An Evaluation of Game-based Training Effectiveness: Context Matters

Krista Langkamer Ratwani, Kara L. Orvis

Aptima, Inc.

Woburn, MA

kratwani@aptima.com, korvis@aptima.com

Bruce Knerr

U.S. Army Research Institute for the Behavioral and Social Sciences

Orlando, FL

bruce.knerr@us.army.mil

ABSTRACT

Army trainers are increasingly turning to alternative training methods to exploit low-cost, technology-based solutions to fill critical training gaps and increase training effectiveness. One technological approach that has received increased interest over the last decade is game-based training. Army agencies and organizations have recognized that games have the potential to augment military training for both individuals and collectives. However, compared to more traditional training effectiveness and design studies, empirical investigation of game-based training is in its infancy. The existing body of research is only starting to provide insight as to how well game-based training works relative to other methods, not why or when to use it. Therefore, the purpose of this research was to investigate the general effectiveness of game-based training using principles generated through decades of research on training effectiveness. Also, the research literature indicates that training effectiveness is determined by the training program (e.g., the game), the trainee (e.g., personal characteristics), and the situational context of the training (Campbell & Kuncel, 2001). Therefore, this study also focused on the conditions under which game-based training is effective. This paper describes the methods, measures, and results of an evaluation with 165 Soldiers participating in game-based training as units. Pre- and post-training measures were administered. Results indicate that game-based training influenced training effectiveness. Contextual variables such as level of preparation prior to the training also influenced the effectiveness. The results of this evaluation provide important points for all training designers to consider when using game-based training.

ABOUT THE AUTHORS

Krista Langkamer Ratwani is an Industrial-Organizational Psychologist at Aptima, Inc. with experience in leader development and training, training evaluation and design, survey development, and qualitative data analysis. At Aptima, her work focuses on assessing the merits and effectiveness of game-based training, the development of training programs to foster adaptive capabilities within leadership teams, and the development of tools to aid decision-makers in choices made regarding training programs. Prior to joining Aptima, Dr. Ratwani was a Research Fellow at the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) where her work included making assessments regarding retention among Army officers. Dr. Ratwani holds a Ph.D. and M.A. in Industrial-Organizational Psychology from George Mason University and a B.A. in Psychology from Monmouth University.

Kara Orvis is an Industrial-Organizational Psychologist and Aptima, Inc.'s Team Lead for Training Development. Dr. Orvis has expertise in the areas of team leadership, dispersed team collaboration, dispersed leadership, and training technologies. Prior to joining Aptima, Dr. Orvis worked as a Post-Doctoral Research Fellow for the Consortium of Universities at the Army Research Institute where she conducted research projects involving teams, leadership, and training technologies. Her projects included the evaluation of several computer supported collaborative and game-based learning tools. Dr. Orvis holds an M. A. and a Ph.D. in Industrial-Organizational Psychology from George Mason University and a B.A. in Psychology from Ohio Wesleyan University.

Bruce Knerr is the leader of the Virtual Training Environments Team at the Orlando Research Unit of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI). He received a B.S. in Psychology from The Pennsylvania State University and an M.S. and Ph. D. in Engineering Psychology from the University of Maryland. From 1971 – 1973 he was on active duty in the U.S. Army as a Personnel Psychologist. He began work as a civilian Research Psychologist with ARI in Arlington, VA in 1973. In 1988 he assumed his present position in Orlando. Since then he has been involved with the use of simulation for training, with a concentration during the last 18 years on the use of virtual simulations and serious games.

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Orlando, FL
bruce.knerr@us.army.mil

INTRODUCTION

There has been an increased interest in the use of serious games, or the use of games for non-entertainment purposes (e.g., training), over the last decade. Training challenges driven by an increased diversity of operational environments, the complexity of possible domestic and global missions, and competing requirements for training resources have resulted in military branches, including the Army, turning to games for training. Games are seen as an innovative, low-cost technology-based solution that can rapidly fill critical training gaps and increase the impact and effectiveness of training for our Soldiers in a time of war.

