An Examination of the Role Individual Differences Play in Videogame–Based Training

Karin A. Orvis
Old Dominion University, Norfolk, Virginia

Daniel B. Horn
Booz Allen Hamilton, McLean, Virginia

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

Videogames are emerging as an increasingly popular training tool in the military. Given this trend, it is important to investigate factors that maximize the effectiveness of this training medium. The present research analyzed the impact of trainee attributes (i.e., prior videogame experience, videogame self-efficacy, and goal orientation) on game-based training outcomes. Participants completed a game–based tactics training exercise. The training exercise used America’s Army, a first-person-perspective videogame with a single-player section to introduce game-specific tasks, followed by a multiplayer section where participants form small teams to conduct collaborative missions. Prior to and after the training exercise, participants completed online questionnaires. Results suggest that the trainee attributes, as a set, had a positive impact on trainee motivation, trainee satisfaction, ease in using the training game interface, metacognitive strategies utilized during training, and time spent engaging in the training game. These findings have implications for instructors using videogames as training tools. Recommendations for future research in this area are provided.

Videogames have emerged as a popular training tool across the U.S. military (Hays, 2005). One rationale for using videogame–based simulations for training...
purposes is that they can be motivating to use (Prensky, 2001). Further, research demonstrates that increased trainee motivation, and hence time and effort devoted to training, subsequently improves learning outcomes such as knowledge/skill acquisition and retention (Colquitt, LePine, & Noe, 2000; Mathieu, Tannenbaum, & Salas, 1992). Unfortunately, research also suggests that in self-directed, technology-delivered training environments, such as E-learning and videogame–based training, trainees with low motivation sometimes terminate training before mastering the training content (Bell & Kozlowski, 2002). Consequently, determining how to motivate trainees to continue engaging in game-based training environments is of great concern to instructors.

Research on training games has primarily focused on videogame features (e.g., interactivity and visual/auditory presentation) that may influence a trainee’s motivation to learn along with other training outcomes (Belanich, Sibley, & Orvis, 2004; Garris, Ahlers, & Driskell, 2002). This prior research has enhanced our understanding of training game design and its relationship with training effectiveness. Yet, to date, little research has examined trainee individual differences that may facilitate or impede trainee motivation to learn. The purpose of the present research is to identify trainee attributes that maximize trainee motivation, as well as several learner choices and outcomes relevant to videogame–based training environments.

According to social cognitive theory, individuals’ cognitions and behaviors during a learning experience are influenced by two motivational constructs: (a) self-efficacy: personal perceptions of one’s ability to accomplish a task; and (b) goals: one’s reasons for engaging in the task (Bandura, 1986; Pintrich & Schunk, 1996). Traditional training and E-learning research has shown that self-efficacy and goal orientation are related to trainee motivation, time on task, and other learner outcomes (e.g., K. G. Brown, 2001; Colquitt et al., 2000). Research has also demonstrated that trainees’ prior videogame experience is positively related to time on task in game-based training environments (Orvis, Orvis, Belanich, & Mullin, 2007). Thus, this article focuses on self-efficacy, goal orientation, and prior videogame experience as antecedents of trainee motivation to learn, as well as several learner choices and outcomes relevant to game-based training (see Figure 1 for the specific constructs investigated in this article). The ability to identify such individual attributes that lead to success in PC game-based training environments will help to better prepare military personnel for training and will lead to increased operational capabilities.

TRAINEE MOTIVATION AND LEARNER CHOICES/OUTCOMES RELEVANT TO GAME-BASED TRAINING

Training Motivation

Pretraining motivation, also referred to as motivation to learn, reflects a trainee’s desire to learn the content of the training program (Noe, 1986). Pretraining motiva-
Metacognition involves planning, monitoring, and revising goal appropriate behavior (A. L. Brown, Bransford, Ferrara, & Campione, 1983). Learners who en-
gage in greater task-relevant metacognitive activity during training should learn more effectively because they actively monitor their learning progress, self-evaluate where they are having difficulties, and adjust their behaviors to address these difficulties (A. L. Brown et al., 1983; Ford et al., 1998; A. M. Schmidt & Ford, 2003). Metacognition may be a particularly important learner choice in game-based training because this type of learning environment typically provides little external structure or feedback on the most effective way to learn while progressing through the training game.

**Time on Task**

The length of time a learner is engaged in learning has been demonstrated consistently to be an important predictor of learning in a variety of contexts (e.g., Bloom, 1974; K. G. Brown, 2001; Bugelski, 1962, 1970). For example, K. G. Brown found that the amount of time spent engaged in an E-learning program was positively related to knowledge acquisition.

**Training Satisfaction**

Training satisfaction focuses on both emotionally-based opinions of the training (e.g., liking the training) and reactions to the utility of the training (e.g., believing the training enhanced one’s knowledge or skills). Trainees’ level of satisfaction with the training has been found to be related to learning in an E-learning environment (Wasserman et al., 2009).

