter. He describes an IED attack on his convoy—the very bomb that the insurgent in the previous video detonated. In the next video, he describes his TTPs and other rules of thumb (e.g., "stay alert; stay alive"), and how they are used to counter IED attacks. Nearby exhibits provide a historical timeline of IED attacks (dating back to the American Civil War) and suicide attacks (dating back to the Biblical story of Samson). The common message is that IEDs are relatively well understood and can be defeated—that they are dangerous and require caution, but do not necessarily need to instill fear.

Finally, the trainees are asked to complete an interactive quiz (detailed later) on a touch screen monitor. After the quiz is completed, the screen instructs the trainees to exit the trailer and proceed to CB2. When they close the exit door behind them, a green light near the entrance to CB1 is illuminated, signaling the next fireteam that they may enter and begin training.

CB2 focuses on elements of search and "Attack the Network," while providing additional concepts around IED attacks, all from the OPFOR perspective, and using a mix of storytelling and physical environments to deliver the messages. CB2 appears to be the interior of a typical Middle Eastern household. However, there are a few clues that the residents might be less than typical. For example, the gloves near the kitchen sink are very thick, heavy rubber—of the type used by people working with volatile or dangerous chemicals. These details offer trainees the immediate opportunity to apply "stay alert; stay alive" to a physical space that represents what they might experience on a real patrol. CB2 also includes videos in which the insurgent leader explains his motives and provides instruction on the creation and emplacement of IEDs. CB2 ends with another interactive quiz.

CB3 provides further training as well as preparation for the simulation the trainees will encounter in CB4. The trainees are immediately confronted with a quiz that (among other things) requires them to recall details from the IED-maker's home. They then see a video that is narrated by the Warfighter from CB1 as he patrols a route. Suddenly, an IED detonates, damaging another vehicle in the convoy. The Warfighter stays calm, maintains situational awareness, and follows appropriate TTPs. Other videos and exhibits describe CREW devices (which can jam insurgents' remote-control detonators) and the route that will be patrolled in the simulation in CB4. CB3 ends with a fourth interactive quiz.

Trailer 4: Simulated Mounted Patrol

Finally, the three fireteams gather in CB4 to apply their newly augmented counter-IED training. This application takes the form of a simulated mounted patrol and IED-based attack on a virtual route.

Two fireteams take the role of Coalition forces; each team enters their own mock-HMMWV. Individual trainees act as driver, team chief, and turret gunner. Each of the positions' roles and responsibilities are consistent with what one would expect to see in the field. For example, the driver is responsible for driving the vehicle, while the team chief is responsible for

orchestrating the mission. On the route, the trainees are able to execute the skills learned in the preceding CBs and perform the mission they were briefed on in CB3 (basic route reconnaissance and clearance).

Meanwhile, the third fireteam takes the role of the insurgents. Their task is to plan and execute a complex attack—IEDs, rocket-propelled grenades (RPGs), and small-arms fire—on the Coalition convoy. Each insurgent has a specific role. One trainee acts as the leader and orchestrates the attack (though the planning is done as a team). Another trainee takes the role of triggerman, and is responsible for detonating the IED (depending on the trigger selected). A third trainee takes the role of the security provider, who is responsible for firing RPGs. The fourth trainee takes the role of cameraman, and is tasked with capturing video footage of the IED detonation. The trainees thus gain direct experience thinking like insurgents. With this additional perspective on counter-IED TTPs, they may be better able to anticipate what insurgents might do during real patrols.

Several conditions can end the simulation (e.g., the IED has detonated and two minutes have passed). When the simulation ends, a post-exercise review (PXR) is presented to the trainees. This PXR is a summary of the simulation in the form of points awarded for various behaviors. For example, as can be seen in in Figure 1, activating CREW devices earns 100 points per vehicle for the Coalition forces. Maintaining appropriate vehicle intervals (i.e., ensuring that a single IED cannot destroy both vehicles) earns 150 points for the Coalition forces. Filming the IED detonation (thereby generating propaganda material) earns 150 points for the insurgent forces.