Many Army agencies and organizations, including the U.S. Army Training and Doctrine Command (TRADOC), have recognized that games have the potential to augment and improve military training for both individuals and collectives. Examples of active game-based training applications include Army DARWARS Ambush and Tactical Iraqi. These games are being used to train Soldiers on a variety of skills including convoy operations, language, cultural awareness, and other tactical drills and tasks.

One of the most recent game-based training efforts is the acquisition and fielding of Virtual BattleSpace2 (VBS2): U.S. Army. VBS2: U.S. Army places military trainees in realistic urban or rural settings and provides them with the opportunity to practice protocols relating to convoy and ambush operations. Trainees can drive Army vehicles, pilot aircraft, and fire weapons across a number of game scenarios. The use of VBS2: U.S. Army is designed to be a stepping stone in Soldier training. Ideally, units will use the game to practice tactics, techniques and procedures prior to going into the field. By engaging in game-based training, Soldiers can improve their skills before participating in a live training exercise.

While the Army has established a game technology program of record, there are still many unanswered questions regarding game technology training effectiveness. In general, game-based training is only beginning to be held to the rigorous standards that surround more conventional training programs. During the last 40 years, there have been a total of seven articles published in the *Annual Review of Psychology* on training; each of these articles serves as a reminder of the progress that has been made in the training realm by focusing on the sound science behind designing and evaluating effective training programs. In comparison, design and evaluation research focusing on game-based training is in its infancy. With the increased interest in using game-based training, it would bode well to apply the same scientific rigor to this specific training approach; in addition, lessons learned from the decades of research on conventional training programs can be examined and integrated into this specific training approach. The science of designing and evaluating training programs must be applied to game-based training if game-based training is going to emerge as a credible and effective training method.

Initial research and theory surrounding game-based training focused on understanding the usefulness of games by examining motivation. Training researchers hypothesize that games are instructive because they engage the player/learner, leading to skill acquisition and retention (Colquitt, LePine, & Noe, 2000; Mathieu, Tannenbaum, & Salas, 1992; Prensky, 2001; Tannenbaum & Yukl, 1992). Empirical research has provided evidence that attributes of games (e.g., challenge, realism, and interactivity) influence trainee motivation and the length of time that trainees are willing to invest in mastering the skills taught during game play (e.g., Corbeil, 1999; Engel, et al., 2009; Garris, Ahlers, & Driskell, 2002). However, research must move beyond motivation to understand how to best make use of games for learning and training. Just because a game is motivating to play does not mean that it will be instructional. In fact, what is motivating about a game may even hinder learning. Research has shown that if the content is not correctly embedded into the game, learners are more likely to walk away with increased knowledge of how to play the game rather than a transferable, operational knowledge or skill (Belanich, Sibley, & Orvis, 2004).

Therefore, there is a need for additional research that leverages sound training theories and practice to gather data on how games influence the acquisition of specific knowledge and skills. Although the last few years have brought increased research and theory published on the use of serious games, there is still much work to be done to understand if and how games can be effective training tools. The existing body of research has only started to provide insight as to how well game-based training works relative to other methods, and why or when (under what conditions) to use it. Decisions to use games to train have been based on a "leap of faith," and there have been few efforts to test that faith through rigorous evaluation of the hypothesized benefits of games over other training methods (Hays, 2005). Training designers need to understand how to incorporate game-based approaches to provide training that is pedagogically sound, as well as motivating and engaging. The impact of game-based training programs will rise dramatically with increased solid empirical research conducted on the effectiveness of such training approaches.