**Ease in Using Game Interface**

Ease in using the training game interface is another criterion that may influence the level of engagement in a videogame–based training environment. If trainees find learning environments to be frustrating and difficult to use, they may experience decreased motivation that prevents them from fully engaging in or completing the instruction (Frankola, 2001). Moreover, prior research has found that trainee perceptions regarding the user interface of an E-learning program were positively related to satisfaction with the overall training, which, in turn, was positively related to learning (Wasserman et al., 2002).

**Training Performance**

An individual’s performance while completing a training program is indicative of the extent to which he or she is acquiring the knowledge/skills being taught within the training. Further, prior research demonstrates that a learner’s training
performance is positively related to knowledge/skill transfer (Ford et al., 1998; Kozlowski et al., 2001).¹

ATTRIBUTES TRAINEES BRING TO THE TRAINING ENVIRONMENT

Prior Videogame Experience

To date, limited gaming research has attempted to identify trainee attributes that influence learner choices/outcomes in videogame–based training environments. Prior research has found that an individual’s prior videogame experience (i.e., frequency of game use) is predictive of his or her future performance in videogame–based environments (Gagnon, 1985; Young, Broach, & Farmer, 1997). Further, Orvis et al. (2007; Orvis, Horn, & Belanich, 2008) found that a trainee’s level of prior videogame experience influenced learner choices during training and subsequent learning outcomes; prior gaming experience predicted a trainee’s time spent engaging in the training game, satisfaction with the training experience, and ease in using the training game interface.

Orvis et al. (2007) also found that the influence of prior experience on these learner choices/outcomes was dependent on the specificity of a trainee’s prior videogame experience. Specifically, prior experiences with games that shared similar characteristics to the training game (e.g., pace, interface, perspective) were more likely to positively influence the learner choices/outcomes. Prior experiences with irrelevant games (i.e., games that do not share similar characteristics) did not predict these choices/outcomes. Consistent with Orvis et al., we expected that prior relevant videogame experience would positively influence motivation to train in a videogame–based training environment, learner choices during training (i.e., metacognitive activity and time on task), affect-based learning outcomes (i.e., training satisfaction and ease in using game interface), and training performance.

Videogame Self-Efficacy

Self-efficacy is a judgment of one’s ability to successfully perform a task (Bandura, 1977). Self-efficacy is domain specific in that it varies across different types of tasks and contexts (Bandura). As such, of particular relevance to video-

¹An important point to note is that, although training performance has been found to be predictive of subsequent knowledge/skill transfer, other research suggests that a trainee’s performance level during training is not always indicative of subsequent transfer (e.g., Healey, Wohldmann, & Sutton, 2006; R. A. Schmidt & Bjork, 1992; Simon & Bjork, 2002).
game–based training environments is videogame self-efficacy—a judgment of one’s ability to successfully play videogames.

Trainee self-efficacy beliefs have been found to be an important predictor of pretraining motivation (Colquitt et al., 2000), amount of time spent practicing new skills (Bouffard-Bouchard, 1990), trainee reactions to a training program (Mathieu, Martineau, & Tannenbaum, 1993), and learning and performance (Bandura & Cervone, 1986; Colquitt et al., 2000) in various training contexts, including technology-delivered training contexts. In general, prior research suggests that individuals with high self-efficacy tend to exert greater mental effort and persistence while completing a training program and thus experience more positive cognitive, skill, and affect-based learning outcomes. Thus, consistent with this prior work, we expected in the current research that trainees’ levels of videogame self-efficacy would positively influence their motivation to train in a videogame–based training environment, learner choices during training, subsequent affect-based learning outcomes, and training performance.

Goal Orientation

Goals are recognized as being central to the understanding of motivated behavior. Dispositional goal orientation theory suggests that individuals adopt distinct outlooks or mental frameworks regarding learning and achievement contexts (Brett & VandeWalle, 1999). These differing frameworks influence individuals’ reasons for engaging in learning/achievement tasks, beliefs regarding causes of success, and preferences regarding task difficulty (Dweck, 1986). Thus, a trainee’s goal orientation should influence his or her cognitions and behaviors during a learning experience. To our knowledge, goal orientation has not been examined within the context of videogame–based training environments.

Learning Goal Orientation

Learning goal orientation (LGO) is a dedication to developing competence by acquiring new skills, mastering novel situations, and learning from experience (Dweck, 1986; VandeWalle, 1997). Individuals high on learning goal orientation view ability and skills as malleable, seeking out novel or challenging situations to increase their competence on a given task (Dweck; Kozlowski et al., 2001). As such, these individuals perceive training as an opportunity to learn, and they believe that demonstrating effort and persistence, even in the face of difficulties, is worthwhile for increasing one’s competence.