After the PXR, the trainees are presented with an after-action review tool called the Sand Table (displayed in Figure 2. This name refers to the common practice of conducting an after-action review by using a stick and sand to indicate where and when various agents were during important events. Similarly, the ExCITE Sand Table offers a top-down view of the route, but provides much more interactivity (per Army Learning Concept 2015). Commanders can scroll forward and backward in time through the most recent simulation run; representations of vehicles and insurgents move accordingly. In this way, tactics and strategies can be reviewed immediately after the confrontation. This learner-centric environment ensures that trainees will be able to understand how their behaviors did and did not contribute to a successful mission—whether they were in the role of Warfighter or insurgent.

Figure 1. Post-Exercise Review

After the PXR and the Sand Table, the trainees switch roles. The insurgents move to occupy one of the mock HMMWVs; the former occupants of that HMMWV move to the other; the remaining fireteam takes the role of insurgents. After another run of the simulation and the associated review tools, this process is repeated.

THE NEED FOR ASSESSMENT

Anecdotally, the ExCITE engine has successfully driven MCIT training. Trainees report that they are engaged—and it is obvious from their behavior that these reports are genuine. After IED detonations or firefights, there are celebrations and high-fives throughout CB4. At an installation where access was made available during the weekend, Warfighters on base *chose to spend their free time in a training system*. ExCITE is more than a good video game. Trainees report that they identify and even empathize with the Coalition Warfighter in the videos. Trainees who have been deployed further state that the patrol routes are eerily accurate; one pointed at a building in the simulation and said, in disbelief, "I bought a Coke in there."

Thus, ExCITE is fun, immersive, engaging, and authentic—but is it an effective training system? Do trainees understand more about IEDs and how insurgents use them? Do they know more about how to counter insurgents' efforts? Are trainees less intimidated by IEDs as a result?

The design alone could not answer these questions. Instead, we needed to perform several in-depth assessments of the trainees' knowledge and attitudes, as well as assessments of the training itself. We therefore collected quantitative data from three sources. Each is described below.

Figure 2. ExCITE Sand Table

Quizzes

One of the sources of data for our assessments was the four quizzes that trainees encountered in the first three trailers. The quizzes contain multiple-choice and true-false questions. Some of these questions were designed to assess trainees' understanding—not just their memory—of content they had just seen. The quizzes also have questions specific to video content and other specific to physical environment content (wall graphics, etc). Trainees' performance on these questions can indicate where their attention is focused.

Other questions acted as signals to trainees that they needed to be constantly alert in a counter-IED context. These questions ask about, for example, the color of an insurgent's headdress. Although the color is not important, the question itself underscores the message that paying attention to *everything* is necessary to defeat IEDs.

In addition to the questions, the quizzes contain various interactive exercises. One asks trainees to rapidly identify the tactical advantage provided by various terrain features. The trainees must quickly indicate on a touch-screen map where IED attacks are most likely (e.g., choke points, sharp turns). Another exercise asks trainees to categorize elements of IEDs (e.g., switches, charges) by dragging images of components to different bins. This exercise is designed to make the trainees more familiar and, thus, comfortable with IEDs. To the extent that IEDs are demystified, this exercise—and ExCITE training overall—may help reduce the degree to which trainees are intimidated by the enemy.

Simulation Log

Another data source for our assessments was the trainees' behavior during the simulated convoy patrol. Twice per second, over 50 variables are captured and written to a log. These variables include the coordinates of each vehicle and insurgent, the direction in which the vehicle's gunner is aiming, vehicle speed, vehicle interval, and many more. These data allow us to determine, for example, vehicle speed during a firefight, or whether trainees move out of the danger zone after an IED attack. The log also contains the number of points earned by each side during the patrol.

Pretest-Posttest Survey

Finally, we devised a survey to be used as a pretest and posttest. Care was taken to avoid measuring non-attitudes, constructing non-neutral scales, and other common problems in survey studies (Asher, 2007).

The pretest and posttest were completed individually, and included two types of items. Trainees first responded to questions about ExCITE content. Examples include "True or false: Insurgents are not as smart as Coalition Warfighters" and "Multiple choice: Why do insurgents try to watch Coalition troop movements every day?" These items were designed to determine how much counter-IED knowledge the trainees had before training (i.e., their pretest score) and how much they gained from ExCITE (i.e., their gain from pretest to posttest). It is important to note that we used the CTA to create these questions—not the ExCITE experience itself. In this way, we avoided creating a test that just measured whether someone had completed ExCITE training (i.e., "testing to the teach").