The purpose of this paper is to use scientifically tested theories of training design and evaluation to frame empirical research which examines the general effectiveness of training games. In addition, the research literature indicates that training effectiveness is influenced by three primary determinants: a) the training program itself (e.g., the game), b) the trainee (in terms of personal characteristics and attitudes), and c) the situational context in which the training takes place (Campbell & Kuncel, 2001; Colquitt, et al., 2000; Mathieu, et al., 1992; Salas & Cannon-Bowers, 2001). Therefore, in addition to studying the overall effectiveness of game-based training, this research also investigates how features of the game (specifically, game difficulty), as well as situational variables (i.e., level of unit preparation prior to the training and level of leader involvement during the training) impact training outcomes. Such a multi-pronged approach helps to gather data not only on *if* games are effective training tools but also begins to explain *why* the game-based approach may or may not be effective. By understanding the conditions under which game-based training may be more or less effective, suggestions can be made for improving future game-based training endeavors.

Training Research and Hypothesis Development

This paper explores two areas in order to develop the hypotheses that are tested: 1) why should games make effective training systems? And 2) under what conditions can games offer maximum training effectiveness? Both of these questions can begin to be answered by first examining the vast literature on training effectiveness.

Games as Trainers

As discussed above, common thinking about the use of games for training is that they are motivating enough to engage the trainee, and hence, lead to learning. Training motivation is certainly a precursor to any type of learning and should not be neglected; after all, if learners are not motivated, it becomes difficult to get them to even pay attention to the material being presented (Noe & Colquitt, 2002). However, moving beyond motivation, there are a number of reasons why games should, and can be, effective trainers. Essentially, games have several inherent attributes that can make them effective training systems. A comprehensive review of these attributes, and how and why they are related to training outcomes, can be found in Wilson, et al. (2008). In this work, Wilson and colleagues synthesized the general training literature and the research on games to develop a matrix linking 18 gaming attributes (e.g., challenge, assessment, control) to 15 training outcomes (e.g., motivation, application, declarative knowledge). The attributes identified by Wilson, et al. can be associated with general principles of learning. For example, greater amounts of control present within a game indicate that the user can manipulate and adjust more things within the gaming environment and hence may be more actively involved in the training game. This active involvement should promote more deliberate cognitive processing, and ultimately lead to more learning (Kraiger, 2003). As another example, the constant feedback and assessment that is possible through a game can raise the self-efficacy of the learner so he or she is more likely to exert more effort and keep moving toward goal accomplishment (Cannon-Bowers, 2010). This research illustrates that games should inherently be effective training tools (simply based on their features). However, even with all of this theory, there is still a dearth of research showing empirical evidence of learning occurring through game-based training.

Therefore, this research first sought to demonstrate the general effectiveness of game-based training. In the current study, training effectiveness is primarily defined at the unit level. The reason for examining unit process and other unit level variables is because no matter the specific technical training objective that was targeted, the game-based training studied in this research required individuals to work together to accomplish their mission. There was a focus during all training events on communication, learning the roles of others, and working together. The findings presented in this paper focus on training effectiveness as defined according to the impact (from pre- to post-training)

training has on four unit-level variables that all serve as indicators of a unit working well together:

Hypothesis 1: Game-based training positively impacts the training outcomes of a) Unit Process, b) Unit Cohesion, c) Unit Efficacy, and d) Unit Effectiveness.

Maximizing Training Effectiveness

The second question that this study sought to empirically examine concerned how to maximize the effectiveness of game-based training. Two sets of variables were examined: 1) characteristics of the game design, and 2) contextual variables surrounding the training.

In terms of characteristics of the game, the current study focused on the difficulty of the training scenario. Wilson et al (2008) identified Challenge as one of the attributes of a game that can be tied to specific learning outcomes. According to Wilson et al., this attribute describes the general difficulty of the game and "possesses multiple clearly specified goals, progressive difficulty, and informational ambiguity" (p. 230). The amount of challenge or difficulty in a game should prompt trainees to acquire new knowledge in order to overcome the difficulties presented in the game (Cannon-Bowers, 2010). Therefore, the difficulty of the training scenario was examined, and a hypothesis concerning how the difficulty of the game would relate to training effectiveness as made. In general, the difficulty of the training is hypothesized to be positively related to training effectiveness:

Hypothesis 2: Difficulty of the training scenario positively impacts the training outcomes of a) Unit Process, b) Unit Cohesion, d) Unit Efficacy, and d) Unit Effectiveness.