Prior research conducted on classroom and technology-delivered training has demonstrated that LGO is positively related to learning (Fisher & Ford, 1998) and pretraining motivation (Colquitt & Simmering, 1998). LGO has also been associated with positive effects on learner choices during training. Trainees who ap-
proach learning environments with the purpose of mastering new knowledge/skills engaged in greater metacognitive activity (Ford et al., 1998; A. M. Schmidt & Ford, 2003), reported decreases in their off-task attention (K. G. Brown, 2001), and demonstrated greater effort during training (Fisher & Ford, 1998). Further, prior research has demonstrated beneficial effects of LGO on an individual’s affective reactions (e.g., satisfaction with performance; Jagacinski & Nicholls, 1984). Accordingly, we expected LGO to positively influence motivation to train, the learner choices of metacognitive activity and time on task, the affect-based learning outcome of training satisfaction, and training performance.

Performance Goal Orientation

Individuals with high performance goal orientation (PGO) believe that their ability and skill levels are stable and unlikely to change. Performance-oriented learners focus on demonstrating and validating their competence by seeking good performance evaluations and avoiding negative ones (Dweck, 1986). These learners prefer learning environments that are easy to master and ensure positive evaluations of their capabilities, because their concern with competence is more about superficial demonstration than substantive development (VandeWalle, Cron, & Slocum, 2001). Accordingly, the desire for positive evaluation of one’s competency does not necessarily correspond with engaging in cognitions and behaviors needed to develop competence.

Similar to prior research (e.g., Elliot, 1994; VandeWalle, 1997; VandeWalle et al., 2001), we conceptualized PGO as consisting of two separate dimensions: performance avoid goal orientation (PAGO) and performance prove goal orientation (PPGO). We examined the independent effects of these two dimensions on the learner choices/outcomes, in addition to the effects of LGO.

PAGO focuses on avoiding demonstrations of low ability/skill levels and negative evaluations from others (VandeWalle, 1997). Prior research has generally demonstrated that PAGO is associated with negative effects on learner choices during training and subsequent learning outcomes (Ford et al., 1998; A. M. Schmidt & Ford, 2003; VandeWalle et al., 2001). For instance, A. M. Schmidt and Ford found that trainees with a higher PAGO engaged in less task-relevant metacognitive activity during training. Metacognition involves actively monitoring for and determining instructional content areas in which one is having personal difficulties mastering. Individuals with high PAGO seek to avoid evaluations concerning personal areas in need of improvement, regardless of whether the evaluation is other or self-generated; thus, they tend to avoid engagement in task-relevant metacognitive activity.

In contrast, PPGO focuses on demonstrating or proving one’s competence by outperforming others and gaining favorable evaluations from others (Brett & VandeWalle, 1999; VandeWalle, 1997). Research is still inconclusive about the
role of PPGO in learning. In general, PPGO has failed to demonstrate a consistent positive or negative relationship with any given learning criterion, including metacognitive activity, goal setting, posttraining self-efficacy, knowledge acquisition, or skill-based learning (e.g., A. M. Schmidt & Ford, 2003; VandeWalle et al., 2001).

Based on this prior work, we expected that trainees with high PAGO would be less motivated to train in a videogame–based training environment than those with lower levels of PAGO. Further, in general, we expected PAGO to negatively influence learner choices during training, affect-based learning outcomes, and training performance. We did not expect to find any significant relationships between PPGO and the six training criteria.

METHOD

Participants

Participants were first-year U.S. Military Academy cadets who took part in a videogame–based tactics training exercise. The mean age of participants was 18.89 years (SD = 1.26 years). Prior to and after the 4-day training exercise, cadets were asked to voluntarily complete online questionnaires for the current research. The pretraining questionnaire assessed trainee characteristics and pretraining motivation; 364 cadets who participated in the training exercise completed the pretraining questionnaire. The posttraining questionnaire assessed learner choices and outcomes; 80 of the 364 cadets completed the posttraining questionnaire.

Videogame

The videogame used in the training exercise was America’s Army, an online PC-based, first-person-perspective game with both single-player and multi-player sections. America’s Army, created by the Office of Economic and Manpower Analysis at the U.S. Military Academy, was originally developed to serve as a recruiting tool to inform potential recruits about the U.S. Army. The game allows for the simulation of small team environments that require decision-making and collaboration skills.

Procedure

Prior to the start of the tactics training exercise, the instructor provided the Web site address of the online questionnaires and informed the cadets of their opportunity to participate in this research. Before the 4-day training exercise, interested cadets completed the pretraining questionnaire in their own time. Then, they used
the videogame as part of the training exercise. Cadets began with the “basic training” single-player section of the videogame, where they learned how to use the game. After completing the basic training section, cadets were eligible for the multiplayer section. In the multi-player section, cadets were placed into small teams to conduct collaborative missions. A team’s mission objective was either to attack or defend a radio tower (two teams would compete against one another in a given mission). Regardless of the team’s goal within a given mission (i.e., attack or defend), cadets took the perspective of a U.S. soldier, and the opposing team was depicted as the enemy. Team members interacted in terms of observing each other’s actions within the game environment and via typed communication using a chat feature built into the game interface. No limits on the number of team missions were set. After completing the training exercise, interested participants completed the online posttraining questionnaire.