Trainees then provided ratings about their attitudes toward IED defeat and their perceptions of their own counter-IED skills. Examples include: "Please rate from 1 (very little) to 7 (very much) how much danger IEDs present" and "Please rate from 1 (very little) to 7 (very much) how much IEDs frighten or intimidate you." These items were designed to determine whether ExCITE was able to demystify the IED.

The pretest version of the survey differed from the posttest in that it also included several demographic questions. For example, trainees reported their rank and occupational specialty (e.g., civil affairs). They also responded to several questions about their IED-relevant experience (e.g., how many times they had been deployed and to where, how many IEDs they had encountered, and what had been the consequences of those encounters). These items were included as part of a validation effort. That is, trainees who had been deployed multiple times should have performed better on the pretest—and potentially on the quizzes and in the simulation, as well. We would also be able to partial out the effect (if any) of prior experience when analyzing pretest-posttest gains.

(The entire set of questions we used and samples of each type of data we collected are available upon request.)

FORMATIVE ASSESSMENT

As soon as the first ExCITE prototype was deployed, we began using *formative* assessments to provide information about the system (Bloom, Hastings, & Madaus, 1971). This information was then used to improve the trainees' experience, the training itself, and even the measures we used.

Qualitative Approaches

Observation

One qualitative approach we used was to simply observe trainees as they progressed through the system. Immediately, this approach revealed just how engaging the narrative in the first three trailers was. Trainees almost never took their eyes off of the video screens. However, combined with some of our other design decisions, this engagement initially posed an *obstacle* to learning. As mentioned above, the videos and screens were sequenced so that the trainees were advanced from one end of the trailer to the other as the video-driven narrative progressed. The unintended result of this shuttling and the engaging videos, however, was that trainees mostly ignored the non-video exhibits in CBs 1-3.

In response to this observation, we added brief "intermissions" to some videos, during which trainees were instructed to look around the trailer. We created "go-to" quiz questions, which instructed the fireteam to send a trainee back to a particular exhibit to answer a question. Subsequent observations have suggested that trainees' attention has been better allocated to training content.

Focus Groups and Interviews

Another qualitative approach we took was conducting focus groups with trainees after they had completed ExCITE training. By waiting until they had proceeded through all four trailers, we were able to collect the trainees' impressions of it as a whole. This feedback led us to vary the point values in the post-exercise review to better reflect the priorities for various actions (e.g., maintaining appropriate inter-vehicle intervals). The trainees and their commanders also expressed the desire to conduct a "hot-wash" (i.e., an after-action review) without leaving the CB, which led us to develop the Sand Table tool.

The trainees also identified issues that detracted from the realism of the ExCITE experience. Because we developed and produced the first prototype in less than six months, it was unsurprising that a few mistakes cropped up in the massive amount of video and physical content we developed. For example, the trainees pointed out that the Coalition Warfighter's rank was inconsistent with his seating position in the vehicle in one of the videos. They also noticed that his hair was longer than regulations required. In response to this and other input, we revised the content of the videos as well as several of the exhibits. In subsequent interviews, trainees have not reported that any of the training content appears to be unrealistic or distracting from the learning objectives.

Quantitative Approaches

Quizzes

In addition to qualitative measures, we also used the data that we collected from the trainees to evaluate and refine the system. One data source was the quizzes that were administered throughout the first three trailers.

Questions that trainees frequently answered incorrectly served as a warning. Upon reviewing the questions and the system content, we found three causes for this issue. First, there was one instance in which a quiz question had been based on video content that had been edited out during the final weeks before the prototype was delivered. We simply removed this question (and omitted it from our other analyses).

We also found that a small number of questions were worded in a confusing way; trainees might have known the appropriate counter-IED behavior, but were unable to indicate it given the available multiple-choice options. We reviewed all of the questions and revised several to ensure that they asked clearly and directly about ExCITE content, and that correct answers indicated sound decision-making.

Finally, frequent errors on a question might have indicated the need to refine training. Trainees may not have understood that something in a video was important or may have overlooked something in an exhibit. In response, we revised the questions (sometimes turning them into "go-to" questions), revised the video content, or modified the physical exhibits. We also turned the lights up in the trailer during the quiz and provided two extra minutes for trainees to examine its contents during the quiz.