Although games possess many inherent attributes, such as their difficulty level, that make them viable training tools, the training conditions under which games are used may not always be optimal. In other words, the design of the training game itself is not enough to result in learning. The situational context is an important piece of any training effectiveness evaluation, including when using games as training tools.

One of the fundamental hypotheses of Noe's (1986) influential work on training effectiveness is that pre-training variables influence learning during training. Such variables can enhance or negate the actual impact that the training has. One such determinant of effectiveness is organizational support. If trainees see that the organization supports and values the training in which they are going to engage, they are likely to take it more seriously and get more out of it. The same argument can be made for the involvement of leaders during training exercises. Leaders are important social influences and can "positively or negatively influence trainees' motivation for training or their perceptions of the utility of training" (Kraiger, 2003, p. 173). This research surrounding general training effectiveness can and should be applied to game-based training as well. Even though the importance of pre-training variables has been well-documented, when it comes to game-based training, it seems that training designers and organizations may believe that the game itself is enough to result in learning. However, these contextual variables must be taken into consideration in order to maximize training effectiveness using games.

The current research examined the impact of two contextual variables on training effectiveness: the level of unit preparation for the training (i.e., how much did the unit prepare for the training beforehand), and the level of leader involvement during the training. Both of these variables can serve as indicators of organizational and leader support. A higher level of pre-training preparation as well as a higher level of leader involvement may encourage the trainees to take the training more seriously and ultimately get more out of it. Therefore, we have made several hypotheses concerning the impact of these contextual variables on various measures of training effectiveness:

Hypothesis 3: The level of Unit Preparation for the training positively impacts the training outcomes of a) Unit Process, b) Unit Cohesion, d) Unit Efficacy, and d) Unit Effectiveness.

Hypothesis 4: Leader Involvement in training positively impacts the training outcomes of a) Unit Process, b) Unit Cohesion, d) Unit Efficacy, and d) Unit Effectiveness.

METHOD

During FY 2009, the Army distributed copies of VBS2: U.S. Army to many training locations all over the world. With such an aggressive application of game-based training, there was a need to evaluate the effectiveness of the game-based training platform. One of the main training objectives of units using VBS2: U.S. Army is convoy training. However, no matter the specific technical objective, things like crew coordination, teamwork, and communications were a major focus of all training sessions.

It is important to note that the research described here represents a field study. Therefore, we had little control

over the training objectives and content. As a result, the measures developed had to be generic enough to span a variety of training objectives chosen by the units conducting the training.

Training Procedures

Training using VBS2: U.S. Army is typically conducted in a training facility that contains individual computers for each Soldier completing the training. After the training unit entered the training facility, each Soldier was assigned a different role or position for the convoy scenario – driver, gunner, truck commander (TC), or observer. One Soldier was also assigned the position of convoy commander. In addition, the role of higher headquarters is filled by either a training facilitator or someone in a leadership position (e.g., company commander) within the unit. By having all of these roles filled during the training, the Soldiers are able to get a sense of what each role does, learn how to utilize each position, and also learn to convey the appropriate information to the appropriate person.

Before beginning actual training missions, Soldiers were given initial training on how to use the game in order to get all trainees comfortable with the controls. Following this initial training period, the training unit was given its mission, and planning for the mission commenced. All Soldiers were then briefed on the mission (typically by the convoy commander) and given time to ask questions. Following the mission brief, Soldiers then went through the mission. Throughout the mission scenario, training facilitators played the role of the opposing forces (OPFOR) and embedded attacks in the form of insurgents, snipers, and improvised explosive devices (IEDs) into the scenario. The unit had to achieve their mission objectives while contending with attacks from the OPFOR. During training missions, it was not uncommon for a Soldier's avatar to experience a casualty during the scenario. All of these elements added a sense of stress to the training mission, encouraging the Soldiers to take the training seriously. In addition, the complexity of the attacks by the OPFOR differed from one training mission to another. Therefore, there was variance in the level of challenge and difficulty present in the missions.

