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Enhancing Training Outcomes in the Context of e-Learning: The Impact of Objective Learner Control, Training Content Complexity, Cognitive Load, Learning Goal Orientation, and Metacognitive Strategies

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Enhancing Training Outcomes in the Context of e-Learning: The Impact of Objective

Learner Control, Training Content Complexity, Cognitive Load, Learning Goal

Orientation, and Metacognitive Strategies

by

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Dedication

  This dissertation is dedicated to my loving parents, Ed and Liz Granger as well as my late grandmother, Gloria Granger and my grandfather, Alfred Granger who supported and encouraged me throughout my graduate career. I also dedicate this dissertation to my son, Benjamin and my daughter Leigh Katherine. I hope that this will serve as a reminder to them of the rewards of hard work and perseverance. Finally, I dedicate this to my loving wife, Lindsey, who has supported me throughout this long and arduous process and who made many sacrifices to allow me to accomplish this great achievement.

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Abstract

Learner-controlled e-learning has become a preferred medium for the delivery of organizational training. While e-learning offers organizations and trainees many advantages, it also comes with several potential disadvantages. The aim of this study was to explore the relative efficacy of learner- and program-controlled e-learning for content that differs in its complexity. This study also explored cognitive load as a differential mediator of the interaction between learner control and training content complexity for predicting cognitive and behavioral learning outcomes. Finally, learning goal orientation was explored as a motivational individual difference that helps learners cope with complex, learner-controlled e-learning environments. Results suggest that while there is little difference between learners in learner- and program-controlled e-learning environments for content that is relatively simple in nature, complex, learner-controlled e-learning environments are detrimental to cognitive learning relative to complex, program-controlled environments. Moreover, the results suggest that this interaction is differentially mediated by cognitive load, suggesting that complex, learner-controlled environments induce high cognitive demands onto learners which ultimately inhibit cognitive learning. Finally, learning goal orientation was identified as more facilitative individual difference in learner-controlled e-learning environments relative to program-controlled and simple training environments. Theoretical and practical implications of these findings are also discussed.

Introduction

Given the increasing popularity of electronic learning media (e-learning) in

organizational and educational settings (Sugrue & Rivera, 2005), it is becoming

increasingly important for research to keep pace with its practice. It is evident that, for

better or worse "e-learning is undoubtedly here to stay" (Spector, 2008, p. 193). The

dramatic increase in the use of electronic technology to deliver training has been dubbed

the "e-Learning Revolution" (Galagan, 2000, p. 25), but training researchers have not

been uniformly enthusiastic. A key characteristic of e-learning that has garnered a great

deal of attention is learner control. Although not uniformly the case, e-learning usually

grants learners high levels of control over the learning environment (Bell & Kozlowski,

2002; DeRouin, Fritzsche, & Salas, 2004; Ely, Sitzmann, & Falkiewicz, 2009). While

learner control is indeed a key component of e-learning, the issues surrounding learner

control clearly apply to training content delivered via other modalities. However its role

in e-learning has been a focus of much of the recent research on e-learning and thus, that

modality of training content delivery is emphasized here. Regardless of the means of

delivery however, much is still unknown about which learners benefit from high levels of

learner control, which do not, when it works and why.

In general, training researchers have investigated situational and contextual

factors that influence training effectiveness (Narayan & Steele-Johnson, 2007) such as

organizational climate and career planning (Colquitt et al., 2000) and supervisory support

(Mathieu & Martineau, 1997). More recent work has uncovered a variety of core training

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design factors that lead to enhanced learning and transfer in learner-controlled training environments. For example, Bell and Kozlowski (2008) found that exploratory learning and manipulations to encourage making errors during training have positive effects on trainees' adaptive transfer. Training research has also focused on the interrelationships among various individual difference variables and training outcomes (e.g., Blume, Ford, Baldwin, & Huang, 2010; Brown, 2005; Brown, 2001; Ely et al., 2009; Fisher & Ford, 1998; Ford, Smith, Weissbein, Gully, & Salas, 1998; Schmidt & Ford, 2003; Sitzmann, Bell, Kraiger, & Kanar, 2009). The extant research has confirmed that while certain interventions may be beneficial for some trainees, they are not necessarily beneficial for others. This research has been extended to learner-controlled e-learning environments (e.g., Brown, 2001; Fisher, Wasserman, & Orvis, 2010; Schmidt & Ford, 2003; Sitzmann et al., 2009), but additional research is needed to confirm many of the propositions and assumptions often made about e-learning and arguably its most important feature: learner control (Granger & Levine, 2010).