Since these improvements, there have been no questions to which trainees are never able to provide the correct answer. (Of course, scores vary widely and trainees often do not answer every question correctly—but they no longer all answer the same question incorrectly.) Further, these revisions allow the quizzes to *improve* learning as well as simply diagnose it. This improvement comes as a result of the direct power of testing (Kornell, Hays, & Bjork, 2009) as well as the improved guidance they provide for the learning environment (Mayer, 2004).

Simulation Log

Another source of formative assessment data was the log of events collected during the simulated convoy patrols. We intended to use information from these logs to make various adjustments to the simulation. For example, if Coalition forces won every engagement, the simulation would not be balanced, and there would be no reward for effectively thinking like an insurgent. This was not the case, however. The Coalition forces were able to complete the route patrol approximately two-thirds of the time, although the insurgent forces were able to score more points (e.g., by destroying one vehicle with an IED and successfully filming the attack) approximately two-thirds of the time. For various definitions, the simulation was balanced. Many other analyses yielded similar results. We attribute this outcome to our focus on the simulation during development; we spent dozens of hours testing each route in the simulation with the goal of making gameplay as pedagogically valid as possible.

However, as with any training system, there were issues that our designs and plans were unable to predict. For example, in the first research prototype, each route was approximately 10 km long. On these routes, there were nine *emplacement locations*—areas several hundred meters in diameter in which the IED could be concealed. The result was that the Coalition convoy would sometimes pass the first site while the insurgents were still deciding whether to emplace their IED there. Understandably, this situation tended to disrupt training. To prevent this issue, we programmed the Coalition vehicles to have "mechanical difficulties" early in the route—until the insurgents have completed the emplacement process.

We also noticed that, in the logs, it appeared that insurgents tended to stop using the last six or seven emplacement sites a few weeks after an MCIT system came online. We learned that the trainees' commanders instructed them to choose sites early in the route so that training would be able to be completed in the allotted time. With this information, we revised the routes to be only 3-4 km long. We also built new geo-specific routes to ensure that we did not omit any terrain features described in the CTA.

In addition to these and similar changes, the logs have helped us identify small software errors ("bugs") in the simulation. (These bugs can be expected to manifest in any complicated piece of software—particularly one that was developed so rapidly.) Beyond the route-length issue and minor bug-fixes, the logs have served primarily as tools for summative assessment (discussed below).

Pretest-Posttest Survey

We also used the survey instrument as a source of information about ExCITE training and about the survey itself. First, we were able to remove questions to which trainees overwhelmingly provided the correct response on the pretest. These items covered counter-

IED information that trainees already possessed; the resulting *ceiling effect* would have masked true gains caused by ExCITE training.

We also examined items that trainees almost never responded to correctly on the posttest. Upon review, the issues with these items fell into the three categories discussed in the section about issues with the quizzes (above). Where appropriate, we revised the system content and/or the survey items. Later administrations of the survey indicated that trainees were able to make reliable gains on every tested item (although, of course, not all did, and scores varied widely).

SUMMATIVE ASSESSMENT

After making the adjustments prescribed by the results of our formative assessments, we began conducting *summative* assessments. The results of these assessments indicated what and how much trainees were learning and how they were using the ultimate result of our efforts: a stable research prototype (Bloom et al., 1971).

As can be inferred from the above description of our various metrics and measures, we collected a massive amount of information. Space limitations in the present paper restrict our report to descriptive statistics, broad correlations, and overall comparisons. Nevertheless, these results reveal much about the consequences of Warfighters' experience in this training system.

Quizzes

The data used in the analyses of quiz scores was taken from 494 fireteams. In CB1, the average quiz score was 68.4% (*SE* = 0.6%). This score was statistically significantly greater than chance: $t(493) = 51.72$, $p < .001$. This result suggests that the trainees were typically paying attention during training.

In CB2, the average quiz score was 89.4% (*SE* = 0.4%). This score was statistically significantly greater than the score in CB1: $t(493) = 33.29$, $p < .001$. The questions on both quizzes, however, are of approximately equal difficulty. This result, then, suggests that trainees understood and responded to the message we intended to convey with the questions on the first quiz: they needed to pay attention to *everything*.

