Technical Report 1135

UTILITY OF GAME INSTRUCTIONS

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April 2003

United States Army Research Institute
for the Behavioral and Social Sciences

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

A Directorate of the U.S. Total Army Personnel Command

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REPORT DOCUMENTATION PAGE

1. REPORT DATE:	2. REPORT TYPE:	3. DATES COVERED:
April 2003	Final	September 2001 – September 2002

4. TITLE AND SUBTITLE:	5a. CONTRACTOR OR GRANT NUMBER:
Utility of Game Instructions	
	5b. PROGRAM ELEMENT NUMBER: 0602785A
6. AUTHOR(S): Jessie Y. C. Chen (Consortium of Universities of the Washington Metropolitan Area)	5c. PROJECT NUMBER: 2O262785A790
	5d. TASK NUMBER: 233
	5e. WORK UNIT NUMBER: H01
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences ATTN: TAPC-ARI-IF 5001 Eisenhower Avenue Alexandria, VA 22333-5600	8. PERFORMING ORGANIZATION REPORT NUMBER:
9. SPONSORING / MONITORING ABENCY NAME(S) AND ADDRESS(ES): U.S. Army Research Institute for the Behavioral and Social Sciences 5001 Eisenhower Avenue Alexandria, VA 22333-5600	10. MONITOR ACRONYM: ARI
	11. MONITOR REPORT NUMBER: Technical Report 1135

12. DISTRIBUTION / AVAILABILITY STATEMENT:
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES:

14. ABSTRACT *(Maximum 200 words)*:

Due to the increasing usage of computer games for military training purposes, it is more important than ever to understand how computer games can be utilized in an effective and efficient manner. One important issue facing the military training community is that training time is at a premium and trainees need to be able to play the game within as short a time as possible so they can start using the game to train the skills of interest. This report describes an experiment that examined various game-related performance measures and concluded that the two different instructional techniques (i.e., computer-based tutorials and game tips) appeared to be effective in different ways, and players with access to both learned the game most effectively. To be more specific, computer-based tutorials appeared to be more beneficial for motor elements such as maneuvering and actions. On the other hand, those who had access to game tips performed better in cognitive segments of the game such as setting up game plans and familiarity with the game interface. These results can be incorporated in military training programs where computer games are part of the curriculum. Future military game development can also utilize these results to determine which type of instructional material to be included in the games.

15. SUBJECT TERMS:
Computer games, computer-based tutorial, game tips, instructions

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON (Name and Telephone Number)
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unclassified	38	Dr. Stephen L. Goldberg 407/384-3980

Technical Report 1135

Utility of Game Instructions

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April 2003

Army Project Number
2O262785A790

Personnel Systems
and Performance Technology

FOREWORD

The U.S. Army has shown increasing interest in utilizing computer games for training purposes. Some games have been modified from existing COTS (commercial off-the-shelf) wargames and some are being developed exclusively for various Army training activities. An important issue facing the military training community is that training time is at a premium and trainees need to be able to play the game within as short a time as possible so they can start using the game to train the skills of interest.

The goal of this research is to examine the usefulness of various tutorial techniques used in current COTS computer games in helping novice players reach an acceptable level of skill where they could play the game effectively. The focus of this research effort is to investigate how two often-used instructional media (i.e., game tips and computer-based tutorials) affect the acquisition of basic computer game-playing skills. Computer-based tutorials appeared to be more beneficial for motor elements such as maneuvering and actions. Those who had access to game tips performed better in cognitive segments of the game such as setting up game plans and familiarity with the game interface. These results can guide the introduction of computer games in military training programs. Future military game development can also utilize these results to determine which type of instructional material to be included in the games.

The work described here is a product of the newly established post-doctoral program of the Consortium of Universities of the Washington Metropolitan Area. The U.S. Army Research Institute for the Behavioral and Social Sciences, Simulator Systems Research Unit, supervised this research effort. The findings were briefed to the cooperating agency, the ADL (Advanced Distributed Learning) lab of the Simulation Technology Center of RDECOM (Research, Development, and Engineering Command).

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ACKNOWLEDGMENT

This research could not have been accomplished without the guidance and mentoring by Drs. Michael J. Singer and Stephen L. Goldberg. The author also wishes to express appreciation to RDECOM (Research, Development, and Engineering Command) - Simulation Technology Center and Mr. Bill Pike, in particular, for providing equipment and facility for this research effort.

EXECUTIVE SUMMARY

Research Requirement:

The U.S. Army has made substantial efforts on computer games development for training purposes over recent years. Some games are modified from existing commercial off-the-shelf (COTS) computer games and some are developed exclusively for various Army training activities. As computer games become more and more complex, it is necessary to examine issues such as how these games, which increasingly employ complex plots and sophisticated response mechanisms, can be included in Army training in an effective and efficient fashion. Since training time is at a premium, trainees need to be able to progress from learning the game to using the game to achieve training objectives within a short time. The goal of this research is to examine the usefulness of various techniques used in current COTS in helping novice players reach an acceptable level of skill where they could play the game effectively. The focus of this research effort is to investigate the effectiveness of two often-used instructional media, game playing tips and computer-based tutorials (CBT), for the acquisition of basic computer game-playing skills.

Procedure:

In this experiment, novice players went through one of the following training regimes for learning a first-person-shooter game: both types of instructions (i.e., game tips and CBT), only one type of instructions (tips or CBT), or no instructions. Training effectiveness was evaluated by testing the participants, after three hours' of training, on the game interface as well as game playing. More specifically, the training outcomes were defined as how sophisticated the participant's game plan was, how familiar the participant was with the game interface, the game scores, and whether critical commands were incorporated in the game plan.

Findings:

Overall, the results support three conclusions: (1) a combination of both tips and CBT are the most effective in enhancing overall game performance compared to the tips-only, CBT-only, and the free play (No Training) conditions; (2) game playing tips are effective in training novice player to become familiar with various aspects of game playing, including game interface and how to set up more elaborate game plans; (3) CBT can be effective in enhancing novice player's game scores.

Utilization of Findings:

Army training that incorporates PC games will proceed most rapidly by introducing the game through highly structured computer-based instruction combined with goal and strategy oriented tips. The experimental results reported in this study should be used by Training specialists to select the more appropriate instructional media. Future military game development should utilize these results to guide the development of instructional material to be included in the games used for Army training.

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Introduction

The utility of commercial off-the-shelf (COTS) personal-computer (PC) games for military training has been explored over the years. One of the first efforts was the Marine Corps' report on assessment of COTS wargames and the subsequent development of Marine Corps Doom® (Loughran, 1999). Although Marine Corps Doom® was never widely implemented in formal training programs, the Marine Corps has continued to investigate the value of using PC games for training (e.g., Marine Expeditionary Unit 2000®). The Army is also evaluating the merits of PC games for training purposes, which range from adapting PC games for inclusion in courses (e.g., SPEARHEAD® application within the Armor Captains Career Course at Ft. Knox) to investigating first-person shooter games for cognitive skill practice and doctrinal correctness (Tarr, Morris, & Singer, in preparation). Some games are modified from existing COTS wargames and some are developed exclusively for various Army training activities. One of the examples of modified COTS game is FBCB2/SPEARHEADII®, which was extended from SPEARHEAD II® (co-developed by MAK Technologies and Zombie), an M1 Abrams tank simulation wargame. MAK Technologies is also developing a tactical decision-making game, BC2010®, for training future Army Brigade and Battalion commanders. One of the Army's most recent wargame development efforts is the joint-venture among the Program Executive Office- Simulation, Training, and Instrumentation (PEO STRI), Institute for Creative Technologies (ICT) of University of Southern California and a team of game-making companies (Shachtman, 2001). Two games, Full Spectrum Command® and Full Spectrum Warrior®, will be available in the near future, and both employ urban warfare settings (for more information, see the ICT site at http://www.ict.usc.edu/disp.php?bd=proj_games). These games, potentially, can be used to train complex military leadership tasks ranging from rescuing hostages to dealing with social/political issues.