E-learning is linked to a number of different approaches to training and learning such as active learning (Bell & Kozlowski, 2008), hypermedia learning (Scheiter & Gerjets, 2007), distributed learning (Kraiger & Jerden, 2007) and self-directed learning (SDL) (Lee & Lee, 2008). Despite their distinctions, one of the hallmarks of active learning media, such as e-learning, is learner control. In learner-controlled training environments, learners are active participants in the learning process (Frese & Altmann, 1989; Salas & Cannon-Bowers, 2001) and are responsible for regulating their own learning (Bell & Kozlowski, 2008). As pointed out by Lee and Lee (2008) this approach to learning is supported by the constructivist educational philosophy which focuses on

how the learner builds an understanding of the world through exploration and interaction with the environment (Rovai, 2004). From this perspective, a learner's active participation in training is clearly viewed as advantageous. Despite the exciting potential of learner control and the fact that it is often considered an advantage of e-learning or active learning media (Kinzie & Sullivan, 1989), a growing body of empirical work suggests that many adult learners do not effectively utilize the high levels of control afforded to them in e-learning (e.g., Bell & Kozlowski, 2002; Brown, 2001). And while some research has been devoted to understanding which learners benefit from learner-controlled e-learning and which do not (e.g., Brown, 2001; Schmidt & Ford, 2003), much has yet to be examined.

Nevertheless, the research on learner-controlled training has predominantly focused on contextual and interpersonal factors that influence learning and post-training performance. Relatively less research has focused on aspects of the training content itself. One key characteristic of the training content that is not well understood in the context of e-learning is its intrinsic complexity. Recently, Granger and Levine (2009) found that the intrinsic complexity of the content being trained is an important determinant of the effectiveness of learner-controlled training environments. Their study raises questions about the appropriateness of delivering complex training content to trainees via learner-controlled e-learning. To my knowledge, this is the only study of this important relationship in the e-learning literature and more research is needed to better understand this relationship and provide guidance to training practitioners and organizations for the delivery of training content via e-learning. As such, this dissertation addresses several gaps in the literature regarding the role of training content complexity in e-learning as

well as a key motivational individual difference (learning goal orientation) that may help some trainees cope with complex training content in learner-controlled e-learning environments.

Study Objectives

The primary aim of this dissertation is to increase our understanding of how training content complexity affects the relationship between learner control and learning outcomes. Much of the research on the efficacy of learner-controlled e-learning is in disagreement (Kraiger & Jerden, 2007) which implies the existence of potentially many intervening variables. As an important factor from both a practical (Liff & Kraiger, 2007; Welsh et al., 2003) and theoretical perspective (Granger & Levine, 2010), I expect the degree of training content complexity to serve as an important boundary condition of the effectiveness of granting trainees high v. low levels of learner control in e-learning. Specifically, the intrinsic complexity of the training content is expected to moderate the learner control-learning relationship in the proposed study, such that a high degree of learner control will be detrimental to learning when the content of training is complex. On the other hand, the degree of learner control granted to trainees is expected to have less of an effect on learning when the content of training is relatively simple.

A question immediately arises as to why this occurs. Thus a second aim of this dissertation is to explore a potential factor, cognitive load, as a mechanism through which content complexity interacts with learner control to influence learning. Specifically, complex, learner-controlled training environments are expected to induce a high level of cognitive load in trainees that is detrimental to learning and thus explain why learning is impaired in such environments.

Third, answering Granger and Levine's (2010) call for additional research on individual differences that may potentially counter the negative combined effect of high levels of learner control and content complexity, this dissertation explores learning goal orientation (LGO) as a trainee characteristic that may predict success (failure) in such training environments. The benefit of a high level of learning goal orientation is hypothesized due to its well-known association with important meta-cognitive strategies (Ames, 1992; Church, Elliot, & Gable, 2001; Dweck, 1986; Chiaburu, Van Dam, & Hutchins, 2010; Fisher & Ford, 1998; Towler & Dipboye, 2001) which are particularly important for learning complex training material in self-paced learning environments (Schmidt & Ford, 2003). Trainees with high levels of learning goal orientation are expected to more effectively handle complex training material when presented with a high degree of learner control than those with low levels of learning goal orientation. That is, high LGO trainees are expected to manage high levels of cognitive load produced by learner-controlled, complex training environments more effectively than low LGO trainees, because of their use of important metacognitive strategies throughout training.

The final objective of this dissertation is to empirically test whether increased metacognitive strategies explain why high LGO learners may more effectively handle learner-controlled, complex training environments than low LGO learners. An understanding of which learners flourish in complex, learner-controlled training environments is indeed important, but an understanding of why this may be the case is also important from both a practical and theoretical perspective. Similar to Schmidt and Ford (2003), I expect metacognition to mediate the relationship between LGO and learning such that high LGO trainees are expected to acquire more declarative and

procedural knowledge and effectively perform trained skills post-training than low LGO trainees in learner-controlled complex training environments due to their use of important metacognitive strategies during training.

In the following section, I define e-learning, my operational definition of learner control, establish the link between the two concepts and provide a brief overview of the research supporting and opposing their effectiveness. Next is the presentation of training content complexity as a potential moderator of the objective learner control-learning outcomes relations. I then present a discussion of relevant research on aptitude-treatment interactions (ATIs) in the general training literature as well as the presentation of learning goal orientation which, when high, is expected to predispose certain trainees to success under conditions of high learner control and high content complexity. A review of the current study including the presentation of cognitive load theory (CLT) and formal hypotheses concludes the introduction. A discussion of the study methodology, results and discussion of the findings concludes the dissertation.