Finally, after the mission was complete, a thorough after-action review (AAR) was conducted. Across the observed missions, there was variance in who led and conducted the AAR. For some units, the AAR was led by a higher-level leader who had not actually participated in the training. For other units, it was led by the individual given the position of Convoy Commander during the training, and hence, was deemed "the leader" of the exercise. In other instances, the AAR was conducted by a Soldier who had been selected to conduct the AAR at the completion of the exercise. Finally, for some units, the AAR was led by one of the training facilitators and not by a Soldier or higher-level leader in the training unit. This variance contributed to some AARs being conducted more thoroughly than others.

Measures

Most measures were given pre- and post-training. The difference between the two administrations was in the question stems. The post-training items asked the trainees to respond to the items now that they have engaged in training using VBS2: U.S. Army.

Several measures were administered to assess unit level outcomes. Examining these measures over time provides evidence of the training impact on unit outcomes, and hence, training effectiveness. These unit level variables included the following: Unit Process measure (13 items), Unit Cohesion measure (task and interpersonal cohesion for a total of 11 items), Unit Efficacy measure (7 items), and overall Unit Effectiveness measure (3 items). All of these measures were administered both pre- and post-training. More information about each of these measures is in Table 1.

In addition, several individual level outcomes were assessed: Skill Preparedness (13 items – *How prepared do you feel to engage in...*), Task Performance (15 items – *Please rate your ability to perform each of the following tasks in the simulator...*), and Training Motivation (10 items). Due to variance in training objectives, however, these individual level outcomes were more difficult to measure. Therefore, this paper focuses on presenting in-depth results associated with the unit level outcomes; however, the general patterns of results that emerged with the individual level variables are also discussed.

In order to understand the conditions under which game-based training may be more or less effective, we also generated several measures to assess variables that may impact the effectiveness of the training. These measures were completed by outside observers to the training.

First, the training facilitators completed measures regarding the difficulty of the training and the level of unit preparation for the training. Both of these measures were completed at the end of each mission completed by a unit. For Mission Difficulty, training facilitators assessed the difficulty of the training mission according to three categories: the number and intensity of the OPFOR, the number and intensity of IED attacks, and the stability of the mission (e.g., how

much did the mission objectives change during the mission). Each of these three characteristics was rated on a 5-point scale, ranging from very easy to very difficult. The facilitators were given examples associated with each of the three categories in order to guide their ratings. In order to obtain one rating of mission difficulty, the ratings were averaged across categories and across facilitators if more than one facilitator rated the level of mission difficulty.

Table 1. Training Effectiveness Measure Descriptions

Measure	Measure Description	Example Item(s)
Unit Process	Assess Soldier belief about how well the unit worked together during the training in terms of different teamwork skills (e.g., communication, monitoring progress towards goals). Research has hypothesized that engagement in effective unit processes are directly linked to increased unit performance (e.g., Marks, Mathieu, & Zaccaro, 2001).	"My training unit members and I understand how one another prefer to communicate information to other members." "My training unit members and I understand how members are going to work together to achieve our goals."
Unit Cohesion	Assess Soldier attraction to the unit, including their tasks (task cohesion) and other group members (interpersonal cohesion). Research has shown that unit cohesion influences unit performance (e.g. Gully, Devine, & Whitney, 1995).	*Task Cohesion*: "When one person is struggling with a task, another member of the training unit will step in to help." *Interpersonal Cohesion*: "The members of my training unit get along with one another."
Unit Efficacy	Assess Soldier confidence level in ability of the unit to work together and perform well during the training. Research has shown a positive relationship between unit efficacy and performance (e.g. Stajkovic, Lee, & Nyberg, 2009).	"I am confident that the members of my training unit and I can effectively set contingency plans."
Unit Effectiveness	Assess Soldier belief about how effective the unit was during the training mission	"This training unit is effective."