Commercially available PC games are generally designed to attract customers; "beating the game" is the main challenge and reason for playing. It is not unusual for players to spend long hours playing the game before an adequate level of proficiency can be achieved. For military training purposes, however, excessive difficulty in initially learning a game's interface and rules may degrade or prohibit its usefulness as a tool for acquisition and/or skill maintenance since training time is at a premium in the military. If the user can learn to play the game quickly and efficiently, they will be able to progress from learning the game to using the game to achieve training objectives within a shorter time. For the military, the purpose of using COTS PC games is to both challenge users and provide a tool for acquiring or practicing needed skills. One basic issue in the application of every PC game is ease of acquisition of game skills vs. military skills. In other words, how much time and effort must be spent learning the game interface before being able to exercise the PC game in meeting Army training requirements. Therefore, a careful analysis of the game operation training available in PC games is needed if they are to be effective instruments for military training.

Literature from video game-related performance suggests that game knowledge and game-related motor skills play an important role in determining game performance (Baba, 1993). Baba found that, especially early in learning, game specific knowledge was more important than motor-skill training as a determinant of game performance. Novice players who were trained with game-playing tips performed significantly better than did those without the knowledge.

Although game-related motor skill training was not found to be as effective as knowledge training in Baba's studies, where a maze-running game similar to the popular Pac Man® game was employed, it is questionable if the same results would be found with different types of games. As computer games become more and more complex, it is necessary to examine whether findings from studies employing simplistic games are applicable to those current games with much more complex plots and sophisticated response mechanisms.

The goal of this research is to examine the usefulness of various tutorial techniques used in current COTS in helping novice players reach an acceptable level of skill where they could play the game effectively. The focus of this research effort is to investigate the effectiveness of two often-used instructional media (i.e., game playing tips and computer-based tutorials) for the acquisition of basic PC game-playing skills. This effort will examine different combinations of instruction with a goal of reducing time required for the user to achieve a sufficient level of proficiency to be able to play the game. Literature in instructional media and training strategies has been reviewed and will be briefly discussed next.

Computer-based Instruction

Literature in instructional media has not provided a consistent conclusion regarding the superiority of instructional effectiveness of one certain medium over other media, and few valid guidelines are available for instructional designers (Swezey & Llaneras, 1997). However, a substantial number of studies have demonstrated that innovative instructional technologies such as computer-based instruction (CBI) can be effective in enhancing student performance and reducing time required for training. For example, Kulik and Kulik (1991) reviewed 254 controlled studies in a meta-analysis on CBI effectiveness and reported a moderate but significant positive effect (i.e., improvement of .30 standard deviations) of CBI on student performance. All studies reviewed involved teaching in real classrooms, and the outcome measure employed most often was achievement examination administered at the conclusion of the CBI training program. In 29 out of 32 studies, in which instructional time was compared, results showed that CBI generally saved about one-third of instructional time compared with conventional instructional techniques (Kulik & Kulik, 1991). In another meta-analysis of 28 military-training related studies by Fletcher (1990), the result shows that interactive video-based instruction improved student achievement by about 0.50 standard deviations over more conventional instructional means (e.g., text, lecture, on-the-job training, videotape). Another meta-analysis of 63 studies was conducted by McNeil and Nelson (1991) on the effects of interactive video on learning, and an average of 0.53 standard deviations improvement in performance was reported. In the context of PC game playing, the above research findings suggests that computer-based tutorials may be more effective in training players to play a PC game compared with other passive media such as a user manual or paper-based tutorial, which is employed in many PC games developed for military training.

Part-task vs. Whole-task Training

Literature in training procedural and psychomotor tasks was also reviewed, since most PC/video game playing involves both knowledge and perceptual-motor execution of game strategies (Baba, 1993). A general finding from this literature is that complex tasks involving

procedural items or perceptual-motor manipulations greatly benefit from part-task training (Kirlik, Fisk, Walker, & Rothrock, 1998). Kirlik and his colleagues suggest that "beginning a training program with part-task training and then proceeding to dual-task or whole-task training may be the most efficient training method" (p. 95). In the context of PC game playing, part-task or segmentation training is utilized in the computer-based tutorials in many commercial games. Those tutorials typically select a number of difficulty elements in the game and suggest that players practice those elements before they play the game. From the standpoint of skill acquisition, opportunities to practice critical/difficult elements of the games should be more effective in training the players compared with simply consulting the user manual or playing the game without the tutorial. Additionally, games that do not have computer-based tutorials cannot provide their users opportunities for part-task training and have to be played in their entirety, which is difficult for some novice players even with the game difficulty adjusted to an easier level.

A series of studies, also known as the Learning Strategies Project, were conducted using Space Fortress®, a video-game-like research tool (Donchin, 1995). Some of these studies investigated the differential utility of part-task vs. whole-task training (Fabiani, Buckley, Gratton, Coles, Donchin, & Logie, 1989; Frederiksen & White, 1989; Gopher, Weil, & Siegel, 1989; Mané, Adams, & Donchin, 1989). A predominant finding from these studies is that part-task training is superior to whole-task training in terms of enhanced game performance and reduced training time. For example, Fabiani et al. demonstrated that different game playing strategies were developed depending on the type of training received. The authors compared the strategies used by the control subjects, who only practiced the game in a whole-task fashion, with those developed by the experimental subjects, who received part-task game-element training. They found that the control subjects' strategies were qualitatively different from those developed by their experimental counterparts, and the control subjects' less efficient strategies resulted in inferior game performance. In addition, three of the Learning Strategies Project studies (Fabiani et al., 1989; Frederiksen & White, 1989; Gopher et al., 1989) report that low-ability subjects benefited more from the part-task regimes than high-ability subjects in improving their game performance. In fact, low-ability experimental subjects in Frederiksen and White's study performed almost as well as the high-ability control subjects playing the criterion game following the completion of training. The high ability subjects did not receive any part-task training other than practicing the game. Therefore, Frederiksen and White suggest that well-designed part-task training may "substantially reduce if not eliminate differences in training performance associated with starting ability" (pp.110-111).

Video Game Performance Training

One study from the Learning Strategies project (Foss, Fabiani, Mané, & Donchin, 1989) investigated the performance of the control group participants, who were only given standard game instructions without any explicit training regimes. They found that although participants were able to continuously improve on game performance, there were systematic individual differences among participants in the strategies they adopted. These different strategies had a significant impact on their game performance and the shapes of their learning curves. In other words, those participants who figured out an effective way of playing the game (Space Fortress®) were able to achieve a better learning outcome than those whose strategies were less

useful. Another study from the same project (Shapiro & Raymond, 1989) examined whether efficient oculomotor movement, which expert game players tend to use, could be trained to enhance game performance. The results showed that the group receiving efficient oculomotor training achieved a significant higher game score than did the group receiving inefficient oculomotor training or the control group, who simply practiced the game. Since novice players tend to use inefficient oculomotor movement if not trained otherwise, it was concluded that efficient eye movement training could benefit novice players in improving their game performance.

Baba (1993) compared the effectiveness of different instructional techniques for enhancing PC game performance. She found that novice game players coached with game specific knowledge/strategies (i.e., game playing tips provided by experts) performed much better and had much steeper learning curves compared with those who were not coached, in playing a maze-running video game, Lady Bug®, similar to the popular Pac Man® game. Game-related motor skill training did not contribute as much to game performance. Essentially, those who received both game knowledge and motor skill training did not perform better than those who only received game knowledge training only. However, both groups performed significantly better than those who received motor skill training only, and better than the control group, who did not receive any training. The latter groups never discovered some crucial game-winning strategies on their own, even over the course of 50 game sessions. A related study from the Learning Strategies Project (Newell, Carlton, Fisher, & Rutter, 1989) also examined different training approaches to enhancing video game (Space Fortress®) performance. The results are consistent with Baba's findings and show that information regarding procedural game strategies is more beneficial than practice of the motor components.

The studies cited above demonstrate the importance of game playing knowledge and strategies in novice player's game skill acquisition. The authors also provide some suggestions regarding instructional approaches based on their findings. For example, Newell et al. (1989) suggest that "optimal approaches to instruction intervention must combine...both the part training of the response dynamics with the development of the appropriate task strategy for completing the task at hand" (p. 214). However, for games different from those employed in these two studies, it still remains unclear whether the combined instructional approach (i.e., game knowledge/strategies plus part-task) is superior to the situation where only one or neither of the training is available.