Learner Control and e-Learning

According to Eddy and Tannenbaum (2003), e-learning refers to training initiatives for which content, communication and learning material are provided to learners via the use of electronic technology. Today, e-learning is often accomplished via computers (Clark & Mayer, 2007) and so computer based e-learning will be the primary focus of this study. As indicated above, numerous researchers have pointed to the importance of learner control in e-learning contexts (Brown, 2005; DeRouin, Fritzsche, & Salas, 2005; Fisher et al., 2010; Granger & Levine, 2010; Kraiger & Jerden, 2007; Orvis, Brusso, Wasserman, & Fisher, 2011; Orvis et al., 2009). Training programs that involve

high levels of learner control typically give trainees control over a variety of aspects such as timing, pacing, and selection of training content (Friend & Cole, 1990; Scheiter & Gerjets, 2007). Because of this, it is important to clarify what is meant by learner control in the current study. In research and practice, learner control usually comes as a "package deal", meaning that learner-controlled e-learning grants trainees control over several aspects of training simultaneously (See Fisher et al., 2010; Orvis et al., 2011; Orvis et al., 2009 and Sitzmann et al., 2009 for typical examples). This is often done out of necessity because it is difficult to disentangle control over many of these aspects (e.g., time spent in training and pacing) and control over one's learning environment is often considered advantageous in practice (Kinzie & Sullivan, 1989; Long & Smith, 2004). In order to increase the external validity of the current investigation, learner control will henceforth refer to control over pacing, sequencing of training content/modules, the amount of time spent on the course as well as individual portions of the course, and the training content that is covered or skipped. Importantly, while there are many other aspects of learner control, each of the aforementioned aspects can be considered *internal* aspects of control that have the potential to affect trainees' exposure to the training content itself. Moreover, these aspects of control are often included in manipulations of learner control in the extant literature (e.g., Granger & Levine, 2009; Orvis et al., 2009; Sitzmann et al., 2009). This study does not address aspects of *external* or *contextual* learner control such as control over the location of training, the time of day trainees engage in training, etc. Unlike internal learner control, these aspects of learner control are not expected to directly impact trainees' exposure to the actual training content.

In addition to the distinction between internal and external learner control, Kraiger and Jerden (2007) have argued for the distinction between objective and subjective learner control. While subjective learner control refers to the extent to which learners *perceive* that they have control over their learning, objective learner control refers to the *actual* degree of control afforded to them. Though they are distinct, they are indeed expected to covary positively (Liff & Kraiger, 2007; Kraiger & Jerden, 2007). This dissertation focuses on the effects of objective learner control as it is expected to precede and largely determine trainees' perceptions of the degree of their learner control (Kraiger & Jerden, 2007).

When describing active learning or learner-controlled approaches to training, it is common for researchers to compare and contrast them with more traditional, presumably passive learning approaches (Bell & Kozlowski, 2008) or program-controlled approaches (Hannafin, 1984). While learner control allows learners to make choices about numerous aspects of their learning, program control does not. These distinctions are useful because they highlight the uniqueness of active learning approaches along with their advantages (or presumed advantages). In more traditional approaches to training (e.g., instructor-led classroom instruction) the learner may be described as a passive participant in training or perhaps more accurately, a participant with little discretion in choosing training content, pacing, sequencing, media, etc., throughout the learning process. In such contexts, the flow of training content is primarily from teacher/trainer to student/trainee. By contrast, trainees assume a central role with expanded discretion and more involvement in the communication of training content when training environments are deemed learner-controlled (Brown & Ford, 2002).

According to learning theories such as the constructivist approach, active learning or learner-controlled approaches to training should lead to enhanced learning outcomes (Lee & Lee, 2008). For example, Bell and Kozlowski (2008) note that active learning approaches promote inductive learning which allows for learner experimentation and exploration. Additionally, Kraiger (2008) has argued that web based training (WBT) or e-learning technologies allow for third-generation learning which is based on the social constructivist approach to learning. That is, according to Kraiger (2008) and the social constructivist approach, learning is primarily a social activity which depends heavily on interactions among trainees and other trainees and among trainers and trainees. Nevertheless, empirical research on learner-controlled e-learning has not been uniformly supportive of the propositions and assumptions made about its effectiveness (Granger & Levine, 2010).

Although it is often taken for granted, it is important to note that many of the primary advantages of e-learning apparently necessitate some degree of learner control and a great deal of the extant research on learner control and e-learning questions their proposed and assumed advantages (Granger & Levine, 2010). To cite one notable example, while Kraiger (2008) has argued that e-learning technology allows for enhanced interaction among trainees and trainers, other researchers have argued that e-learning may not always facilitate positive communications among training participants (e.g., Brown & Klein, 2008; Sitzmann & Ely, 2008). In fact, empirical evidence suggests that asynchronous, e-learning environments foster less or more difficult communication among training participants (Gilbert, Morton, & Rowley, 2007; Hara & Kling, 2001; Rovai & Barnum, 2003) contrary to Kraiger's (2008) contention.