Pretraining Measures

**Video Game Experience**

Prior relevant videogame experience was assessed using a two-item scale adopted from Orvis et al. (2007). Cadets were asked how frequently they had played (a) the first-person-perspective (FPP) game, America’s Army, as well as (b) any videogame categorized in the FPP game type (e.g., Battlefield 1942, James Bond 007, Medal of Honor). Possible responses ranged from 0 (never) to 5 (very frequently). FPP games were utilized as the type of game experience relevant to the current game environment based on Orvis et al. Orvis et al. found that prior experience with this game type and with America’s Army specifically were predictive of several training criteria (e.g., training satisfaction, ease in using game interface, and team cohesion); experience using other game types that did not share several characteristics with America’s Army (e.g., puzzles/card games and life/business simulations) were not predictive of the training criteria.

**Video Game Self-Efficacy**

Videogame self-efficacy was assessed using a two-item scale developed for the present research (e.g., “I am certain I will be successful at most videogames I try to play”). Possible responses ranged from 1 (strongly disagree) to 5 (strongly agree).

**Goal Orientation**

Goal orientation was assessed using a 13-item scale adapted from VandeWalle (1997). LGO was assessed with five items (e.g., “I often look for opportunities to develop new knowledge and skills”). PAGO was assessed with four items (e.g., “I would avoid taking on a new task if there was a chance that I would appear rather
incompetent to others”). PPGO was assessed with four items (e.g., “I prefer to work on tasks/assignments where I can prove my ability to others”). Responses ranged from 1 (strongly disagree) to 5 (strongly agree).

**Pretraining Motivation**

Pretraining motivation for the videogame–based training program was assessed using a five-item scale adapted from Noe and Schmitt (1986; e.g., “I am motivated to learn the information/skills emphasized in the America’s Army game”). Possible responses ranged from 1 (strongly disagree) to 5 (strongly agree).

**Posttraining Measures**

**Metacognitive Activity**

Metacognitive activity was assessed using an eight-item scale adapted from A. M. Schmidt and Ford (2003; e.g., “When I practiced a new skill presented in the game, I monitored how well I was learning its requirements”). Possible responses ranged from 1 (strongly disagree) to 5 (strongly agree).

**Time on Task**

Participants were asked the total number of hours spent playing the game during the 4 days allotted for the training. We believe this reflects motivation to continue training, because videogame–based training, in the present research, represented a self-regulated voluntary training environment.

**Satisfaction with Training**

Satisfaction with the training was assessed using a three-item scale modified from Orvis et al. (2007; e.g., “I was satisfied with the experience of using the America’s Army game”). Responses ranged from 1 (strongly disagree) to 5 (strongly agree).

**Ease in Using Game Interface**

Ease in using the game’s user interface was assessed with a three-item scale from Orvis et al. (2007; e.g., “How easy/difficult was it to learn how to use America’s Army game?”). Possible responses ranged from 1 (very difficult) to 5 (very easy).

**Training Performance**

Training game performance was operationalized at the team level as the proportion of multi-player missions the trainee won out of the total number of missions completed. Cadets were asked to indicate the total number of missions completed, won, and lost.
RESULTS

Descriptive Statistics

Means, standard deviations, coefficient alphas, and intercorrelations of the variables are displayed in Table 1. For videogame experience, 16% of participants reported no experience playing relevant videogames, 65% reported very infrequent or infrequent experience, 12% reported moderate experience, and 6% reported frequent or very frequent experience.

Hierarchical Regression Analyses

The influence of trainee attributes on pretraining motivation and the five additional criteria (i.e., metacognitive activity, time on task, training satisfaction, ease in using game interface, and training performance) were assessed using hierarchical regression. For each criterion, a hierarchical regression analysis was conducted with videogame experience in Step 1, videogame self-efficacy in Step 2, and goal orientation in Step 3. Prior experience and self-efficacy were entered in the first two steps because prior research has shown that these individual differences influence learner choices/outcomes of videogame–based training (Orvis et al., 2007).

Results of these six hierarchical regression analyses are presented in Table 2. The trainee attributes accounted for 32% of the variance in pretraining motivation ($p < .01$). Specifically, prior relevant videogame experience ($R^2 = .11, p < .01$), videogame self-efficacy ($\Delta R^2 = .05, p < .01$), and goal orientation ($\Delta R^2 = .15, p < .01$) significantly predicted trainees’ pretraining motivation. Examination of the individual beta weights indicates support for LGO ($\beta = .32, p < .01$) and PAGO ($\beta = .16, p < .01$). PPGO did not significantly predict pretraining motivation.

