

Watson, A. M., Surface, E. A., & Dierdorff (2008, April). *A comparison of trainee reactions across facets of computer-based training*. Paper presented at the 23rd annual conference of the Society for Industrial and Organizational Psychology, San Francisco, CA.

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The current study examined trainee reactions to different facets of computer-based training (CBT) in the context of on-the-job foreign language training. Trainees displayed differences in perceived engagement, enjoyment, effectiveness, and ease of use with respect to different facets of CBT, ranging from more traditional self-directed learning modules to simulation-based videogames.

Computer-based training (CBT) is quickly becoming the delivery method of choice for employee development in many organizations today (O'Neil, Wainess, & Baker, 2005; Sitzmann, Kraiger, Stewart, & Wisher, 2006). In general, CBT is an interactive experience in which computer software presents learning stimuli, learners must respond to these stimuli, learner responses are analyzed by the software, and feedback is provided to the learners (Noe, 2007). The growing interest in CBT has coincided with the increased availability and technological capabilities of personal computers, as well as the increasingly difficult prospect of training geographically dispersed learners using conventional lecture-based instruction. Further, there is

some empirical evidence of the overall effectiveness of CBT (Kulik & Kulik, 1991; Kulik, 1994; Sitzmann et al., 2006)

It is important to note that CBT programs make use of a variety of instructional methods, such as self-directed learning (e.g., readings/workbooks, programmed instruction), simulated work settings, and interactive videogames (Goldstein & Ford, 2002). A variety of delivery mechanisms are also employed, including CD-ROM/DVD, interactive multimedia, web-based instruction, and video conferencing (Goldstein & Ford, 2002). However, existing research has yet to systematically examine whether these varieties influence outcomes of CBT. That is, prior research has tended to examine

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CBT in a consolidated or holistic approach. Because different facets of CBT represent distinct delivery mechanisms and methods, a more thorough understanding of CBT necessitates a finer-grained examination in which such facets are meaningfully explicated and empirically assessed.

Thus, the purpose of our study is threefold. First, we seek to explicate how various facets of CBT meaningfully differ. Second, we offer definitions of four distinct types of learner reactions that are particularly salient to CBT. Third, we strive to answer previous calls for research to investigate whether or not facets of CBT differ in an empirically meaningful way (Brown, 2005; Fletcher & Tobias, 2006). More specifically, we compare learner reactions to more traditional facets of CBT with newer facets that are videogame-based.

A focus on learner reactions is important in the context of CBT for several reasons. For example, with regard to CBT which incorporates self-directed learning, it is reasonable to assume reactions are indicative of the likelihood at which individuals will continue using and progressing through the training. However, trainees who react negatively to a particular CBT program (e.g., do not enjoy training with the program, do not perceive the program to be effective, etc.) may be less likely to dedicate personal time to training with that program (Brown, 2005). Indeed, previous research has demonstrated that the higher degree of learner control afforded by CBT can have negative consequences on learning outcomes for certain trainees (Brown, 2001). Finally, some have argued that CBT works best when learners are comfortable with using technology (i.e., have favorable reactions to CBT). Thus, trainee reactions constitute informative and useful outcomes of CBT.

More research on newer forms of CBT, such as instructional videogames, is clearly

needed as well. As Fletcher and Tobias (2006) note in their review of current instructional computer game research, “there is more enthusiasm about the opportunities for learning provided by computer games...than there is for conducting empirical studies investigating whether these opportunities are actually realized” (p. 16). In addition, the vast majority of extant research has consisted of undergraduate populations in academic settings, used videogames involving rather artificial tasks (e.g., TETRIS, Space Fortress), and has not compared videogames to more well-established CBT facets (e.g., self-directed learning modules). While these characteristics do not necessarily invalidate previous studies, they do present issues related to the generalizability of existing research.

Differences within Multifaceted CBT

CBT systems use myriad instructional tools to enhance trainees’ knowledge and skills, including modules that not only introduce new content, but also provide practice activities and drills, and performance feedback. While CBT has clearly become multifaceted in its delivery, there exists a lack of empirical attention given to potential differences that may exist in trainees’ reactions to the various facets comprising CBT.