Much like the training media research in general (e.g., Sitzmann et al., 2006), the research on learner-controlled e-learning has yielded mixed results regarding its effectiveness. While some research suggests that learner control leads to favorable learning outcomes (Avner, Moore, & Smith, 1980; Gray, 1987; Kinzie, Sullivan, & Bendel, 1988) other research has found that program-controlled or passive learning approaches are more effective for facilitating learning (Lee & Wong, 1989; Levinson, Weaver, Garside, McGinn, & Norman, 2007; MacGregor, 1988; Steinberg, 1977; Morrison, Ross, & Baldwin, 1992). In addition to the contradictory findings for learning, some of the research on learner control suggests that learners tend to react more favorably to training environments characterized by high levels of learner control (Becker & Dwyer, 1994; Hintze, Mohr, & Wenzel, 1988; Milheim, 1989; Morrison, et al., 1992; Orvis et al., 2009) while meta-analytic evidence suggests that there is little support for the notion that learner control is meaningfully related to trainee affective reactions (Kraiger & Jerden, 2007).

Despite some contradictory findings, the wealth of research that has explored the efficacy of learner-controlled e-learning may lead one to expect that learner control is uniformly, albeit slightly advantageous to learners. Indeed some researchers have pointed to the potential and empirically-derived benefits of granting learners high levels of control during training (e.g., Kinzie & Sullivan, 1989; Orvis et al., 2009). Negative outcomes that have clouded the picture may be attributable to the problem that some trainees do not effectively utilize learner control (Kraiger, 2008; Steinberg, 1989; Tennyson, Christenson, & Park, 1985) and discontinue their involvement in training prior to mastery (Brown, 2001; Schmidt & Ford, 2003). This may account for Kraiger and

Jerden's (2007) meta-analytic findings, suggesting only a slight advantage for learner-controlled environments versus those characterized as program-controlled. Nevertheless, despite the lack of substantial superiority, organizations and educational institutions are implementing e-learning technologies at a staggering pace and are incorporating an unprecedented amount of control for learners over their learning environment (Bell & Kozlowski, 2002; Welsh et al., 2003).

Because of the increased reliance on learner-controlled e-learning in organizational and educational settings and the mixed findings regarding its effectiveness, it is important for researchers to continue investigating the relative effectiveness of high versus low learner-controlled training environments. While some learning theories support the use of active learning and learner control (e.g., the constructivist approach; Rovai, 2004), much of the empirical work suggests that many trainees do not effectively utilize the control afforded to them and consequently impair their learning of the training content (Bell & Kozlowski, 2002; Brown, 2001; Schmidt & Ford, 2003). Clearly, research does not support the unbridled adoption of e-learning paired with high levels of learner control (Granger & Levine, 2010). More research is needed to establish conditions for effective outcomes when these approaches are used. As discussed above, this dissertation attempts to clarify the relationship between learner-controlled e-learning and learning outcomes by exploring training content complexity as a key moderator of this important yet equivocal relationship.

Training Content Complexity

A key issue that has only very recently been explored in the learner control literature is the potential moderating role of training content complexity on the

relationship between the degree of objective learner control and cognitive and skill-based learning. While practitioners (Welsh et al., 2003) and researchers (e.g., Liff & Kraiger, 2007) have expressed concerns about granting high levels of learner control to trainees in complex training environments (e.g., presentation of complex training content), there has been very little research investigating this issue. Recently, Granger and Levine (2009) directly tested this relationship and found that the intrinsic complexity of the training content is indeed an important moderator of the learner control-learning relationship. Specifically, they found that while there were no significant differences between trainees in low v. high learner control conditions for the training of relatively simple content, high levels of learner control were detrimental to declarative and procedural knowledge acquisition when the training content was complex in nature.

Consistent with cognitive load theory (CLT), the framework used by Granger and Levine (2009) to operationally define training content complexity, the manipulation of the complexity of the training content in this study involves increasing the number of distinct bits of information that must be processed by learners (Van Merrienboer & Ayres, 2005) during a training session. Importantly, an increase in the number of elements one must attend to during training inevitably increases the interconnectivity of the elements. In order to learn the material and successfully accomplish a complex learning objective, learners must process many elements and their interrelationships in working memory (Van Merrienboer, Kester, & Paas, 2006).

As is evident in much of the research on learner-controlled e-learning, many trainees make poor decisions that inhibit their learning during learner-controlled training and this may be especially problematic when the training content is complex in nature

(Bell & Kozlowski, 2002; Granger & Levine, 2009; Liff & Kraiger, 2007). However, in their investigation of the interaction between objective learner control and training content complexity, Granger and Levine's (2009) operationalization of learner control confounded the presence of the instructor with the degree of control afforded to trainees. That is, the "high learner control" and "low learner control" conditions were operationalized as learner-controlled computer-based training v. instructor-controlled classroom instruction respectively. This dissertation provides an additional test of this important interaction by disentangling the potential influence of instructor presence and the extent of objective learner control, while keeping the internal dimensions of control granted to trainees consistent (i.e., pacing, sequencing of material, the amount of time one spends in training and on various training modules, and the content that trainees choose to attend to and/or skip) and practically relevant.