The trainee attributes, as a set, also significantly predicted the learner choices/outcomes of metacognitive activity ($R^2 = .33, p < .01$), time on task ($R^2 = .20, p < .05$), satisfaction with the game-based training ($R^2 = .36, p < .01$), and perceived ease in using the game interface ($R^2 = .32, p < .01$). Specifically, the results indicate that videogame experience explained a substantial amount of variance in all of the learner choices/outcomes: metacognitive activity ($R^2 = .16, p < .01$), time on task ($R^2 = .11, p < .05$), training satisfaction ($R^2 = .18, p < .01$), ease in using the game interface ($R^2 = .21, p < .01$), and training performance ($R^2 = .11, p < .01$). Trainee’s self-efficacy for playing videogames explained a significant amount of variance above and beyond videogame experience in ease in using the game interface ($\Delta R^2 = .05, p < .05$).

Finally, trainee goal orientation explained a small to substantial increment of variance in several of the learner choices/outcomes, including metacognitive activity ($\Delta R^2 = .17, p < .01$), training satisfaction ($\Delta R^2 = .17, p < .01$), and ease in using the game interface ($\Delta R^2 = .06, p < .10$). Examination of the individual beta
TABLE 1
Means, Standard Deviations, Coefficient Alphas, and Intercorrelations of Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Videogame experience</td>
<td>364</td>
<td>1.67</td>
<td>1.24</td>
<td>.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Videogame self-efficacy</td>
<td>364</td>
<td>3.78</td>
<td>1.14</td>
<td>.60***</td>
<td>.92</td>
<td>.56</td>
<td>.18***</td>
<td>.22***</td>
<td>.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. LGO</td>
<td>364</td>
<td>3.82</td>
<td>.56</td>
<td>.18***</td>
<td>.92</td>
<td>.56</td>
<td>.18***</td>
<td>.22***</td>
<td>.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. PAGO</td>
<td>364</td>
<td>2.72</td>
<td>.71</td>
<td>.04</td>
<td>-.02</td>
<td>-.11***</td>
<td>.82</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. PPGO</td>
<td>364</td>
<td>3.34</td>
<td>.68</td>
<td>.14***</td>
<td>.92</td>
<td>.56</td>
<td>.18***</td>
<td>.22***</td>
<td>.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Pretraining motivation</td>
<td>362</td>
<td>3.61</td>
<td>.77</td>
<td>.33***</td>
<td>.92</td>
<td>.56</td>
<td>.18***</td>
<td>.22***</td>
<td>.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Metacognitive activity</td>
<td>80</td>
<td>3.46</td>
<td>.59</td>
<td>.39***</td>
<td>.92</td>
<td>.56</td>
<td>.18***</td>
<td>.22***</td>
<td>.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Time on task</td>
<td>54</td>
<td>2.11</td>
<td>1.68</td>
<td>.32**</td>
<td>.92</td>
<td>.56</td>
<td>.18***</td>
<td>.22***</td>
<td>.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Training satisfaction</td>
<td>80</td>
<td>3.74</td>
<td>.64</td>
<td>.42***</td>
<td>.92</td>
<td>.56</td>
<td>.18***</td>
<td>.22***</td>
<td>.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Ease in using interface</td>
<td>80</td>
<td>3.57</td>
<td>.78</td>
<td>.46***</td>
<td>.92</td>
<td>.56</td>
<td>.18***</td>
<td>.22***</td>
<td>.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Training game performance</td>
<td>65</td>
<td>37.1</td>
<td>38.4</td>
<td>.33***</td>
<td>.92</td>
<td>.56</td>
<td>.18***</td>
<td>.22***</td>
<td>.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. All variables were measured on a 1–5 scale except relevant gaming experience (measured on a 0–5 scale), time on task (measured in hours), and training performance (measured as percentage of missions won). Alpha coefficients are reported on the diagonal.

*p < .10, **p < .05, ***p < .01 (two-tailed)
# TABLE 2
Hierarchical Regression Analyses for Videogame Experience, Self-Efficacy, and Goal Orientation Variables on Learner Choices/Outcomes