On the first quiz in CB3, the average score was 86.9% (SE = 0.6%). On the second quiz in CB3, the average score was 92.5% (*SE* = 0.4%). Overall, the quiz scores support our observations that trainees were attending to their videos and their surroundings—and that they were able to use what they had learned to respond to interactive exercises.

Simulation Log

The data used in the analyses of simulation-log scores were generated by 99 fireteams (approximately 350 participants) who completed three runs through the simulation. Because three fireteams participate in each run, these data reflect 33 simulated convoy patrols/IED emplacements.

Space limitations restrict our reported analyses to the overall point totals displayed in the PXR for each of the three simulated patrols. These data are displayed in Figure 3. It is important to note that the point values are fundamentally arbitrary. That is, we could have provided a reward of 600 points to the Coalition forces for maintaining appropriate vehicle intervals, or to the insurgent forces for filming the IED detonation. The *changes* in scores, however, reflect real improvements in trainees' strategies and their ability to think like insurgents.

As can be seen in Figure 3, the Coalition forces' average score increased on each successive run. This increase was statistically significant: $F(2, 64) = 4.85$, $p = .011$. As fireteams gained more experience, they became better at patrolling the route.

It is also apparent that the insurgent forces' average score increased—but not in a linear fashion. On the second run, the insurgents' average number of points was statistically significantly higher than on the first run: $t(32) = 2.63$, $p = .01$. The difference between the

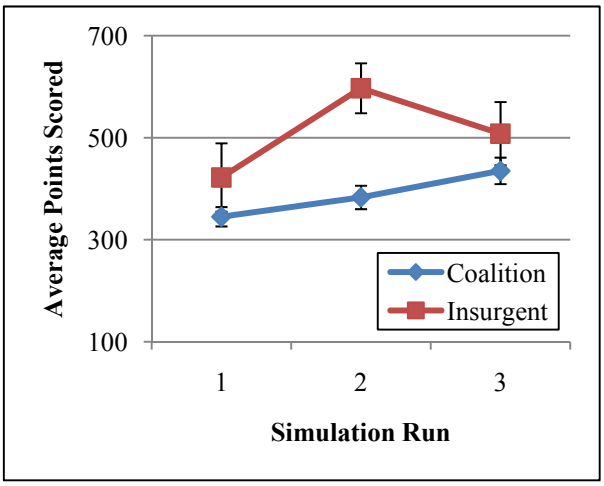

Figure 3. Average Points in Each Simulation Run

second and third runs was not statistically significant: $t(32) = 1.34$, $p = .19$. In fact, the difference between the *first* and third runs was also not statistically significant: $t(32) = .98$, $p = .34$. This pattern of results provides compelling evidence that the trainees became better at patrolling the route. That is, in addition to increasing their own scores, they were able to decrease the insurgents' scores from the second to the third run. This result provides strong evidence that ExCITE is an effective *counter*-IED trainer.

The down-turn in insurgents' scores also suggests that the increase in Coalition forces' scores was not merely due to an improved ability to play the game. In that case, the scores for both teams should have increased monotonically. Instead, these data suggest that trainees' counter-IED *skills* were actually improved by the practice the simulation provided. This result is consistent with our observations that players' strategies quickly improve as they gain a deeper understanding of how insurgents use terrain as a weapon.

Pretest-Posttest Survey

At the time this publication was submitted, we had only had one opportunity to collect survey data from an MCIT installation. As a result, there were only 17 participants surveyed. The reported results should therefore be treated as preliminary.

One of the questions on the pretest asked participants to honestly rate their typical situational awareness during a patrol. We were surprised at their candor; on a scale from 1 (none) to 7 (as much as possible), the participants' average rating was 4.47 ($SE = .34$). This finding is consistent with the Army's emphasis on counter-IED training, and on situational awareness in particular. The trainees themselves are aware that they are not as prepared as they should be. Indeed, none of the respondents marked "7."