Another issue that has yet to be uncovered is *why* the intrinsic complexity of the training content may moderate the relationship between the degree of learner control and learning outcomes. Granger and Levine (2009) found limited support for time-on-task as a mediator of this relationship, suggesting that the reduced time-on-task that is typical for trainees in learner-controlled (v. program-controlled) training environments (Kulik & Kulik, 1991) only partially explained why trainees acquired more declarative knowledge in program-controlled environments for the training of complex material. They speculate that other mediators, such as the degree of cognitive load experienced by learners in these training environments, may explain why trainees acquired more declarative and procedural knowledge in a program-controlled complex training environment than those in a learner-controlled complex training environment.

In demonstrating that the intrinsic complexity of the training content is an important moderator of the relationship between learner control and training outcomes, Granger and Levine's (2009) findings suggest that some trainees performed quite well on the post-training measures of learning in the "high learner control-complex" condition. That is, some trainees were able to effectively handle the high degree of learner control afforded to them under complex training conditions. As is implied by the results in support of moderation, many trainees did quite poorly under these conditions as well. Thus, it is important to identify individual differences that predispose trainees to success (and failure) in such conditions to help guide the practice of granting trainees high v. low levels of learner control in e-learning (Granger & Levine, 2010).

Individual Differences in Trainability

In addition to uncovering various contextual factors (Colquitt et al., 2000; Mathieu & Martineau, 1997) and design elements (Bell & Kozlowski, 2008) that influence training outcomes, training researchers have identified individual differences that lead some trainees to learn and transfer their skills more effectively than others (e.g., Brown, 2001; Fisher & Ford, 1998; Orvis, et al., 2009; Schmidt & Ford, 2003; Sitzmann et al., 2009). The notion of trainability, in general, refers to the ability of certain individuals to benefit from training interventions (Noe, 2008) and there is a substantial body of research directed at investigating individual differences in trainability. Among the many individual differences that predict the trainability of learners, research has identified cognitive ability (Blume et al., 2010; Colquitt et al., 2000; Ree & Earles, 1991; Ree et al., 1995), self-efficacy (Sitzmann et al., 2009), certain personality characteristics (Blume, et al., 2010; Colquitt et al., 2000) and goal orientation (Brett & VandeWalle,

1999; Brown, 2001; Ely et al., 2009; Orvis et al., 2009) as important predictors of learning outcomes that predispose trainees to success in various training environments.

Regarding learner-controlled e-learning specifically, there is evidence that certain individual differences lead trainees to utilize learner control more effectively than others (e.g., Brown, 2001; Orvis et al., 2009; Schmidt & Ford, 2003). This is consistent with Saks and Haccoun's (2008) general notion that different trainees may benefit from different instructional methods. Research on aptitude-treatment interactions (ATIs) suggests that learners react quite differently to the same or similar learning environments (Snow, 1992). According to Cronbach and Snow (1977), an aptitude refers to an individual characteristic that influences the probability that a learner will benefit from a certain treatment. A treatment, on the other hand, typically refers to the various instructional techniques that are expected to influence learning outcomes (Snow, 1991).

Empirical evidence suggests that many learners are poor judges of their own learning (Koriat & Bjork, 2005) and utilize poor learning strategies (Bjork, 1994; Kraiger & Jerden, 2007) especially in learner-controlled e-learning. Based on this evidence trainees do not appear to be universally equipped to effectively regulate their own learning. As a result Kraiger (2008) for one has stated that, "more control and more responsibility assigned to learners is not necessarily a good thing" (pp. 505). Kraiger's (2008) commentary on active learning approaches to training suggests a number of avenues for researchers to pursue, among them identifying individual differences that interact with learner control to influence training outcomes. As with the training research in general, it is important to identify trainee characteristics that interact with certain

conditions that are presented by the various training media for clearly one size does not fit all when it comes to e-learning.

Overall, past research has pointed to the importance of several variables that may affect the success of training. Among the potential myriad of individual differences that may interact with the degree of learner control and training outcomes, this dissertation explores learning goal orientation because of its link to important metacognitive/ self-regulatory strategies (Ames, 1992; Chiaburu et al., 2010; Church et al., 2001; Dweck, 1986; Ford et al., 1998; Mesmer-Magnus & Viswesvaran, 2007; Schmidt & Ford, 2003) and the likelihood that high levels of learning goal orientation will thus predispose trainees to effectively manage high levels of cognitive load (Granger & Levine, 2010). Additionally, from a practical perspective, evidence from the training literature suggests that a learning goal orientation can be induced to some extent (Button et al., 1996) and be positively influenced by external factors that can in turn be influenced by trainers, instructional designers, supervisors, etc. (Chiaburu et al., 2010; Heckhausen & Kuhl, 1985; Kozlowski & Bell, 2006), thus making it an individual difference that can be influenced prior to and during training.