Military Games

PC games that are being used or developed for use at the Advanced Distributed Learning (ADL) lab of the Simulation Technology Center of Research, Development, and Engineering Command (RDECOM) were evaluated based on the characteristics of their instructions for game playing. The evaluation showed that PC games developed for military use (e.g., BC2010®, FBCB2/Spearhead II®) generally lacked computer-based tutorials, which were available in many commercial PC games. Some military-developed games (e.g., TacOps®) used paper-based tutorials or very rudimentary computer-based tutorials, which did not provide opportunities for practice. As for user manuals, those provided in commercial PC games tended to be more detailed while those of military games varied in their degrees of detail. Finally, none of the

military-developed games provided game-playing tips, although some games had brief paper-based walkthroughs in their user manuals. For the two military-developed games available at the ADL lab (i.e., BC2010® and TacOps®), no game-playing tips were found on any military or game-related web sites. For popular commercial games, on the other hand, game-playing tips could be found on many game-related web sites and in video game magazines.

Based on the results of the above evaluation, a multi-dimensional scale (Figure 1) was developed to describe PC game playing instructional approaches and is depicted below (i.e., availability of computer-based tutorial, degree of detail of user manual and availability of game playing tips). Four games available at the ADL lab are included here based on the initial examination of their instructional approaches.

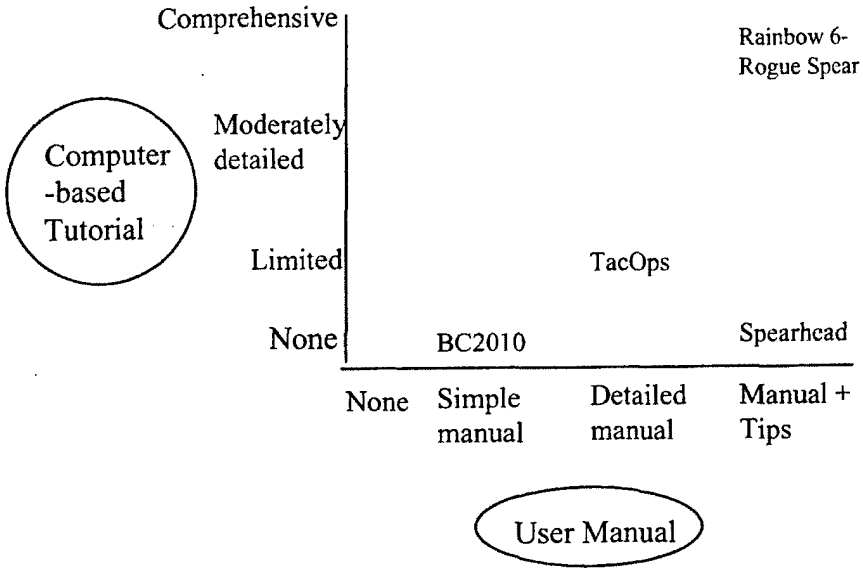

Figure 1. PC game playing instructional approaches.

Based on the literature reviewed previously, computer-based tutorial with opportunities for the player to practice critical/difficult elements of the game (i.e., part-task training) is expected to be superior to paper-based tutorial or user manual in its training effectiveness. Game-playing tips are also expected to be beneficial for training novice players. An anti-terrorism PC game, Rainbow Six-Rogue Spear®, was selected as the experimental tool for its availability of instruction components on both dimensions. The Secret Service and the Marine Corps have been using Rogue Spear® for interactive training, and the Army is working on linking One Semi Automated Force (OneSAF) with Rogue Spear® (Bill Pike, personal communication). The modified Rogue Spear® mainly focuses on training decision-making skills at the small-unit level (Kennedy, 2002). The Army is also evaluating the utility and doctrinal correctness of Rogue Spear® for training purposes (Tarr, Morris, & Singer, in preparation).

Current Study

An experiment was carried out to examine the effects of PC game instruction techniques (i.e., computer-based tutorial and paper-based game playing tips) on training outcomes, which was defined as player's game performance after being exposed to various instructional methods. The focus was on which combination of instruction techniques resulted in a better performance in initial game playing.

The independent variable in this experiment was the type and extent of instruction for PC game playing. Participants' experience in first-person-shooter (FPS) game playing was used as a covariate, since most FPS games share many similarities in game playing and, therefore, the players' experiences were expected to have an effect on their learning. There were three experimental groups and a control group. The first experimental group, CBT&T (CBT and Tips) received the computer-based tutorial to practice essential game elements and, in addition, had access to the full-length user manual plus game playing tips. The second experimental group, CBT, received the computer-based tutorial and had access to the full-length user manual but not game-playing tips. The third experimental group, Tips, only had access to the full-length user manual plus game playing tips and played the game instead of receiving any computer-based tutorial. The fourth group, NoTraining, only had access to the full-length user manual and played the game without any computer-based tutorial or game playing tips. The four groups are depicted graphically below (Figure 2).

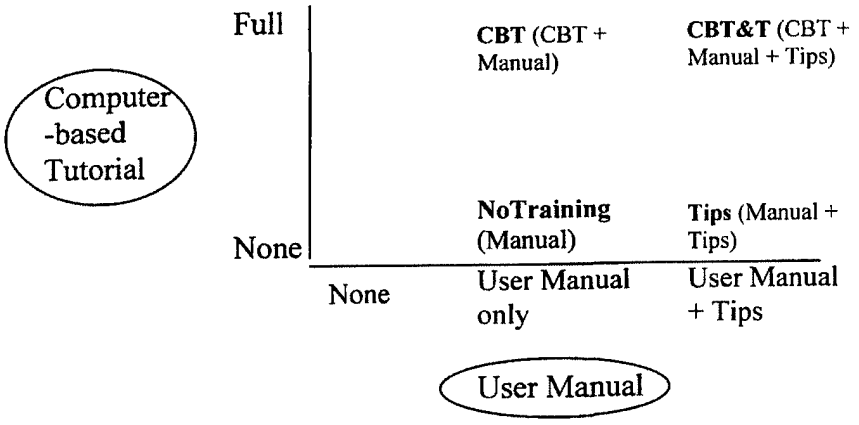

Figure 2. Two dimension training scale presentation of experimental groups.

The dependent variable was participants' performance in the final test session after three hours of training. It was determined that the performance measures would include participants' game scores, quiz scores on game interface, the number of special functions utilized in the game test session, and whether participants' game plans include a critical command "Escort." (The rationale for selecting these measures is presented in the Method section). Game scores might not be entirely reliable for they tend to be contaminated by the artificial intelligence (AI) employed in the game. In other words, some participants may have had higher game scores simply because their plan called for more AI in their games. However, it was decided that game

scores should be one of the measures based on the rationale that they indicated how good the participant's plan was in addition to reflecting the action (i.e., FPS) component of the game.

Hypotheses

Based on the literature review and reasoning presented above, the following hypotheses were generated,

The CBT&T group (CBT + manual + tips) will perform better than the Tips (manual + tips) group, which will perform better than the CBT group (CBT + manual). The CBT group will perform better than the NoTraining group (manual only).

These hypotheses are based on the research findings that part-task training is beneficial for skill acquisition in complex tasks and CBTs are effective in enhancing student performance and reducing training time. In addition, players who have access to game-playing tips are expected to perform better than those who do not (Baba, 1993; Newell et al., 1989). Baba and Newell et al. demonstrated that those subjects who had access to game-tips outperformed those who only received game-related motor skill training. Therefore, the Tips (manual + tips) group was expected to outperform the CBT group (CBT + manual).

Method

Participants

A total of 44 males recruited from the University of Central Florida participated in the study. The ages of the participants ranged from 17 to 40 ($M = 22.6$, $SD = 5.24$). Participants were compensated at a rate of $7.50 per hour or class credit for their participation in the experiment.

User's experience in PC gaming, specifically FPS gaming, was expected to covary with their game performance and, therefore, was included in the analysis. The procedure for matching participants for each group based on their FPS game experiences and the power analysis performed to obtain the appropriate size of each group are reported in Appendix A.