The measure to assess the level of Unit Preparation was designed to account for differences in how much effort the unit leaders put into preparing for the VBS2: U.S. Army training prior to coming to the training facility. Differences may exist in terms of how much the unit communicates with the training facilitators ahead of time in regard to mission objectives, training scenarios, etc. For this measure, facilitators rated each unit on a 5-point scale (1 = Completely Unprepared; 5 = Completely Prepared) based on behaviors such as having discussions with the training facilitators regarding training objectives and mission design. These ratings were averaged across facilitators if more than one facilitator rated the level of preparation. In order to classify the units into more meaningful groups, a dichotomous variable that classified those units who received an average rating of 3 or less as "Less Prepared" and those units who received an average rating of over 3 as "More Prepared." This dichotomy was used throughout all analyses involving this variable. Although the ratings on this measure were based on interactions between the training facilitators and unit leadership, it is thought that if leaders put more time into thinking about and discussing specific training objectives with the facilitators, this level of preparation would have been conveyed to the unit members, and hence, the unit as a whole would have spent more time preparing for the training activity.

Training observers on the project research team completed the Leader Involvement measure as each training session was observed. This measure consisted of six questions targeted at recording the level of involvement from unit leadership (not actually involved as a participant in the training) during each training mission. The qualitative information from each of these measures was transformed to a quantitative three-point scale to measure the level of involvement. A rating of 1 meant that unit leadership was not present at the training exercise (no leader involvement); a rating of 2 meant that unit leadership participated in either the mission brief or the AAR portion of training (some leader involvement); and a rating of 3 meant that unit leadership was present and participating in both of those important aspects of the training (substantial leader involvement).

Participants

One-hundred and sixty five Soldiers at two military installations participated in the evaluation study. These 165 Soldiers represented 9 different platoons. 95% of these Soldiers were enlisted; 4% were officers; and less than 1% were warrant officers. The mean age of the trainees was 25.20 (SD = 5.68). In addition, 33% of the trainees reported having engaged in training using VBS2: U.S. Army in the past.

Upon Soldiers entering the training facility, a brief overview of the project was given. Soldiers were informed that their participation was voluntary and that all of their responses were anonymous and would not be linked back to any single individual. Soldiers then read and signed the informed consent form, and then were given the pre-training questionnaire packet to complete. This set of measures took approximately 15 to 20 minutes for each Soldier in the unit to complete. Following completion of these measures, the unit engaged in training as usual using VBS2: U.S. Army. Soldiers completed the post-training measures after the AAR.

RESULTS

Hypothesis 1 was generated to demonstrate the general effectiveness of game-based training by focusing on unit level outcomes and predicted a positive impact of the game-based training on four unit level outcomes: Unit Process, Unit Cohesion, Unit Efficacy, and Unit Effectiveness. Out of the four unit level outcomes measured, reported levels of Unit Process and Unit Cohesion significantly increased from pre- to post-training. Although not significant, perceived levels of Unit Efficacy and Unit Effectiveness trended in the predicted direction. These results are displayed in Table 2.

Table 2. Pre- to Post-Training Comparisons on Unit Level Variables

Comparison	*M*	*SD*	*t*
Process			
Pre	3.30	.70	-2.71*
Post	3.46	.78	
Cohesion			
Pre	3.41	.68	-1.93*
Post	3.54	.89	
Efficacy			
Pre	3.46	.78	-1.33
Post	3.55	.82	
Effectiveness			
Pre	3.07	.78	-1.40
Post	3.16	.83	

* $p \leq .05$

The results from these analyses provide some evidence of general training effectiveness. The remainder of the hypotheses focused on the conditions under which game-based training can result in maximum effectiveness. First, hypothesis 2 focused on the difficulty of the game-based training scenarios and the impact of that training characteristic on training effectiveness. No parts of this hypothesis were supported; the difficulty of the mission scenarios did not significantly impact any of the training effectiveness outcomes. Analyses did demonstrate, however, that after accounting for pre-training levels of skill preparedness, Mission Difficulty significantly impacted post-training levels of Skill Preparedness (β = .16, ΔR^2 = .03, $p < .05$). These results indicate that while the difficulty of the mission did not have any impact on the unit level training effectiveness outcomes, trainees felt more prepared to apply certain skills (e.g., assessing a tactical situation) following a more difficult training mission.