A more traditional facet of CBT consists of self-directed learning modules that allow learners to take responsibility for all aspects of learning (Warr & Bunce, 1995). These modules typically present readings, videos, and other instructional content that are then followed by self-testing or drilling. These “skill drills” consist of practice exercises, in which trainees can apply newly acquired knowledge and skills to specific tasks. The primary learning objective of this facet of CBT is repetitive demonstration of narrow sets of newly acquired skills in rule-based

environments in order to develop automaticity in newly acquired cognitive process and skills (Shebilske, Goettl, & Garland, 2000). Because this CBT facet uses a predetermined structure, the degree to which learners have autonomy within skill-drilling is limited. Although learners may be allowed some flexibility to demonstrate capabilities within narrow sets of skills, the overarching structure of the training situation constrains autonomy and control.

A less traditional facet of CBT is simulation-based videogames, which have been generally defined as “systems that attempt to create, augment, extend, or supplant a trainee’s actual experience in the world through the use of simulations and virtual/immersive environments” (Cannon-Bowers, Sanchez, Sawyer, & Greenwood-Ericksen, 2006, p. 2). This facet of CBT is becoming increasingly prevalent in today’s organizations (O’Neil et al., 2005; Ricci, Salas, & Cannon-Bowers, 1996), with benefits purported to include increased user engagement, visual appeal, learner immersion and reduced training time and instructor workload (Mitchell & Savill-Smith, 2004). In addition, such training allows trainees to engage in scenarios that are otherwise too dangerous or not easily recreated in a real world environment (Mitchell & Savill-Smith, 2004) and thus, provides more immediate feedback in low-risk environments which can encourage exploration, experimentation, new opportunities for learning, and maximize transfer (Garris, Ahlers, & Driskell, 2002; Kirriemuir, 2002). In this sense, simulation-based videogames present situations where learner autonomy is relatively high. Such game-based training evokes a greater sense of control when trainees are allowed to choose strategies and make decisions regarding the sequence and pace of training (Garris, Ahlers, & Driskell, 2002). Thus, this CBT facet provides increased flexibility

for trainees to make decisions and perform skills as the situation demands.

In addition to the degree of learner autonomy and control, facets of CBT differ with respect to the degrees to which they possess psychological fidelity (i.e., similarity of the cognitive and attention processes between training and real world). Generally speaking, simulation-based videogames present learners with training situations of higher fidelity than more traditional self-directed learning facets. This fidelity stems from the use of virtual environments that are designed to immerse learners within similar contextual conditions to the “real world” (Fletcher & Tobias, 2006). Thus, skill-drills within self-directed learning modules focus less on contextual fidelity and more on assessment of instructional content acquisition, while videogames seek to enhance the application of instructional content to different virtual contexts.

Four “E’s” of Trainee Reactions to CBT

Previous CBT research has tended to be rather broad in the assessment of trainee reactions. For example, there has been a tendency to assess only overall satisfaction with training, or to combine measures of distinct reactions such as enjoyment and relevance, even though empirical evidence suggests reactions are best considered distinct, yet related, constructs (Brown, 2005). With respect to the instructional videogame literature, learner reactions have received similar inconsistent treatment, as well as suffered from a clear definition of various types of learner reactions. For instance, Gonos and Wollert (2006) assessed law enforcement trainees’ utility reactions to CBT scenarios incorporating virtual environments and characters. In addition to the traditional notion of utility as perceived usefulness of training, Gonos and Wollert’s (2006) measure of utility also incorporated

perceived realism of the virtual scenarios, the adequacy of the actionable cues depicted, and the quality of the system's feedback capabilities. Thus, utility reactions, in this example, were composed not only of perceived usefulness of the virtual training system, but also fidelity and quality of feedback.