<table>
<thead>
<tr>
<th>Regression step</th>
<th>Pretraining Motivation</th>
<th>Metacognitive Activity</th>
<th>Time on Task</th>
<th>Training Satisfaction</th>
<th>Ease Using Interface</th>
<th>Training Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE B</td>
<td>B</td>
<td>SE B</td>
<td>β</td>
<td>B</td>
</tr>
<tr>
<td>Step 1</td>
<td>Experience</td>
<td>.20</td>
<td>.03</td>
<td>.33***</td>
<td>.19</td>
<td>.05</td>
</tr>
<tr>
<td></td>
<td>Self-efficacy</td>
<td>.19</td>
<td>.04</td>
<td>.28***</td>
<td>−.05</td>
<td>.07</td>
</tr>
<tr>
<td>Step 2</td>
<td>Experience</td>
<td>.10</td>
<td>.04</td>
<td>.16***</td>
<td>.22</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>Self-efficacy</td>
<td>.19</td>
<td>.04</td>
<td>.28***</td>
<td>−.05</td>
<td>.07</td>
</tr>
<tr>
<td>Step 3</td>
<td>Experience</td>
<td>.09</td>
<td>.03</td>
<td>.14**</td>
<td>.20</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>Self-efficacy</td>
<td>.15</td>
<td>.04</td>
<td>.22***</td>
<td>−.08</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>LGO</td>
<td>.44</td>
<td>.07</td>
<td>.32***</td>
<td>.47</td>
<td>.12</td>
</tr>
<tr>
<td></td>
<td>PAGO</td>
<td>.18</td>
<td>.06</td>
<td>.16***</td>
<td>.02</td>
<td>.09</td>
</tr>
<tr>
<td></td>
<td>PPGO</td>
<td>.09</td>
<td>.06</td>
<td>.08</td>
<td>−.03</td>
<td>.11</td>
</tr>
</tbody>
</table>

Note. $R^2 = 0.11***$ for Step 1; $\Delta R^2 = 0.05***$ for Step 2; $\Delta R^2 = 0.15***$ for Step 3, for pretraining motivation. $R^2 = 0.16***$ for Step 1; $\Delta R^2 = 0.01$ for Step 2; $\Delta R^2 = 0.17***$ for Step 3, for metacognitive activity. $R^2 = 0.11***$ for Step 1; $\Delta R^2 = 0.01$ for Step 2; $\Delta R^2 = 0.09$ for Step 3, for time on task. $R^2 = 0.18***$ for Step 1; $\Delta R^2 = 0.02$ for Step 2; $\Delta R^2 = 0.17***$ for Step 3, for training satisfaction. $R^2 = 0.21***$ for Step 1; $\Delta R^2 = 0.05***$ for Step 2; $\Delta R^2 = 0.06$ for Step 3, for ease in using interface. $R^2 = 0.11***$ for Step 1; $\Delta R^2 = 0.01$ for Step 2; $\Delta R^2 = 0.02$ for Step 3, for training game performance. $N = 361, 79, 53, 79, 74, and 64$, for pretraining motivation, metacognitive activity, time on task, training satisfaction, ease in using interface, and training game performance, respectively.

*p < .10. **p < .05. ***p < .01.
weights indicates that LGO positively predicted trainee engagement in metacognitive activity ($\beta = .44, p < .01$) and training satisfaction ($\beta = .26, p < .05$). PAGO negatively predicted one’s training satisfaction ($\beta = -.22, p < .05$) and perceived ease in using the game interface ($\beta = -.27, p < .05$). PPGO was not predictive of the learner choices/outcomes.

**DISCUSSION**

The purpose of this research was to investigate the influence of trainee attributes on motivation, learner choices, and learning outcomes of videogame–based training environments. This article extends existing research by demonstrating the importance of a trainee’s prior videogame experience, videogame self-efficacy, and goal orientation for the prediction and explanation of these training criteria.

With regard to prior videogame experience, this research suggests that trainees’ prior relevant videogame experience has implications for several learner choices/outcomes of videogame–based training. Specifically, results suggest that the more experience individuals have playing relevant videogames, the more motivated they are to learn with a training videogame and the more satisfied and at ease they are using the training videogame. More experienced individuals also made more effective learner choices during training than those with less experience. Specifically, they reported thinking more about how well they were learning the information/skills presented during the training game and strategies they could use to improve their level of learning. They also reported spending more time engaging in the training game compared to individuals with lower levels of prior relevant game experience.

Next, self-efficacy for playing videogames was examined for its unique contribution to the prediction of the learner choices/outcomes, after controlling for prior experience. Trainees’ self-efficacy for playing videogames explained a significant amount of variance above and beyond videogame experience in pretraining motivation and ease in using the game interface. This indicates that trainees with greater confidence in playing videogames are more motivated and at ease training in game-based environments than trainees with lower videogame self-efficacy. Note that when self-efficacy was examined independently as a predictor (i.e., separately from prior experience), this trainee characteristic also significantly predicted training satisfaction and training performance. Thus, videogame self-efficacy is influential on several learner choices/outcomes of videogame–based training environments; however, it does not add substantially to the prediction of most of these criteria beyond trainees’ previous experience. This may be because an individual’s self-efficacy for succeeding on a given task is shaped, in part, by his or her prior experiences engaging in the task (Bandura, 1977); thus, once the common variance was held constant in the hierarchical regression, the unique vari-
ance of videogame self-efficacy did not contribute significantly in explaining the remaining variance in training satisfaction and training performance.