As mentioned above, understanding why high LGO learners may more effectively handle high levels of cognitive load produced by complex, learner-controlled environments is also important. An understanding of this relationship will help guide organizations, trainers and instructional designers to deliver training material more effectively by embedding or including specific self-regulatory prompts (e.g., Sitzmann & Ely, 2010; Sitzmann et al., 2009) and/or inducing states prior to and during training that lead to more effective management of challenging training environments and ultimately

better learning. The link between LGO and metacognitive activity (e.g., Church et al., 2001; Ford et al., 1998; Mesmer-Magnus & Viswesvaran, 2007; Schmidt & Ford, 2003) is expected to help high LGO learners handle high levels of cognitive load and effectively learn the training content under complex training conditions.

In summary, a high learning goal orientation is hypothesized to serve as a facilitating individual characteristic that helps trainees succeed in complex, learner-controlled e-learning environments. The intrinsic complexity of the training content is expected to present trainees with increased cognitive load which high LGO learners are expected to handle more effectively than low LGO learners through the use of effective metacognitive strategies during training. A low LGO is expected to place learners at a critical disadvantage when presented with complex training content in a learner-controlled e-learning environment primarily because of reduced metacognitive activity in the face of high cognitive load.

The Current Study

The primary objective of this study is to further clarify the moderating role of training content complexity on the relationship between objective learner control and several important training outcomes. This study builds on the research of Granger and Levine (2009) by isolating the degree of learner control[1] and content complexity as the key independent variables as well as a mediator of this relationship, cognitive load. In using cognitive load theory (CLT) as a framework for the conceptualization and manipulation of content complexity, cognitive load is expected to explain the proposed moderation between learner control and content complexity for predicting learning outcomes. Learning goal orientation (LGO) is then presented as a facilitating individual difference that is expected to help some learners handle complex, learner-controlled e-learning environments through the application of important meta-cognitive strategies. A model linking the focal variables in this study is presented in Figure 1. The figure illustrates that the interaction between objective learner control and training content complexity will be mediated by cognitive load for predicting learning outcomes. It further illustrates that the hypothesized interaction between objective learner control and content complexity will be moderated by learning goal orientation for predicting learning outcomes, and that learning goal orientation's impact on learning outcomes will be

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[1] As discussed above, Granger and Levine's (2009) operationalization of learner control confounded the degree of objective control granted to trainees with the presence (absence) of an instructor. In other words, learner control was further operationalized as the presence vs. absence of an instructor who guided the training course in the low learner control condition.

mediated by metacognition. The next section specifically addresses the various training

outcomes that will be measured in this study and a description of CLT.

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                              │   LGO   │
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                           ┌──────────────┐
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┌──────────┐    ┌──────────────┐   ▼    ┌──────────┐
│ Objective│    │  Cognitive   │───────▶│ Learning │
│ Learner  │───▶│    Load      │        └──────────┘
│ Control  │    └──────────────┘
└──────────┘  ▲
        ┌──────────┐
        │ Intrinsic│
        │ Content  │
        │Complexity│
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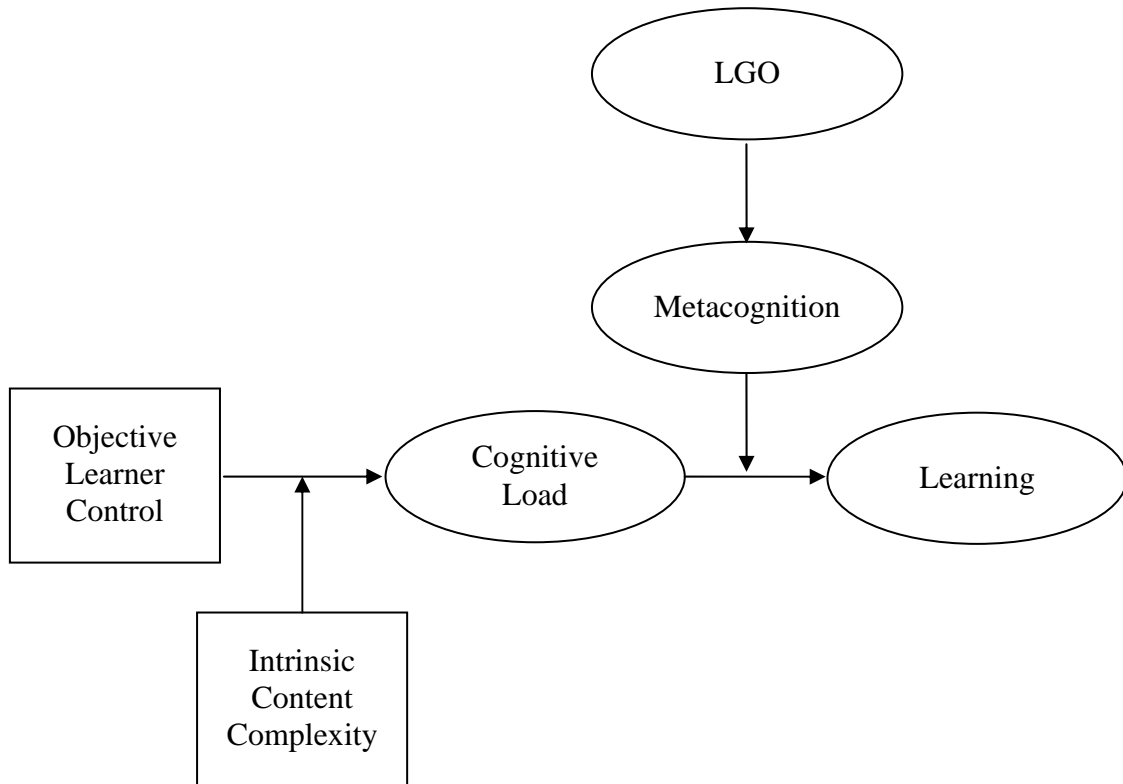
Figure 1. Summary of Hypothesized Relationships among the Focal Variables