Based on the literature reviewed on gender differences in video game performance (Sanchez-Ku & Arthur, 2000; Brown, Hall, Holtzer, Brown, & Brown, 1997), it was decided that only male participants would be included in the experiment to prevent additional variance from gender differences on dependent measures. Results from the studies by Brown et al. indicated that male participants performed better in playing a video game than did the female participants with a comparable video game experience level. Sanchez-Ku and Arthur evaluated female participants' performance in playing Space Fortress®, which has only been played previously by male participants in the series of studies conducted in the Learning Strategies project (Donchin, 1995). Their results showed that their female participants' performance was lower than that obtained for males in previous studies, although both received the same training protocol and their demographic characteristics and general attitudes toward video games were similar.

Materials

An anti-terrorism FPS PC game, Rainbow Six-Rogue Spear®, and its user's manual and training component were used. The CBTs consisted of skill training and course familiarization training. Skill training covered drills of fire and movement, room clearing, hostage rescue, open training, and terrorist hunt. Users were advised to select a skill set and practice it using various course setting (shooting ranges, obstacle course, grenade practice, door breaching, etc.). Limited on-line performance feedback was available in the tutorial. Game-playing tips were gathered from several Rogue Spear®-related web sites. The tips included detailed game-playing techniques (e.g., Do's and Don'ts) and mission walk-throughs with illustrations of screen shots from the game.

The game consisted of two phases: Planning and Actions. During the Planning phase, the player created a plan, in which elements such as Roster selection, Kit selection, Team set up, and Waypoints planning were incorporated. The Waypoints planning was the critical part of the Planning phase and determined the paths for the teams not controlled by the player (i.e., the teams controlled by AI) and the orders for those teams. The game could be played in either single-player or multiple-player mode. In this study, only the single-player mode was used. A screen shot form the planning phase and a screen shot from the action (game) phase are presented in Figure 3.

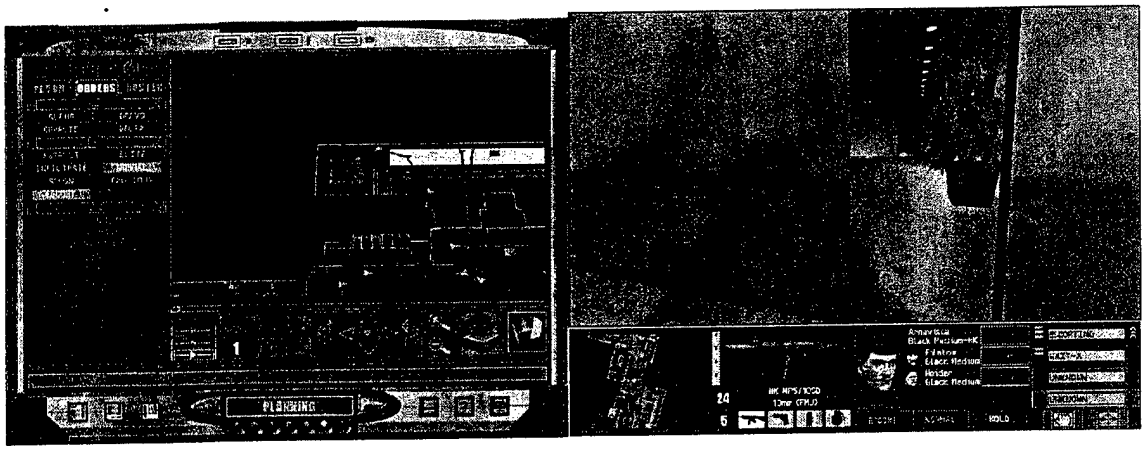

Figure 3. Screen shots from Rogue Spear® (left: planning phase; right: action phase).

Procedure

The experiment protocol was set up as follows:

Consent and Questionnaire on Computer/Gaming Experience. All participants listened to a recorded message about the experiment procedure and then filled out the consent form. After consenting to participate in the study, the participants filled out a questionnaire on their computer and gaming background (see Appendix B).

Initial training according to group assignment (2 hours). Participants in the CBT&T and the Tips groups were asked to start by studying the game playing tips (including paper-based walk-through). The CBT&T group then completed the tutorial and the Tips group started playing the first mission using the tips and user manual. The CBT&T participants were allowed to start playing the same game mission with access to the tips and manual after they finished the tutorial. The CBT group started by going through the tutorial and were allowed to play the game once the tutorial was completed. The NoTraining group practiced playing the game during the entire initial training session. The game included two components: Planning phase and Action phase. In the Planning phase, the participant had to devise a plan according to the scenario briefing, and the plan included team member selection, weapon selection, and waypoint planning, which included Special Functions the participants thought to be beneficial for the outcome. In the Action phase, the participant essentially executed the plan he devised and played the game in a FPS fashion. All four groups had access to the user manual at all time during this phase, and those who achieved satisfactory results on the first mission were allowed to go on to the remaining missions. All games played in this segment were at the Recruit (easy) level.

Practice of game playing (1 hour). After the initial training, all participants continued practicing the game at the Recruit level. All participants were allowed to consult their user manual while playing, and the CBT&T and the Tips groups also had access to the game tips. The game statistics were saved for analysis.

Quiz on game interface (15 minutes). All participants were administered a quiz with 10 short questions on the game interface (see Appendix C).

Test on game playing (about 40 minutes). Participants were asked to complete two game tests, which were the first mission played twice at the Veteran (intermediate) level. They had access to the user manual, but the CBT&T and the Tips groups no longer had access to the game tips. All game scores (including successful completions of games) and time spent on game playing were recorded.

Survey and Debriefing (about 10 minutes). After the tests, all participants filled out a questionnaire on the usefulness of the instructions they received, ease of use of the game interface, and other lab-related issues (see Appendix D for a sample). During the debriefing session, the participants were informed of the nature of the study and were also asked to recall two of the most difficult areas in their game learning.

Measures

The following measures were employed in the study.

Special Functions. The number of special functions used in the Waypoints planning was used as a dependent measure. A larger amount of special functions indicates a higher level of sophistication of the plan. The special functions include: Go-codes, Rules of Engagement (ROEs), Speeds, and actions such as Snipe, Cover, Defend, Flashbang usage, Frag grenade usage, and Breaching charges.

Quiz scores. Participants' quiz scores were used for measuring their familiarity with the game interface. The quiz consisted of ten short-answer questions, covering both the Planning and Action phases (see Appendix C). A full score would be 10 points.

Game Scores. The number of kills was the game score and it determined the outcome of the game unless the participant successfully escorted the hostages to a safe zone (i.e., Extraction Zone), in which case a full score of 15 points would be assigned. Although the game scores partially depended on the AI, which in turn depended on the soundness of the plan, it was decided that it could still provide a comprehensive indicator of both planning quality and game skill.

Escort. As stated above, the game could also be won by escorting the hostages to the Extraction zone instead of killing all the terrorists. Therefore, it was critical to include the Escort command in the plan and plot the waypoints leading to the Extraction Zone so that the AI teams could execute the plan accordingly. A plan without this order was considered incomplete. More specifically, a plan was considered complete only if the Escort command was included *and* the final waypoint was placed in the Extraction Zone.

Results

A two-factor (CBT x Tips) multivariate analysis of covariance (MANCOVA) was performed to analyze the data with Special Functions, Quiz scores, and Game Scores as the dependent measures and FPS Game experience as the covariate. An additional one-way analysis of variance (ANOVA) and post-hoc tests were performed to examine the differences in the dependent measures among the groups. Chi-square tests were used to determine if there was an association between the instruction type (e.g., Tips or No Tips) and the number of participants whose plans included the Escort command. Statistical significance is reported for all tests at a probability equal to or less than .05. Descriptive summary (means and standard deviations) for the first three measures are provided in Table 1.

TABLE 1. Descriptive Summary (Means and Standard Deviations) for Number of Special Functions, Quiz Scores, and Game Scores

	Special Functions	Quiz	Game Scores
NoTraining	2.36 (2.20)	4.73 (2.23)	10.45 (2.50)
CBT	2.36 (3.04)	5.32 (1.94)	11.64 (1.80)
Tips	4.91 (1.81)	6.82 (1.90)	10.73 (2.90)
CBT&T	5.45 (1.44)	7.32 (2.03)	12.82 (3.43)

Note. Standard deviations appear in parentheses.

The percentages of participants who included Escort command in their plans are presented in Table 2.