We would like to point out that this does not necessarily mean that a trainee’s self-efficacy is less relevant than his or her prior experience. Our findings may be due to the difference in specificity in the measurement of these two constructs. In the present study, videogame experience was assessed with respect to FPP games (including America’s Army specifically), whereas self-efficacy was assessed with respect to all types of videogames. Thus, it is possible that self-efficacy may have been more influential if investigated with respect to FPP videogames (i.e., the same game type as the training game used in the present study). Future research should examine whether this difference in specificity is of consequence.

Trainee goal orientation also had a unique impact on the learner choices/outcomes beyond prior experience and self-efficacy. As expected, LGO was positively associated with pretraining motivation, metacognitive activity, and the affect-based learning outcome of training satisfaction. These findings suggest that trainees who approach instructional environments with the purpose of mastering new knowledge/skills are more motivated to train and more satisfied learning in a videogame-based training environment compared to trainees with a low LGO. Further, trainees high on LGO made more effective learner choices during the training. They reported being more active in monitoring their learning progress and in implementing new strategies to address any difficulties they were experiencing in learning the content of the training game.

PAGO generally exhibited a negative impact on the learner choices/outcomes, including training satisfaction, perceived ease in using the game interface, and time on task. These findings suggest that trainees who seek to avoid negative evaluations from others or demonstrating low ability/skill levels are less satisfied and less at ease learning in a game-based training environment. Further, they reported spending less time engaging in the training game compared to trainees with a low PAGO. Intuitively, these findings make sense because multi-player videogame–based training environments often require trainees to work interdependently to be successful in the game. This high level of interaction among trainees during the game may increase a high performance avoid learner’s perceptions concerning his or her likelihood of demonstrating low ability/skill levels and therefore result in negative training-related cognitions and behaviors.

Contrary to our expectations and prior research, PAGO was found to be positively related to pretraining motivation. To investigate a possible reason for this unexpected finding, we revisited our measurement of pretraining motivation. Some of the items reflected motivation to learn the training content, and a few items better reflected motivation to succeed/perform well in the training. Therefore, we divided the items into two subscales reflecting these two aspects of training motivation. Correlations between these subscales and PAGO suggest that high performance avoid learners were motivated to perform well in the training game.
(r = .18, p < .01); however, they were not motivated to learn from the training (r = .07, ns). In other words, a possible reason underlying their high training motivation was to avoid demonstrating low ability/skill levels rather than to work hard to master the knowledge/skills taught in the game.

Finally, PPGO did not significantly predict the learner choices/outcomes in the hierarchical regression analyses. PPGO did approach significance in its prediction of trainees’ satisfaction with the training experience (β = .21, p = .08). This finding suggests that trainees who seek to outperform others and demonstrate high ability/skill levels are more satisfied engaging in a videogame–based training environment than those with a low PPGO. A possible explanation for this unexpected finding may be that these individuals perceived the interactive, multi-player nature of the game-based training as an opportunity to demonstrate their competence or outperform other trainees; therefore, they enjoyed this type of learning environment.

Practical Implications

This research suggests that the attributes trainees bring to the training environment (i.e., their prior experience, self-efficacy, and goal orientation beliefs) are important variables to consider when implementing game-based training. The good news is that these attributes are relatively malleable trainee characteristics that can be influenced by others, such as instructors (e.g., Frey, Hartig, Ketzel, Zinkernagel, & Moosbrugger, 2007; Tompson & Dass, 2000; Weissbein & Ford, 2002). Based on the present research findings, we provide some specific recommendations for instructors utilizing game-based training.

First, we suggest that instructors assess trainees’ prior game experiences. By assessing the amount of relevant gaming experiences trainees possess, instructors can identify those who lack the prerequisite game experience. Instructors can then provide these trainees with targeted opportunities to gain the necessary experiences prior to, or as part of, the training.

It may be assumed that most military trainees who grew up in the digital age would have a great deal of experience with videogames and therefore additional orientation and practice with videogames would be unnecessary. This assumption does not seem warranted given that a majority of participants reported little to no experience playing relevant videogames (16% reported no experience and 65% reported limited experience). These findings parallel prior experience levels observed in Orvis et al. (2007). Given the number of cadets with little to no experience, providing an orientation or additional practice with relevant games would likely be valuable whenever implementing a game-based training program.

Further, by providing relevant practice opportunities, trainees’ self-efficacy may increase with regard to their ability to learn in a training environment utilizing a comparable game. One way to enhance self-efficacy is to initially provide rela-
tively easy practice sessions. Then, when learners are successful at these practice sessions, provide positive feedback and encouragement. Such feedback could be provided by the instructor or could be built into the videogame content and delivered during game play. These suggestions are consistent with Bandura (1977), who proposed that obtaining experiences resulting in successful performance and receiving feedback on one’s capabilities are two ways in which to develop positive self-efficacy beliefs.