Training Outcomes

When the efficacy of instructional approaches or training media is discussed, it is

important to distinguish among the relevant training outcomes. One of the most popular

training evaluation taxonomies was developed by Kirkpatrick (1976). In his original

taxonomy, it was suggested that training programs should be evaluated on four distinct,

yet related outcomes. Specifically, Kirkpatrick's (1976) taxonomy includes trainee

reactions (Kirkpatrick, 1959) (i.e. are trainees satisfied with training?), learning of the

material (i.e. do trainees learn what is being taught?), demonstration of the behaviors taught (i.e. can trainees engage in the specific behaviors being trained, how easily do trainees perform the behaviors, and what is their capacity to perform in other contexts?), and organization-level outcomes or results. Although it was originally suggested that the outcomes were hierarchically organized such that lower level outcomes (trainee reactions) must be sufficiently positive for subsequent outcomes to occur, conceptual (e.g., Alliger & Janak, 1989) and meta-analytic (e.g., Arthur et al., 2003; Sitzmann et al., 2008) work highlight a number of problems with this notion.

More recently, training researchers have offered more nuanced conceptualizations of training outcomes (e.g., Alliger, Tannenbaum, Bennett, Traver, & Shotland, 1997; Kraiger, Ford, & Salas, 1993). For instance, while training researchers and practitioners have at times treated learning and affective outcomes each as unidimensional, they are now known to be multidimensional (Brown, 2005; Kraiger et al., 1993). Regarding non-affective training outcomes, Kraiger et al. (1993) explicitly pointed out the distinction between declarative and procedural knowledge. Unfortunately, measures of declarative knowledge are often the only learning measures used to evaluate the effectiveness of training (if any learning measures are used at all). In fact, one recent meta-analysis comparing web-based to traditional classroom media (Sitzmann et al., 2006) only tested moderators for declarative knowledge due to the small number of studies measuring procedural knowledge. To address these issues in how the effectiveness of training has been assessed in past research, the current study utilizes multiple measures of learning (declarative knowledge, procedural knowledge, and skill-based procedural knowledge).

In distinguishing declarative and procedural knowledge, Kraiger et al. (1993) define declarative knowledge as knowledge of facts and principles and the relationships among relevant elements. In contrast, they define procedural knowledge as knowledge of *how* to perform a skill or carry out a process. Traditionally, declarative knowledge has been measured with recall tests such as multiple choice examinations that measure learners' ability to recall facts and principles that are covered in a training course. While less frequently measured in the training literature and in practice, procedural knowledge has been measured in two general ways: learners demonstrate that they recall the steps that must be taken to carry out a set of actions or learners actually demonstrate the skills being trained. The relevance of both measurements to the construct of procedural knowledge is supported by Sitzmann et al.'s (2006) meta-analysis which coded both approaches as measures of procedural knowledge. Both measurements of procedural knowledge are included in this study. Throughout the remainder of this paper, I refer to the latter of these approaches as skill-based procedural knowledge.

Cognitive Load Theory

Given its importance for the operationalization of intrinsic content complexity and its role as a key mediator in this study, a brief review of cognitive load theory (CLT) is presented. As a theory, CLT is focused on the human cognitive architecture (Cierniak, Scheiter, & Gerjets, 2008) and is based on the fundamental notions that the human working memory is limited in its storage capacity and its ability to process new information (Baddeley, 1992; Miller, 1956) while long term memory is nearly limitless in the amount of information that can be stored (Krischner, 2002). In CLT, working memory is considered a bottleneck to learning such that any information that passes to

long-term memory must first be processed in working memory (Gerjets & Scheiter, 2003). CLT distinguishes among sources of cognitive load that impact learners' limited working memory resources: intrinsic, extrinsic, and germane cognitive load (Sweller, 2005). These sources of cognitive load play a part in the overall cognitive load or mental effort experienced by the learner during training.