Hypotheses 3 and 4 focused on the impact of contextual variables (Unit Preparation and Leader Involvement) on training effectiveness. All of these hypotheses were tested using an Analysis of Covariance (ANCOVA) to control for pre-training levels of the outcome variables.

In general, results demonstrate that both contextual variables impact game-based training effectiveness. Specifically, all parts of Hypothesis 3 were supported; trainees in units with less preparation reported lower levels on all four outcomes compared to trainees in units with more preparation: a) *Unit Process* (M_{adj} = 3.34 vs. M_{adj} = 4.00, $F(1, 126) = 10.23$, $\eta^2 = .08$, $p < .01$), b) *Unit Cohesion* (M_{adj} = 3.43 vs. M_{adj} = 4.05, $F(1, 126) = 6.72$, $\eta^2 = .05$, $p < .01$), c) *Unit Efficacy* (M_{adj} = 3.46 vs. M_{adj} = 3.92, $F(1, 125) = 3.95$, $\eta^2 = .03$, $p < .05$), and d) *Unit Effectiveness* (M_{adj} = 3.07 vs. M_{adj} = 3.60, $F(1, 125) = 5.00$, $\eta^2 = .04$, $p < .05$). Figure 1 illustrates the impact of Unit Preparation on Unit Process. The results from the other parts of the analyses all follow the same pattern.

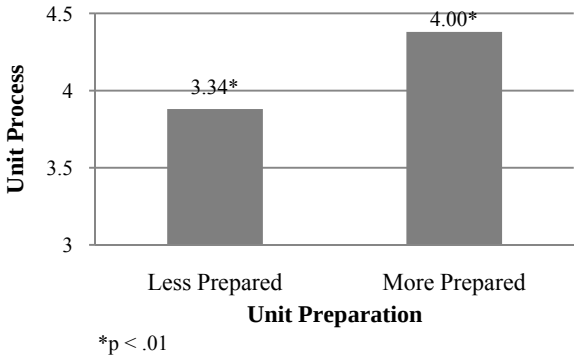

Figure 1. Impact of Unit Preparation on Unit Process.

In terms of the impact of Leader Involvement on training effectiveness (Hypothesis 4), significant relationships existed only with Unit Process. Trainees in units with increasing levels of leader involvement during the training reported higher levels of unit

process, after adjusting for pre-training levels of the outcome variable, $F(2, 137) = 4.02$, $\eta^2 = .06$, $p < .05$. Figure 2 displays the results of this analysis.

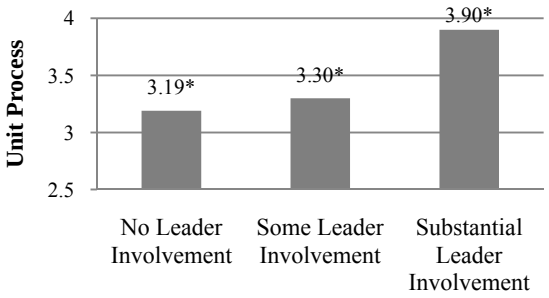

Figure 2. Impact of Leader Involvement on Unit Process.

Results examining the impact of Unit Preparation and Leader Involvement on the individual level outcomes showed a similar pattern of results. Trainees in units with less preparation reported significantly lower levels on all three outcomes (Skill Preparedness, Task Performance, and Training Motivation) compared to trainees in units with more preparation. In addition, trainees in units with increasing levels of Leader Involvement during the training reported significantly higher levels of task performance and training motivation, after adjusting for pre-training levels of the outcome variables.

DISCUSSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

The purpose of this research was to collect empirical data on the general effectiveness of serious games, as well as on the characteristics and conditions that may help to maximize the effectiveness of game-based training. This paper was intended to begin to apply some of the sound science and rigor that characterizes training effectiveness studies to game-based training.

In this paper, training effectiveness focused on four unit level outcomes: Unit Process, Unit Cohesion, Unit Efficacy, and Unit Effectiveness. Although the increase from pre- to post-training levels was not statistically significant for all of these variables, all trended in the predicted direction, with trainees reporting lower levels of these variables pre-training as compared to post. These results demonstrate the general effectiveness of game-based training.

Perhaps more informative, however, are the results of the other analyses looking at the impact of game characteristics (specifically, Mission Difficulty) and the context of the training in relation to the training effectiveness outcomes. First, the difficulty of the training did not have an impact on any of the unit level training effectiveness outcomes. Even though the difficulty of a game is purported to build engagement within the players in terms of encouraging them to continue trying to overcome the challenges, this line of theory may not apply to the unit level outcomes examined in this paper. Perhaps as the training missions got more difficult, the individual trainees become more focused on the technical portion of the game, and focused less on communicating with their unit members, for example. This theorizing is backed up to some extent by Mission Difficulty positively influencing the Skill Preparedness of trainees following the training. This result illustrates that perhaps the influence of mission difficulty is not so much on how a team works together, but more on individual skill acquisition and feelings of readiness. In addition, there may be moderator variables masking the impact of training difficulty on training effectiveness at the unit level. For example, perhaps mission difficulty only impacts training effectiveness for those trainees that had some degree of experience using the game-based training program. It is important to match the degree of difficulty and challenge in any training program to a level appropriate for the trainees. This relationship should continue to be investigated in future research.

The final set of analyses presented in this paper demonstrated the importance of taking situational factors into account when using game-based training. Specifically, the results reported here demonstrated the impact of Unit Preparation for Training and Leader Involvement on training effectiveness (for both unit and individual level outcomes). Soldiers in units that were more prepared for the training reported higher levels of Unit Process, Unit Cohesion, Unit Efficacy, and Unit Effectiveness following the training compared to Soldiers in units with lower levels of preparation. It is likely that units that spent time preparing for the training exercises emphasized and focused on getting the unit to work together. This emphasis was reflected in the results. In addition, Unit Preparation had a positive impact on all three individual level outcomes. Therefore, it appears that units who put more time into preparing for the training also passed on training information to unit members, perhaps focused on taking the training seriously and also about how to get more out of the training. It may also be the case that the units with the higher preparation levels had more well-defined training objectives which helped unit members get more out of the training. Whatever the case may be,

unit preparation prior to the training seems to be a powerful antecedent to game-based training effectiveness.

In contrast to the influence of Unit Preparation on all four unit-level variables, the level of Leader Involvement in the training only influenced the level of Unit Process reported by the trainees. Understanding the nature of this involvement may help to explain why process was the only variable influenced. When unit leadership was involved during the training, their involvement likely came in the form of feedback about how the unit was working together (i.e., their team processes) and was not centered on motivational states or overall performance feedback. Future research should look at this variable in closer detail to understand what exactly it is about leader involvement that potentially makes it an important variable. For example, is it enough for leaders to just be present during training, or do they need to provide a certain type of feedback to be influential? What is clear from these results, however, is that the context in which game-based training is embedded is not inconsequential. Training designers must carefully consider the surrounding environment when deciding to make use of game-based training. By making sure that trainees feel supported during the training, the effectiveness of that training is likely to be maximized.

In general, the results of this study illustrate the importance of going beyond assuming that games are effective training tools because they are motivating and engaging for the trainee. In order to further the use of games for training, principles generated under general training effectiveness research must be utilized.

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