The broader training literature has established the importance of examining distinct learner reactions, as opposed to broader measures of reactions (Alliger, Tannenbaum, Bennett, & Traver, 1997; Brown, 2005). From our review of the literature, there appears to be four distinct learner reactions that are particularly relevant to CBT: engagement, enjoyment, effectiveness, and ease of use. These are discussed below along with their hypothesized differences across facets of CBT, when possible.

Engagement refers to the degree to which the training system holds trainees' attention throughout training. Engaged learners report being highly absorbed and immersed in the training tasks (Garris et al., 2002). Previous research suggests CBT that incorporates game-like facets will result in increased user engagement and immersion (Cannon-Bowers et al., 2006; Mitchell & Savill-Smith, 2004). For instance, one goal of the high level of aesthetic detail and interactivity of videogame-based training is to produce a high level of immersion and engagement in the virtual environment (Mitchell & Savill-Smith, 2004). In this way, simulation-based videogames should promote greater levels of user engagement than less interactive facets of CBT (e.g., skill drill modules of self-direct learning). Thus, we hypothesized that learners will perceive CBT facets that incorporate more videogame-like elements as more engaging compared to facets with less game-like elements.

Hypothesis 1: Trainees perceive videogame-based CBT training as more engaging than CBT facets with less videogame elements (e.g., skill drills).

Enjoyment refers to the degree to which trainees liked using the training system. Trainee enjoyment, in the context of game-based training, is consistent with traditional conceptions of general affective reactions to training (Alliger et al., 1997). Previous research has found trainees tend to report greater levels of enjoyment with game-based training relative to lecture-based instruction (Fletcher & Tobias, 2006; Ricci et al., 1996). Proponents of game-based training suggest games are designed to be sources of fun and enjoyment, which will enhance and sustain trainees' interest (Garris et al., 2002). Thus, we hypothesized that learners will perceive game-based CBT to be more enjoyable relative to CBT with less game-like elements.

Hypothesis 2: Trainees perceive videogame-based CBT training as more enjoyable than CBT facets with less videogame elements (e.g., skill drills).

Effectiveness refers to the degree to which trainees believe the training system is a valuable means of learning and practicing the training content. While videogame-based training is argued to enhance learner engagement and enjoyment, it is unclear as to whether learners will perceive game-based training to be a more effective means of training relative to more traditional facets of CBT. Research suggests perceived effectiveness of game-based training may differ as a function of trainee characteristics (Brown, 2001; Orvis, Belanich, & Horn, 2006) and situational characteristics (Gredler, 2004). For instance, trainees with

greater prior knowledge have been shown to make more effective choices during training relative to those with less domain knowledge (Brown, 2001). Thus, low knowledge trainees may not make the best use of the increased autonomy granted by videogame-based training, which may impact their perceptions of effectiveness. Given the lack of research comparing the relative effectiveness of videogame-based training and more traditional CBT facets, we did not offer a formal hypothesis but rather posed the following research question.

Research Question 1: Do trainees perceive videogame-based CBT training to be more or less effective than CBT facets with fewer videogame elements (e.g., skill drills)?

Ease of use refers to the degree to which learners view the CBT systems as difficult or simple to use. Trainees' perceptions of ease of use of CBT represent valuable information because poor usability can serve as a barrier to training progress. Though researchers have indicated the importance of usability in the context of CBT (Hasan & Ahmed, 2007), there is a lack of research comparing learners' perceptions of usability across various facets of CBT. Previous research has demonstrated trainees report a greater intention to use computer-based applications that they also feel are easy to use compared to applications less easy to use (Hasan & Ahmed, 2007). However, the highly interactive nature of game-based training likely places greater demand on learner capability to properly use the CBT system. For example, deficiencies in the interface and game-play may more heavily detract from the training experience when learner control is high. With the added complexity (e.g., enhanced graphics, voice recognition) incorporated in most training

videogames, trainees require additional time and resources to become comfortable with interface. Thus, we hypothesized that learners will perceive game-based CBT to be more difficult to use relative to CBT with less game-like elements.

Hypothesis 3: Trainees perceive videogame-based CBT training as more difficult to use (i.e., lower ease of use) than CBT facets with less videogame elements (e.g., skill drills).