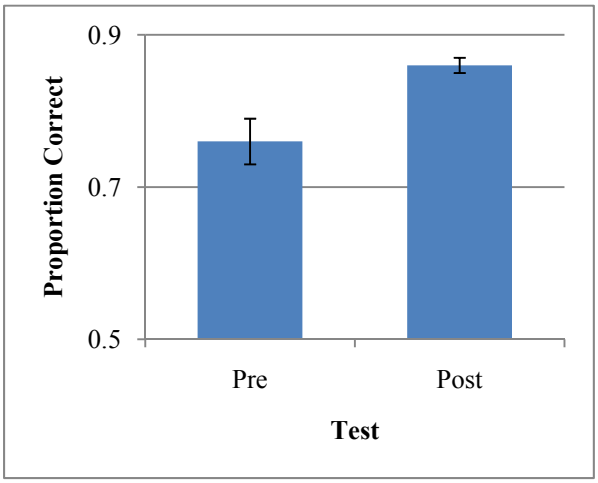

Figure 4. Learning from ExCITE

For questions about counter-IED content, the participants' average score on the pretest was 76% ($SE = 3\%$). Their average score for these questions on the posttest was 86% ($SE = 1\%$). This gain was statistically significant: $t(16) = 3.10$, $p = .007$. Even with our small sample size, we were able to detect a reliable increase in counter-IED understanding as a result of the ExCITE training approach. This improvement in understanding is displayed in Figure 4.

The participants' average rating of the danger posed by IEDs was 6.82 ($SE = .13$) on the pretest and 6.88 ($SE = .08$) on the posttest. Their average rating of their fear of IEDs was 6.12 ($SE = .26$) on the pretest and 5.94 ($SE = .30$) on the posttest. This reduction in fear was not reliable: $t(16) < 1$, *ns*. The absence of an effect here does not appear to be due to a small sample size; the numeric reduction in fear ratings is negligible. Instead, this result appears to suggest that ExCITE's attempts to demystify IEDs are unsuccessful—but that interpretation is inconsistent with what several of the trainees reported during our interviews and focus groups. They stated that they still understand that IEDs are dangerous, but now also understand how to overcome them. The apparent lack of reported fear reduction may therefore be an artifact of the question wording. Indeed, it may have been unreasonable to expect ratings of danger to remain constant but ratings of fear of that danger to drop. We are revising these questions. Our goal is to more directly examine whether ExCITE effectively demystifies IEDs, and whether that may inoculate them from forgetting their training in the high-stress environment of a potential IED attack (Beilock & Carr, 2001).

Future Work

At present, our primary goal is to collect additional and better data. We also plan to devise software solutions that will allow us to effectively link trainees' pretest and posttest responses with their quiz scores and simulation log data. This linkage will allow us to validate our data in various ways. For example, we will be able to determine whether higher quiz scores translate into better simulation performance. We will also be able to link the demographic information collected on the pretest (e.g., number of previous deployments) with these data. We will therefore be able to determine whether more counter-IED experience translates into higher pretest scores (or

greater pretest-posttest gains), higher quiz scores, or better simulation performance.

One such solution is to integrate the pretest and posttest into the learner-management system that administers the quizzes and collects the simulation-log data. We are currently collaborating with the contractor that produces MCIT systems to achieve this integration. Meanwhile, we will continue to refine the pretest, quizzes, logging system, and posttests, in attempts to evaluate ExCITE training as accurately as possible.

CONCLUDING STATEMENT

By designing and executing rigorous, iterative formative assessments, we have ensured that our summative assessments truly reflect the consequences of ExCITE training. From careful observation and analysis, it appears that we have been successful in teaching trainees not about current insurgent TTPs, but instead about how insurgents themselves generate *new* TTPs. With that understanding and the practice that ExCITE permits, these trainees are better prepared for the battle to evolve, and will be more effective Warfighters for the foreseeable future.

ACKNOWLEDGEMENTS

The project or effort described here has been sponsored by the U.S. Army Research, Development, and Engineering Command (RDECOM). Statements and opinions expressed do not necessarily reflect the position or the policy of the United States Government, and no official endorsement should be inferred.

The authors thank Mr. Milton Rosenberg, Mr. Edgar Evangelista, Mr. Robert Finney, Mr. Esau Vargas, Mr. Jonathan Bobrow, and Mr. Tyler Friddle for their contributions to the development and research efforts. We thank Mr. Fred Silhol and Mr. Phil Rasmussen of A-T Solutions for collaborating with us in our data collection efforts.

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