TABLE 2. Percentages of Participants Who Included Escort Command in the Plan

	NoTraining	CBT	Tips	CBT&T
Percentage for employing Escort command	18%	9.1%	100%	82%

Levene's tests of equality of error variances were performed on the variances of the three dependent measures to examine their homogeneity. The results did not show the variances of any of the measures to be heterogeneous (all *p*s > .05). In addition, Box's test of equality of covariance matrices indicated that the observed covariance matrices of the dependent variables were not significantly different across groups. Normality tests were performed on all three dependent measures for all four groups. It was discovered that for Special Functions, two of the distributions (i.e., NoTraining and CBT) were not normally distributed; for Game Scores, two of the distributions (i.e., NoTraining and CBT&T) were not normally distributed. Since these were only moderate departures from normality, it was decided that ANOVAs should be robust enough for testing the differences (Howell, 2002). The kurtosis and skewness scores of all 12 distributions were within –2 and 2 except for the kurtosis score for Special Functions-NoTraining, which was slightly lower than –2.

The main effect of "Tips" was significant, $F(3, 37) = 7.23, p < .005$. None of the other main effect, the covariate, and interactions among the factors was statistically significant. Further analyses reveal that groups with Tips employed significantly more Special Functions in their plans than did the groups without Tips, $F(1, 39) = 19.05, p < 001$. Figure 4 displays the average number of Special Functions employed in the plan for the four groups. Post hoc (LSD) tests revealed that the differences between the NoTraining (mean = 2.36) and the Tips (mean = 4.91) groups as well as between NoTraining and the CBT&T (mean = 5.45) groups were both statistically significant, $p < .05$. In addition, the differences between the CBT (mean = 2.36) and the Tips groups was also statistically significant, $p < .05$.

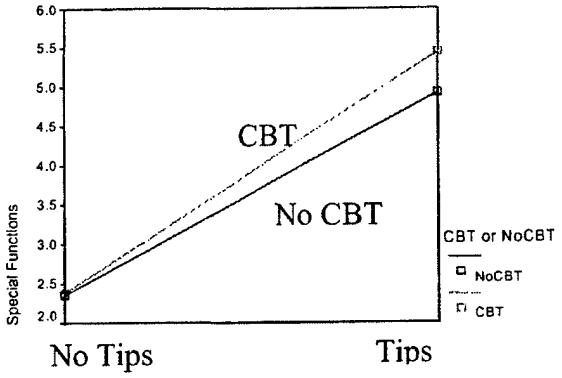

Figure 4. Average number of Special Functions employed in the plan for the four groups.

The groups with Tips also scored significantly higher on their Quiz of game interface than did the other two groups without Tips, $F(1, 39) = 12.20, p < .005$. Figure 5 shows the mean scores (out of 10 points) of Quiz on the game interface for the four groups. Post hoc (LSD) tests revealed that the differences between the NoTraining (mean = 4.73) and the Tips (mean = 6.82) groups as well as between NoTraining and the CBT&T (mean = 7.32) groups were both statistically significant, $p < .05$. In addition, the difference between the CBT (mean = 5.32) and the CBT&T groups was also statistically significant, $p < .05$.

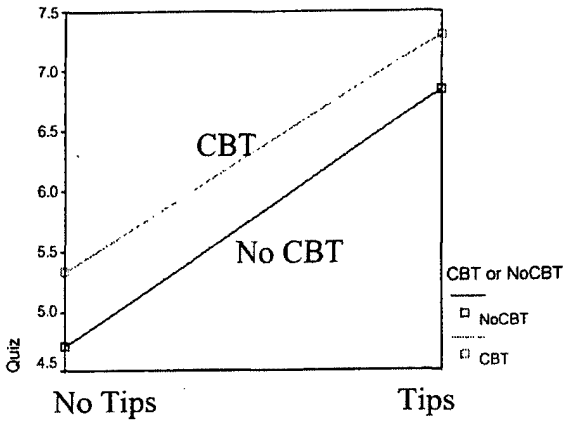

Figure 5. Mean scores of Quiz on the game interface for the four groups.

The groups with CBT were found to have higher Game Scores than did the other two groups without CBT training, although the differences were only moderate, $F(1, 38) = 4.105, p = .055$. Figure 6 shows the average Game Scores (highest possible score being 15) for the four groups. Post hoc (LSD) tests revealed that only the difference between the NoTraining (mean = 10.45) and the CBT&T groups (mean = 12.82) was statistically significant, $p < .05$. Figure 7 shows the average number of Special Functions, Quiz scores, and Game Scores for each group.

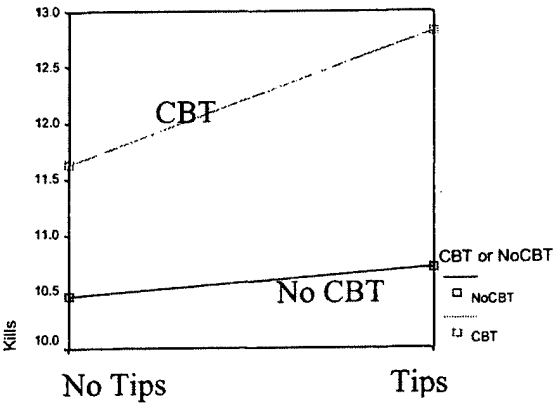

Figure 6. Average Game Scores for the four groups.

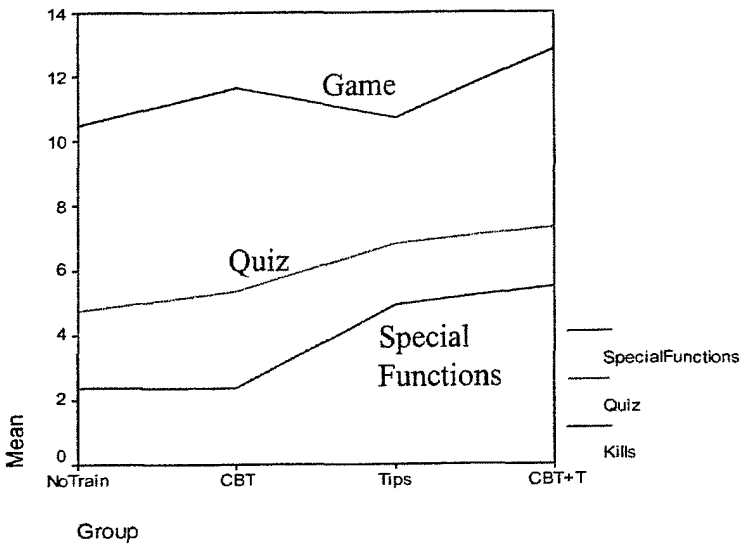

Figure 7. Average Special Functions, Quiz scores, and Game Scores for the four groups.

The covariate, FPS Game experience, was found to be a significant factor for different performances on Quiz, $F(1, 39) = 5.30, p < .05$. Figure 8 shows the relationships between Special Functions and Tips for frequent FPS game players (those who play FPS games at least once a month) and infrequent players (those who never or rarely play FPS games and those who play FPS games once every few months). Infrequent FPS players who had access to game tips employed more Special Functions (mean = 4.6) than did frequent FPS players who did not have access (mean = 2.9), although the difference was not statistically significant, $p > .05$.

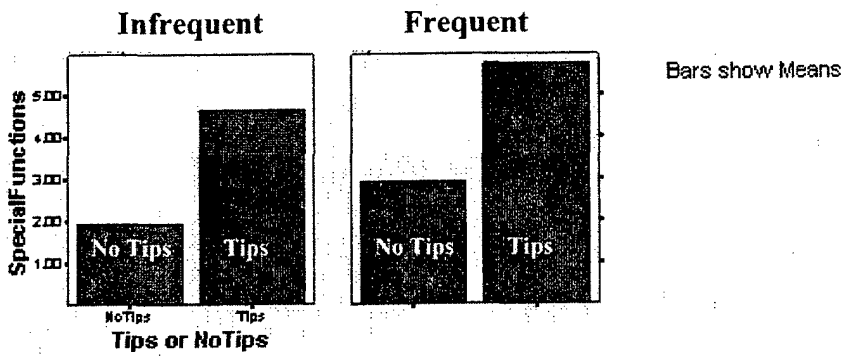

Figure 8. Relationships between Special Functions and Tips for frequent FPS game players and infrequent players.