Method

Participants

Study participants were 268 U.S. Army Infantry personnel who participated in a mission-related training program prior to deployment in Iraq. The training was conducted at a large military installation in the Midwest. 170 trainees completed the post-training questionnaire, which contained the reaction measures in question. Of the 170 post-training respondents, 153 complete and usable responses were retained for analysis.

Training Context

All trainees participated in required foreign language training as a component of the broader mission-related pre-deployment training. Training content was directly related to trainees' deployment location (Iraq) and post-deployment job requirements and mission tasks. Training included both classroom lecture provided by expert Iraqi instructors and CBT. The duration of the Iraqi language training was 40 hours, which included approximately 28 hours of CBT and 12 hours of classroom. One to two training sessions per week were scheduled over a period of 10 weeks. CBT training sessions were one to four hours in duration. Classroom training sessions were two hours

in duration. The training objectives indicated trainees should achieve quiz scores of at least 60% for all 28 Tactical Iraqi lessons specified.

Tactical Iraqi

The Tactical Iraqi™ Language & Culture Training System is a self-paced CBT program designed to teach individuals how to communicate in Iraqi Arabic. Tactical Iraqi includes three learning modules: Skill Builder; Arcade Game; and, Mission Game. Tactical Iraqi incorporates both traditional computer-based training methods (e.g., Skill Builder) and videogame-based training methods (e.g., Arcade and Mission Games). Trainees used version 3.1. Table 1 provides brief descriptions of the instructional content, required tasks and activities, and the degrees of autonomy and fidelity associated with each of these modules.

Research Design

The field study used a modified pre-post research design with several “during training” assessments to assess longitudinal effects. All assessments were administered via paper forms and completed on-site at the military installation under standardized conditions. The post-training questionnaire, containing the measures of interest, was group administered by the researchers.

Measured Variables

Post-training reactions were assessed for each of the components of Tactical Iraqi. Participants completed a separate section of reaction items for each component (i.e., rated the skill-builder, mission game, and arcade game separately), which included specific items capturing reactions regarding perceptions of effectiveness, enjoyment, engagement, and ease of use. These items are shown in Table 2.

Results

Means and standard deviations for each trainee reaction item are presented in the Table 2. Correlations between reaction items are presented in Table 3. As expected, reaction items displayed stronger correlations within each CBT module relative to those between modules. In addition, Arcade Game and Mission Game reaction items displayed stronger correlations amongst each other relative to items pertaining to the Skill Builder module. Thus, trainees’ reactions appeared to differentiate between CBT modules.

To address each hypothesis and research question, one-way repeated measures analyses of variance (RM-ANOVAs) were conducted for each reaction item. The CBT facet (i.e., Skill Builder, Arcade Game, Mission Game) targeted by each item represented the grouping variable for the RM-ANOVA. Results of the RM-ANOVA are presented in Table 2.

Results indicated evaluations of perceived engagement during training differed across CBT facets [$F(1, 151) = 11.65, p < .01$]. Post-hoc analyses, using the Bonferroni adjustment for multiple comparisons, indicated that the Skill Builder was evaluated as significantly more engaging compared to both the Arcade Game ($p < .05$) and the Mission Game ($p < .01$). Thus, Hypothesis 1 was not supported. Evaluations of perceived enjoyment differed across CBT facets [$F(1, 152) = 6.48, p < .05$]. Post-hoc analyses indicated that the Skill Builder was evaluated as significantly more enjoyable compared to Mission Game ($p < .05$), but not the Arcade Game. Additionally, the Arcade Game was reported to be significantly ($p < .05$) more enjoyable compared to the Mission Game. Thus, Hypothesis 2 was not supported.