With respect to goal orientation, though this construct is often characterized as a fairly stable personal trait, the goal orientation literature does suggest that an individual’s goal orientation can be shaped by situational factors (e.g., Kozlowski et al., 2001; A. M. Schmidt & Ford, 2003; Weissbein & Ford, 2002). For instance, Weissbein and Ford found that a pretraining intervention was successful at influencing trainees’ attributions such that trainees adopted a more learning goal-oriented perspective. Accordingly, we recommend that instructors implementing a game-based training program should emphasize learning and acquiring new skills during the game versus the perspective of striving to reach a high game score.

Limitations and Directions for Future Research

The present research has potential limitations that should be noted. The main limitation of this research is the self-report nature of the data. Though self-report measures were the most logical means for assessing the trainees’ personal attitudes about the training (e.g., their training motivation, training satisfaction, ease in using the game interface) as well as their standing on the trainee attribute variables, a more precise and objective assessment of time on task and training performance would have been preferred.

Further, training performance was measured as the self-reported proportion of missions won. We were unable to capture performance of a particular individual within a team; instead, this measure captured team-level performance. Though an individual’s level of performance may directly contribute to his or her team’s performance, this assumption may not necessarily be the case. This may account for why we found that the trainee individual differences accounted for a smaller proportion of variance in training performance compared to the other examined learner choices/outcomes, which were assessed at the individual level.

Another possible limitation stems from the fact that only a subset of the research participants (80 out of 364 cadets) completed both the pretraining measures (i.e., the trainee attribute variables and pretraining motivation) and the posttraining measures. Thus, it is possible that the participants who completed both sets of measures versus those who completed only the pretraining game measures were significantly different, such that the more experienced videogame players or more motivated players were more likely to complete the posttraining measures. To help address this potential issue, we conducted independent sample t-tests to compare
these two groups with respect to their reported pretraining motivation, as well as their standing on the trainee attributes of prior videogame experience, videogame self-efficacy, and the three types of goal orientation. The results of these analyses suggest that these two groups of cadets did not significantly differ from one another with respect to pretraining motivation or any of the trainee attributes ($p > .05$). Thus, though we cannot say for certain that these two groups were not different from one another, these results do suggest that both sets of cadets were comparable on the trainee attributes they brought into the training environment, as well as their pretraining motivation for the videogame–based training program.

Concerning directions for future research, the results of the present research suggest several interesting points worth further consideration. First, though the learner choices/outcomes examined in this research have been associated with learning in other training contexts, future research is needed to enhance our understanding of the role of trainee attributes in predicting more distal training outcomes, such as transfer of training and retention, in videogame–based training environments. Another avenue for future research is to examine how trainee attributes and common training game features may interact to influence trainees’ choices made during the training and learning outcomes. Prior research has demonstrated such attribute–treatment interactions within other types of training environments. For example, individual differences, such as cognitive ability, have been found to interact with features/attributes of classroom-based instructional environments to influence a trainee’s level of learning and retention (see Campbell & Kuncel, 2001; Snow & Lohman, 1984). We suggest future research investigate possible interactions within game-based training and consider whether game features can be altered to better accommodate different types of trainees.

**SUMMARY**

Gaming technology has captured the attention of training professionals (Garris et al., 2002) and PC-based videogames have emerged as a popular training tool in the military (Hays, 2005). Prior game-based training research has made solid strides in documenting the effect of videogame features (e.g. challenge, realism, and interactivity) on various training outcomes of game-based training environments (e.g., Corbeil, 1999; Garris et al.). Yet, little research had been directed toward identifying specific individual attributes of trainees that facilitate or impede the effectiveness of videogames as training tools. Thus, the present research extends the game-based training literature by demonstrating that the attributes trainees bring to game-based training environments may influence their motivation to learn, learner choices, and learning outcomes. Specifically, trainees’ prior videogame experience (or lack of experience), videogame self-efficacy, and goal orientation made significant differential contributions to the prediction of several criteria in-
cluding training motivation, metacognitive activity, time on task, training satisfaction, ease in using the training game, and training performance. Ensuring that such military trainee differences are addressed in videogame–based training will maximize the likelihood that this method of training is effective and generalizable.

ACKNOWLEDGEMENTS

At the time of this research, Karin Orvis was employed as a contractor at the U.S. Army Research Institute for the Behavioral and Social Sciences through the Consortium of Universities of the Washington Metropolitan Area, and Dan Horn was employed as a Research Psychologist at the U. S. Army Research Institute for Behavioral and Social Sciences.

The views, opinions, and/or findings contained in this article are solely those of the authors and should not be construed as an official Department of the Army or DOD position, policy, or decision, unless so designated by other documentation.

REFERENCES