Figure 9 shows the relationships between Quiz scores and Tips for frequent FPS game players and infrequent players. Infrequent FPS players who had access to game tips had slightly higher Quiz scores (mean = 6.2) than did frequent FPS players who did not have access (mean = 5.9), although the difference was not statistically significant, $p > .05$.

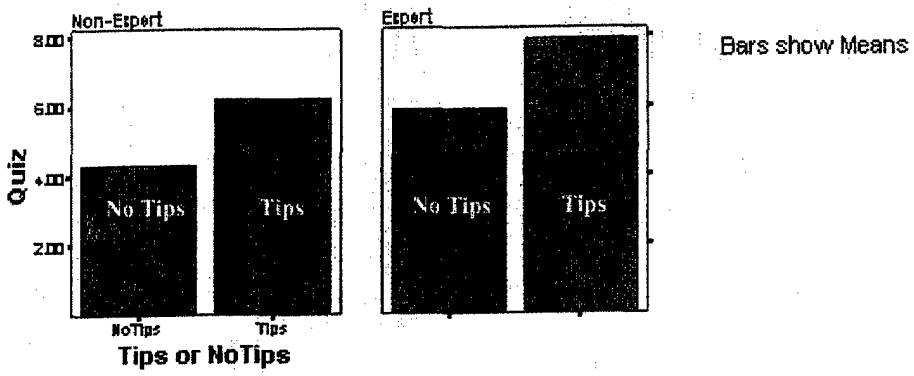

Figure 9. Relationships between Quiz scores and Tips for frequent FPS game players and infrequent players.

Escort Command

Chi-square tests revealed that the groups with Tips had a significantly higher tendency to include Escort commands in their plans, $x^2 = 16.6, p < .005$. 91% of the participants who had access to the game tips included critical commands such as Escort in their planning, while only 13.5% of those who did not have access to game tips employed the Escort command. Figure 10 shows that percentages of participants who included complete Escort command in their plans vs. those who included incomplete Escort command for the Tips groups (i.e., Tips and CBT&T) and non-Tips groups (NoTraining and CBT).

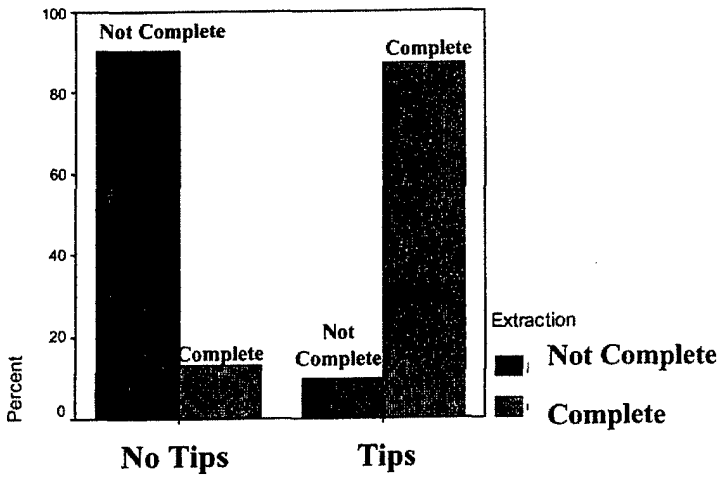

Figure 10. Percentages of participants who included complete Escort command vs. those who included incomplete Escort command for the Tips groups and non-Tips groups.

Qualitative Data

Participants' comments as to the usefulness of the training session (i.e., practice, game tips, and CBT), the amount of information during training, the ease of use of the program, and

their own performance during the game were obtained from the usability survey. A common comment from all four groups was that the planning phase was complicated and assistance in addition to the user's manual would be very helpful. One of the NoTraining group participant responded: "I spent about an hour trying to get to the actual game playing because I didn't realize that I was setting up a path on the floor plan for a wrong team. I never played this game and could have used a little assistance." A CBT group participant responded: "The CBT was a great way to learn how to play." Another CBT group participant stated: "In training section, the game must show some useful windows and tips and how to command the teams. There is not enough information available in the manual.... There must be a section where we can find the basic steps that must be followed to achieve certain goals." Many Tips group participants responded that the game tips were very helpful, and one stated: "Walkthrough was short and quick and got me playing quick!" However, one Tips group participant responded: "There should be tutorial missions to orient the player to the game and controls." One CBT+T group participant responded: "The game tips were good and easy to understand. The time duration to get acquainted with the CBT was short; perhaps a bit extra time should be given. The program is very user friendly." These comments suggest that a combination of CBT and Tips might provide the most comprehensive instructions for a novice player to get familiar with the game. The comments are partially presented in Appendix E.

Discussion

The goals of the present research were to examine the effectiveness of PC game instruction techniques (i.e., computer-based tutorial and game tips) for training novice players to learn a FPS game. The training outcomes were defined as how many Special Functions were used in the game plan, how familiar the participants were with the game interface (Quiz scores), the Game Scores, and whether critical commands such as Escort were incorporated in the game plan. Overall, the results support three conclusions:

a. a combination of both tips and CBT is the most effective in enhancing overall game performance compared to the tips-only, CBT-only, and the free play (No Training) conditions;
b. game playing tips (walkthroughs) are effective in training novice player to become familiar with various aspects of game playing, including game interface and how to set up more elaborate game plans by employing more Special Functions and game critical commands (e.g., Escort);
c. computer-based tutorial (CBT) can be effective in enhancing novice player's game scores.

The findings of this research suggest that game tips and CBT are effective in quite different ways. Game tips seem to be more effective than CBT in enhancing cognitive aspects of game performances (e.g., planning and familiarity with game interface); while CBT, on the other hand, is more effective in enhancing game scores. Participants who had access to the game tips employed more Special Functions in their plans, indicating that their plans were more elaborate than those of the groups that did not have access to game tips. In fact, infrequent FPS players who had access to game tips employed more Special Functions than did frequent FPS players who did not have access, although the difference failed to achieve statistical significance. From

military training perspective, however, these results indicate that game tips might be more effective in teaching the trainees how to develop an elaborate plan for the game.

Over ninety percent of the participants who had access to the game tips included critical commands such as Escort in their planning, while only 13.5% of those who did not have access to game tips employed the Escort command. Further examination of the time spent reading user's manual revealed that those who did not have access to the game tips but employed the Escort command spent an average of 38 minutes reading the user's manual, while those who did not have access to the game tips and did not employ the Escort command spent an average of 10 minutes reading the manual. These results suggest that the users were less likely to be aware of the command if they did not spend more time reading the user's manual.

Game tips were also found to be effective in enhancing Quiz scores. FPS experience was also significantly correlated with Quiz scores. The latter result should not be surprising, considering that most FPS games share similar command structures. Experienced FPS players have the advantage of well-established schemas for game playing, while inexperienced FPS players tend to learn the task/interface by using trial-and-error methods (Pillay, 2003). What is worth noticing is that inexperienced FPS players who had access to game tips were able to achieve Quiz scores that were at the same level as the experienced FPS players who did not have access to the game tips. These results suggest that game tips might be useful in helping inexperienced FPS players learn the game interface in a more efficient manner and, therefore, in reducing training time.

CBT was effective in enhancing game scores, although the differences between CBT groups (i.e., CBT and CBT&T) and non-CBT groups (i.e., NoTraining and Tips) were only marginally significant. However, CBT&T group did have significantly higher game scores than did the NoTraining group, indicating that a combination of CBT and game tips resulted in more effective learning of game playing and higher game scores. Although the measure of game scores was contaminated by the artificial intelligence component of the game engine, it still provides a comprehensive indicator of game performance, including both the planning and the action components. Presumably, CBT&T group had the highest game scores because they benefited from both the game tips for the planning component and the part-task tutorials for the action component.

Overall, the results of this research are consistent with some previous studies on video game performance training and demonstrate that game tips and CBT can be effective in enhancing game performance (e.g., Baba, 1993; Newell et al., 1989). In addition, our data show that the effectiveness of game tips and CBT appears to be task-specific. Tasks involving mainly cognitive components (e.g., planning and game interface) benefit from game tips while a combination of game tips and CBT appears to be most effective in enhancing the overall game performance (i.e., game scores). As stated in Newell et al., mere game scores may not provide a sufficient basis from which to assess all aspects of game performance. Previous gaming studies that only show advantages of game tips or part-task training may not have examined all the aspects of the games or the games employed in the studies may be more cognitive-oriented or motor-oriented. When both cognitive and motor components are critical for the game

performance, a combination of game tips and part-task training would probably be the optimal approach. This conclusion is consistent with the suggestion by Newell et al.