Results indicated evaluations of perceived effectiveness of training differed

across CBT facets [$F(1, 151) = 19.78, p < .01$]. Post-hoc analyses indicated that the Skill Builder was evaluated as significantly more effective compared to both the Arcade Game ($p < .05$) and the Mission Game ($p < .01$). Evaluations of perceived ease of use differed across CBT facets [$F(1, 152) = 30.61, p < .01$]. Post-hoc analyses indicated that the Skill Builder was evaluated as significantly easier to use compared to both the Arcade Game ($p < .05$) and the Mission Game ($p < .01$). Additionally, the Arcade Game was rated significantly ($p < .01$) easier to use compared to the Mission Game. These results are supportive of Hypothesis 3.

Discussion

The goal of this study was to examine trainees' reactions to various facets of CBT. Specifically, we compared trainees' perceptions of engagement, enjoyment, effectiveness, and ease of use across instructional, game-based skill drilling, and simulation-based training modules of a CBT program. Contrary to our hypothesis, trainees reported the simulation-based videogame facets to be less engaging than the self-directed learning module. This finding is contrary to suggestions in the game-based training literature that purport game-like elements will increase learner engagement (e.g., Cannon-Bowers et al., 2006). Perhaps in the context of CBT, self-directed learning modules present as much, if not more, user engagement compared to simulation-based videogames due to the near constant stream of new material and feedback associated with self-directed learning. Trainees may have expected the "typical level" of engagement provided by commercially available "first-person shooter" games (e.g., Medal of Honor), which is not characteristic of Tactical Iraqi, and were disappointed. Additionally,

learning and speaking Iraqi Arabic is a difficult task under any circumstances. Trainees may have had difficulty feeling engaged (as in a typical game) while constantly having to request hints and word translations.

Also contrary to our prediction, learners did not report greater levels of enjoyment when using the videogame modules relative to the self-directed learning module. In fact, trainees reported less enjoyment with the simulation-based videogame facet compared to the other CBT facets. This finding suggests introducing game-like elements into training does not always lead to greater enjoyment and highlights the difficulty of adapting game features for purposes of instruction without removing what makes games enjoyable (Garris et al., 2002). In addition, although not hypothesized, trainees reported the self-directed learning module as providing a more effective learning experience compared to both game-based training modules. This latter finding suggests learners perceive more traditional approaches to instruction as more effective relative to game-based training.

Supporting our prediction, we found trainees reported the self-directed learning module to be easier to use relative to both game-based CBT modules. Additionally, learners found the simulation-based videogame to be the most difficult to use. This finding is consistent with the notion that the added level of control and complexity associated with videogames may impair some users' ability to easily interact with the system. In the context of the present study, the combination of videogame elements and the voice recognition interface likely contributed to users reporting more difficulty using the simulation game.

Limitations and Directions for Future Research

One limitation of the present study is the reliance on single-item measures of trainee reactions; however, this is not atypical for facet-specific training reactions. Scales composed of multiple items are typically preferable to ensure reliability and adequate coverage of the construct domain. Another limitation is the specific focus on trainee reactions as a measure of training outcomes. Reactions constitute one of many important training outcomes established in the training literature (e.g., Alliger et al., 1997). Future research should examine the impact of different facets and delivery mechanisms of CBT to other affective, behavioral, and cognitive training criteria. More research is also needed to identify specific characteristics of game-based training software that lead to decreased usability and examine potential design strategies to attenuate these negative effects.

Conclusion

With the increasing prevalence of CBT in organizations today, research into the strengths and weaknesses of novel training tools must remain current to maximize its impact. The influx of videogame elements into CBT solutions represents a growing trend in need of basic research. This study found trainees conducting on-the-job foreign language training displayed differences in perceived engagement, enjoyment, effectiveness, and ease of use with respect to different facets of CBT, ranging from self-directed learning modules to simulation-based videogames. As a field-based empirical study of videogame training, this research addresses a major shortcoming of existing research by enhancing our understanding of how trainees completing on-the-job training in an organizational setting react to the use of game-based training methods. These findings address

calls for empirical research into videogame-based training in applied settings, as well as highlight directions for future research.

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Table 1. Tactical Iraqi Module Descriptions

Module	Instructional Content	Tasks/activities	Learner Autonomy	Psychological Fidelity
Skill Builder	Vocabulary, grammar, pronunciation, culture, and basic system instruction (i.e., how to use the CBT software)	Structured exercises and quizzes requiring learners to listen and speak to the system. Speech recognition interface provides feedback on pronunciation. Learners view and respond to brief conversations between non-player controlled characters (NPCs).	Low	Low to Medium
Arcade Game	Pronunciation and listening skills relate to spatial directions (e.g., right, left, etc.), colors, common landmarks, numbers, and military ranks	Computer characters are maneuvered through mazes or a village while listening to or speaking Iraqi Arabic; “points” are earned by correctly interpreting spoken instructions or producing correct speech.	Medium	Low to Medium
Mission Game	Pronunciation, listening, speaking, culture, interpersonal interactions (e.g., building rapport)	Computer characters interact with other NPCs, using verbal and nonverbal (e.g., hand gestures) communication. Each mission game scene presents specific objectives to complete in the simulated environment. Access is provided to a computer-based “tutor,” which, when accessed, will offer suggestions.	High	High

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Table 2. Means and Standard Deviations of Evaluation Items Across CBT Facets

Item Theme	Skill		Arcade		Mission	
	Builder		Game		Game	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Provided Engaging Experience [†]	4.79	1.44	4.51 ^a	1.19	4.42 ^a	1.18
Provided Enjoyable Experience ^{††}	4.66 ^a	1.46	4.46 ^a	1.18	4.39	1.13
Provided Effective Experience [†]	4.89	1.33	4.58 ^a	1.08	4.45 ^a	1.08
Easy to Use ^{††}	4.96	1.48	4.63	1.20	4.36	1.27

Note. $N^{\dagger} = 152$. $N^{\dagger\dagger} = 153$. For each item, means that do not share the same letter (i.e., a) are significantly different ($p < .05$). Reaction items: “The [CBT module] provided an engaging learning experience (that is, kept my attention throughout training)”, “The [CBT module] provided an enjoyable learning experience”, “The [CBT module] provided an effective learning experience for me to learn Iraqi Arabic language and culture”, “The [CBT module] was easy to use/play.” Responses were made using a 7-point Likert-type scale, ranging from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*). Higher means indicate more positive evaluations.

Table 3. Intercorrelations Between CBT Reaction Items ^a

Item Theme	1	2	3	4	5	6	7	8	9	10	11	12
Skill Builder												
1 Provided Engaging Experience	1.00											
2 Provided Enjoyable Experience	.80	1.00										
3 Provided Effective Experience	.79	.80	1.00									
4 Easy to Use	.71	.66	.62	1.00								
Arcade Game												
5 Provided Engaging Experience	.26	.37	.41	.27	1.00							
6 Provided Enjoyable Experience	.35	.41	.35	.34	.85	1.00						
7 Provided Effective Experience	.37	.31	.28	.30	.75	.83	1.00					
8 Easy to Use	.35	.28	.33	.45	.69	.65	.67	1.00				
Mission Game												
9 Provided Engaging Experience	.49	.42	.44	.37	.65	.68	.67	.48	1.00			
10 Provided Enjoyable Experience	.49	.50	.49	.43	.60	.61	.50	.48	.86	1.00		
11 Provided Effective Experience	.49	.45	.50	.42	.69	.64	.61	.57	.91	.88	1.00	
12 Easy to Use	.45	.32	.37	.52	.40	.35	.46	.63	.65	.68	.71	1.00

Note. $N = 152$. ^aAll correlations were significant at $p < .001$.

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- Organizational effectiveness
- Test development and validation
- Program/training evaluation
- Work/job analysis
- Needs assessment
- Selection system design
- Study and analysis related to human capital issues
- Metric development and data collection
- Advanced data analysis

One specific practice area is analytics, research, and consulting on foreign language and culture in work contexts. In this area, SWA has conducted numerous projects, including language assessment validation and psychometric research; evaluations of language training, training tools, and job aids; language and culture focused needs assessments and job analysis; and advanced analysis of language research data.

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