Implications for Military Training

Due to the increasing usage of computer games for military training purposes, it is more important than ever to understand how computer games can be utilized in an effective and efficient manner. As stated previously, one important issue facing the military training community is that training time is at a premium and trainees need to be able to play the game within as short a time as possible so they can start using the game to train the skills of interest. The results reported in this study suggest that the two different instructional techniques (i.e., CBT and game tips) seem to be effective in different ways, and players with access to both seem to learn the game most effectively. To be more specific, CBT may be more beneficial for games involving more maneuvering and actions such as those in FPS games; on the other hand, it may be more advantageous to employ game tips for games with predominantly cognitive components such as setting up game plans. These results can be incorporated in military training programs where computer games are part of the curriculum. Future military game development can also utilize these results to determine which type of instructional material to be included in the games.

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Appendix A
Group matching and power analysis

User's experience in PC gaming, specifically first-person-shooter gaming, was expected to covary with their game performance and, therefore, was included in the analysis. Based on the information obtained from the U.S. Army (e.g., The Computer Background of Soldiers in Infantry Courses: FY 99-00 by Fober, Bredthauer, & Dyer, ARI Research Report 1762), a sample that approximated the range and level of experience in the U.S. Army was selected and tested. The military data on soldiers' game experiences is as follows:

Daily	18%
Weekly	24%
Monthly	14%
<Monthly	22%
Never	22%

The Daily, Weekly, and Monthly categories was collapsed to form the Frequent players category (56%); the <Monthly and the Never categories formed the Infrequent players category (44%). Potential participants filled out questionnaires so their PC/video game and first-person-shooter game playing experiences could be classified into these categories, and they could be assigned to conditions to replicate the approximate distribution found in the Army today. However, due to the extreme difficulty of recruiting college male students with limited experience in PC/video games, it was decided that participant's first-person-shooter game experience, instead of PC/video game experience, would be used to match participants for the four groups.

A power analysis was performed to determine the minimum number of participants needed to detect differences among the three experimental groups (Shavelson, 1996). Data from Baba (1993) was used to estimate the necessary sample size based on the rationale that the experimental design (i.e., independent and dependent variables) of her study was similar to that proposed in this study. The four groups in her study (Control, Movement training, Game Strategy training, and Movement plus Game Strategy training) are similar to the groups of this current study (Control, CBT, Tips, and CBT + Tips, respectively). She used game scores as the main performance measurement, which is slightly different from what will be used in this current study (i.e., successful completions of game missions as well as game scores) but is not expected to be greatly dissimilar. Therefore, it was decided that using Baba's data should be adequate for estimating the required sample size. In Baba's study, there were 4 subjects in each group (Control, Movement, Strategy, and Movement plus Strategy) and an estimated effect size of .94 standard deviation unit was obtained when the rate of improvement was compared among the groups. The improvement scores were calculated by subtracting the pre-training game scores from the post-training game scores. The effect size could only be estimated because all groups were not given equal training times. Therefore, the rates of improvement and their standard deviations could only be inferred from the data reported.

The power analysis revealed that 14 participants per group would be sufficient to obtain a power of .80 (i.e., 80% chance of correctly rejecting the null hypothesis). However, due to the difficulty of obtaining participants with limited gaming experience (i.e., Infrequent players), it was decided that each group would include 11 participants. A total number of 44 participants

was selected based on the percentages in the five categories indicated previously but was classified as one of the two categories (i.e., Frequent, Infrequent). These groupings were employed to avoid low numbers of participants in the five categories and to increase the power of statistical analysis. The 44 participants, then, were assigned to the three experimental groups and the control group with a resulting assignment of 6 Frequent and 5 Infrequent participants in each group. Participants were screened to ensure that they did not have prior experience in playing Rogue Spear® or Rainbow Six®, to which Rogue Spear® is a sequel.

Appendix B

Questionnaire on Computer/Gaming Experience

Participant # _____ Age _____ Major _____

1. What is the highest level of education you have had?

Less than 4 yrs of college ____ Completed 4 yrs of college ____ Other ____

2. When did you use computers in your education? (*Circle all that apply*)

Grade School	Jr. High	High School
Technical School	College	Did Not Use

3. Where do you currently use a computer? (*Circle all that apply*)

Home Work Library Other_____ Do Not Use

4. For each of the following questions, circle the response that best describes you.

a. Do you own a personal computer? Yes No

b. How often do you:

Use a mouse? Daily, Weekly, Monthly, Once every few months, Rarely, Never

Use icon-based programs/software? Daily, Weekly, Monthly, Once every few months, Rarely, Never

Use programs/software with pull-down menus? Daily, Weekly, Monthly, Once every few months, Rarely, Never

Use graphics/drawing features in software packages? Daily, Weekly, Monthly, Once every few months, Rarely, Never

Use E-mail? Daily, Weekly, Monthly, Once every few months, Rarely, Never

Use the Internet? Daily, Weekly, Monthly, Once every few months, Rarely, Never

Play computer games? Daily, Weekly, Monthly, Once every few months, Rarely, Never

Play video games? Daily, Weekly, Monthly, Once every few months, Rarely, Never

Play first-person-shooter video/computer games? Daily, Weekly, Monthly, Once every few months, Rarely, Never

5. Which of the following best describes your typing ability? (check √ one)

_____ Hunt and peck slowly
_____ Hunt and peck quickly
_____ Type slowly while not looking at the keyboard
_____ Type quickly while not looking at the keyboard

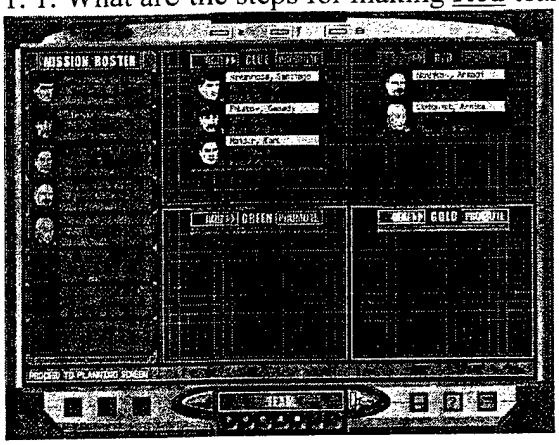
6. Which of the following best describes your expertise with computer? (check √ one)

_____ Novice
_____ Good with one type of software package (such as word processing or slides)
_____ Good with several software packages
_____ Can program in one language and use several software packages
_____ Can program in several languages and use several software packages

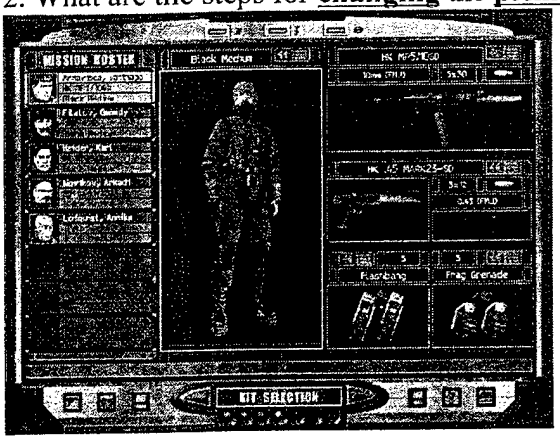
Appendix C

Quiz on Game Interface

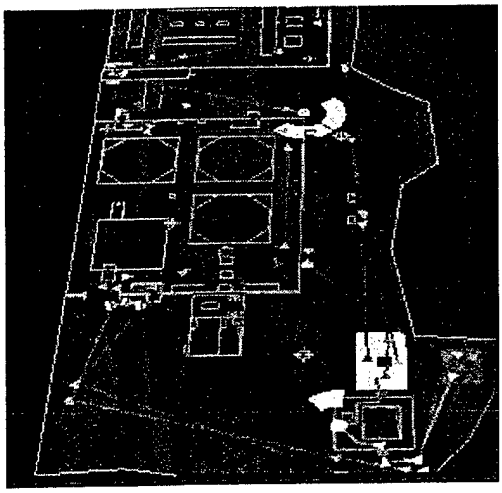
1. 1. What are the steps for making **Red** team's member Bogart the **leader** of **Blue** team?



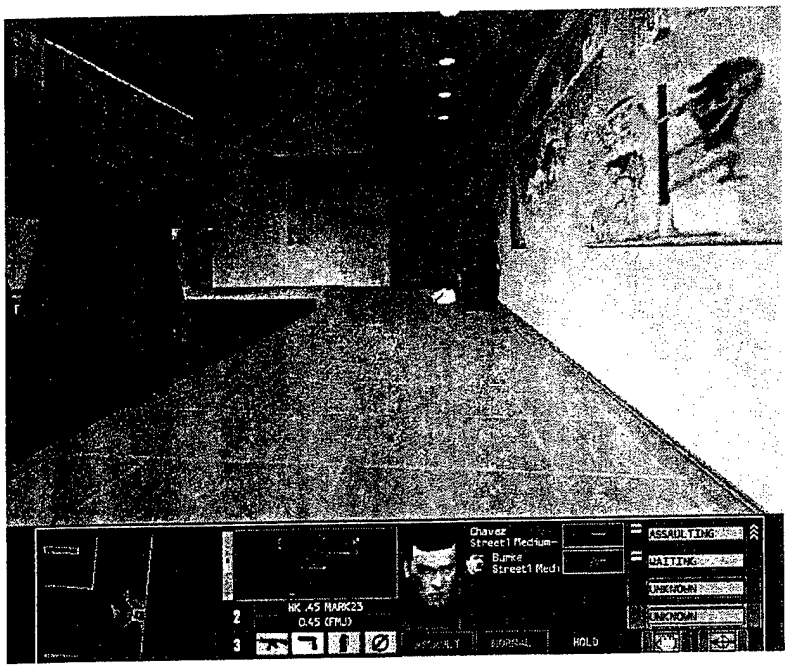
2. What are the steps for **changing** the **primary** weapon and assigning it to all team members?



3. How do you **change the directions** for orders such as "Snipe" and "Cover"?



For questions 4-10, use the screen shot below:



4. How do you **select another weapon**?

5. How do you **zoom in/out** the map?

6. What do the numbers "**3**" and "**2**" mean?

7. How do you **peek**?

8. How do you **change magazine**?

9. How do you change the Rule of Engagement (**ROE**) during mission?

10. How do you issue the **Alpha Go-Code** for Green Team?

Appendix D
Usability Questionnaire
Usability Questions

For the following, circle the number that best describes the degree to which you agree with each statement.

Training Session:

1. The training adequately prepared me for the test (playing the game in the test session).

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree

Comment: _____

2. The user's manual was useful for helping me learn the game.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree

Comment: _____

3. The game tips (walkthrough) were useful for helping me learn the game.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree

Comment: _____

4. The computer-based tutorials were useful for helping me learn the game.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree

Comment: _____

5. There was too much information in the training session to learn all at once.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree

Comment: _____

Game Performance:

6. The program was easy to use overall.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree

Comment: _____

7. I was able to easily recognize objects in the game environment.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree

Comment: _____

8. I was able to identify the characters (teammates, terrorists, and hostages) without difficulty.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree

Comment: _____

9. I was able to move through the game environment without difficulty.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree

Comment: _____

10. The planning phase (Roster selection, Kit selection, and Waypoint plotting) is too complicated.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree

Comment: _____

Lab Environment:

11. I was able to concentrate on my task without much distraction or disturbance.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree

Comment: _____

Appendix E
Participants' Comments

NoTraining Group:

1. It took a long time to get used to the game, and I still do not know what a lot of it means. Without the manual, I would have never been able to figure out the game.
2. A lot of things to remember. During gameplay, multiple things are going on at once, creating a lot of confusing gameplay. The planning phase takes up so much time and it is extremely confusing.
3. The user's manual had all the information; there was just too much to take in at once. Knowledge of the controls and having practice of using the controls is very different. There are a lot of commands that are forgotten while playing. The movement commands are uncomfortable to use (my hand was starting to cramp) and the movement of the sights was too fast at times. The planning phase would become easy after using if awhile, but it is very hard to pick up right away. It was also a little hard to tell the terrorists apart form certain objects (lampposts, paintings, etc.).
4. I spent about an hour trying to get to the actual game playing because I didn't realize that I was setting up a path on the floor plan for a wrong team. I never played this game and could have used a little assistance. The manual helped me understand the overall picture of the game but I mainly figured out how to play the game on my own. There could have been too much information in the training session to learn all at once for a novice such as myself. The key functions must be known in order to navigate during the game. The planning phase was a little tricky and difficult at first but eventually I got accustomed to it.
5. The planning phase is near impossible! The section on planning in the user's manual was very unclear.

CBT group:

1. In training section, the game must show some useful windows and tips and how to command the teams. There is not enough information available in the manual. Some important terms must be explained, such as ROE. There must be a section where we can find the basic steps that must be followed to achieve certain goals.
2. The training did not adequately prepare me for setting up missions.
3. An outline or table of contents would help. The CBT was a great example of game. I was unaware of own team at first. I would like to the map to show the entire location during game. During the planning phase, the waypoint plotting is too complicated; I hardly followed through with it.
4. The CBT was a great way to learn how to play. The planning phase needs to be faster.
5. More training in the planning segment would have helped, I think. The planning phase needs more explanation, but it isn't too complex.
6. There was not enough information in the training session. The planning phase should be already set on certain levels.

Tips group:

1. The planning phase could use some work to make it easier to use.
2. The training material could have been more legibly written and the training time more extensive. The control codes are not intuitive so it takes long to become intuitive with their

use. Planning vs. execution—not sure how correlated (i.e., is there penalty for diverging from plan?). Not being intimately familiar with firearms, the weapons are so much of a blur that picking weaponry is pretty much guesswork (i.e., it helps but it takes a while to get working knowledge to select confidently and appropriately and one doesn't know how if it affects underlying algorithm, if at all). The game tips (walkthrough) were helpful. I was frequently referring to movement codes while trying to watch for and fend off the bad guys! I'm not sure how the planning phase could be simplified but it's definitely a good exercise to have a plan to start from. The up and down stairs were hard to figure out.

3. There should be tutorial missions to orient the player to the game and controls.
4. The game tips (walkthrough) were very helpful. There was too much information in the training session to learn all at once; it was confusing, and I did not master all the things. During the game, it was easy to lose orientation.
5. During the training session, I learned much more than I knew, and was better prepared but not fully. The walkthrough taught me everything I needed for a general understanding. I would rather space out the time than do it all in one session. During the planning phase, roster, kit and waypoint are okay but the alpha plans were confusing.
6. It'd be nice to have shortcut key that showed what victory conditions/successes were. The user's manual was only useful for the weapon specifications. Nobody likes reading instructions; walkthrough was short and quick and got me playing quick! There was not too much information in the training session; I built from session to session. Go-codes were complicated at first.
7. During the training session, more actions and commands need to be shown. During the planning phase, planning for actions and go-codes weren't clear.
8. Best preparation is familiarity with a particular mission. I didn't look at the user's manual; quicksheets covered the important stuff. The walkthrough was good, but for a very straigl t-forward and relatively simple mission.
9. During the training session, there was a lot of info but not too much. Set up the game was difficult. The planning phase have a lot of objects and the go-codes were hard to understand and use.
10. There are a lot of controls to remember. The game tips were very helpful. When using the program, there was a lot to do all at once. The planning phase helps you to plan strategies.

CBT+T group:

1. I was not familiar enough with key-controls. The user's manual helps, but a booklet with explanations would be better. The game tips were useful, but only for the scenario played. The CBT help if I'd known how to use them properly. The planning phase is not too complicated—proper planning leads to higher mission success.
2. The user's manual was very helpful. The game tips were good and easy to understand. The time duration to get acquainted with the CBT was short; perhaps a bit extra time should be given. The program is very user friendly.
3. The user's manual was okay except it was unnecessarily full of not really necessary info. The game tips were good intro for the game and tutorial. Overall, the icon-based things made the program easy but the planning part was difficult.
4. The summary sheet with the controls was very useful.
5. I did not know what to expect before I used the CBT. There was too much to remember without playing the game first.