Intrinsic cognitive load. According to CLT, intrinsic cognitive load is directly influenced by the complexity of the training content itself. For example, manipulations of the intrinsic cognitive load of learning content include increasing the number of elements and the interconnectivity among those elements that must be processed by the learner in working memory (Mayer, 2008; Van Merrienboer, Kester, & Paas, 2006). Overall, it has been suggested that intrinsic cognitive load is determined both by the interactivity of the learning elements and the expertise of the individual learner (Sweller et al., 1998). As learners become more experienced with the training content, they develop schemas that link the interconnected portions of the learned material (Ayers & van Gog, 2009). This then helps learners overcome the known limitations of working memory. For instance, the same learning material can be processed as many distinct elements by novice learners or as a few chunks of information by experienced learners (Chi, Glaser, & Rees, 1982; Van Merrienboer et al., 2006).

Extraneous cognitive load. While intrinsic cognitive load is directly influenced by the complexity or intrinsic difficulty of the actual training content, extraneous cognitive load refers to load placed on learners which is irrelevant to the content being learned. While instructional designers and trainers may be able to reduce the intrinsic complexity of the training content, the tenets of CLT suggest that instructional design techniques

likely have more impact over the extraneous cognitive load experienced by learners (Krischner, 2002). Instructional design features such as the degree of learner control, communication tools, simultaneous audio and video, etc. can and do influence extraneous cognitive load which ultimately reduces working memory space (Bannert, 2002). Similarly, Mayer (2008) suggests that one of the ultimate purposes of instructional design is to reduce extraneous processing, which he defines as "cognitive processing that wastes precious cognitive capacity but does not help the learner build an appropriate cognitive representation" (pp. 763). Indeed, work in CLT suggests that providing full control to learners may impose high levels of extraneous cognitive load (Scheiter & Gerjets, 2007) and research from other fields suggests that granting trainees full control over their learning is often detrimental to learning (Bell & Kozlowski, 2002; Brown, 2001; Kraiger, 2008) as it may place unduly high levels of (extraneous) cognitive load onto learners (Granger & Levine, 2010). As a simple example, if learners are given high levels of control of a computerized learning task, but are relatively unfamiliar with computers, then cognitive resources are devoted to using the computer as opposed to learning the focal content (Eveland & Dunwoody, 2001).

Germane cognitive load. In addition to intrinsic and extraneous cognitive load, proponents of CLT point to a third source of cognitive load known as germane cognitive load. Unlike intrinsic and extraneous cognitive load which consume valuable cognitive resources, germane cognitive load is expected to enhance learning. Specifically, germane cognitive load occurs when portions of unused working memory are actively devoted to instructional activities such as attending to the training material, setting goals, etc. From an instructional design perspective, increasing germane cognitive load often involves

directing learners' attention toward relevant (germane) aspects of the training material. For example, in a series of studies, Sitzmann and colleagues (Sitzmann & Ely, 2010; Sitzmann et al., 2009) presented trainees with self-regulatory and self-evaluative prompts during training. The purpose of these prompts was to direct trainees' attention and effort toward the training content and ultimately improve their learning of the material. Such interventions increase the germane cognitive load experienced by learners, by directing unused cognitive resources toward understanding the content of the training course. While I argue that complex, learner-controlled training environments lead learners to experience greater intrinsic and extraneous cognitive load, germane cognitive load is not expected to result from either of these conditions. Thus, in this study, I operationalize cognitive load as the degree of intrinsic and extraneous cognitive load (or detrimental cognitive load) experienced by learners throughout training.

Moderating Role of Training Content Complexity

Although practitioners (Welsh et al., 2003) and researchers (e.g., Granger & Levine, 2010; Liff & Kraiger, 2007) have argued for the importance of considering the complexity of the content being trained in e-learning, to my knowledge, there has only been one empirical investigation on this issue. In their study, Granger and Levine (2009) found that the intrinsic complexity of the training material was a significant moderator of the relationship between the degree of learner control and cognitive and skill-based learning outcomes, such that a high degree of learner control is detrimental to declarative and procedural knowledge acquisition when the content of the training is relatively complex. The degree of learner control afforded to trainees had no effect on learning when the content of training was simple in nature. As called for by Granger and Levine

(2010), this dissertation attempts to replicate these findings, explore cognitive load as the mechanism through which this interaction is expected to impact learning and investigate learning goal orientation as a potential facilitator countering the potentially negative effects of high learner control in complex training environments.

As previously stated, one of the primary purposes of e-learning is to allow trainees to control their own learning. In learner-controlled e-learning courses, trainees often spend less time on course-related activities than trainees in program-controlled training environments (Brown, 2001; Kulik & Kulik, 1991) and given the known disadvantages of high degrees of learner control, learners are expected to face increasing difficulty in utilizing high degrees of learner control when in complex training environments (Bell & Kozlowski, 2002; Granger & Levine, 2009). That is, one reason why the intrinsic complexity of the training content may moderate the relationship between the extent of objective learner control and cognitive and skill-based learning outcomes is due to decreased time-on-task characteristic of trainees in learner-controlled training courses (Brown, 2001; Freitag & Sullivan, 1995) which should be especially detrimental to trainees presented with complex material. Granger & Levine (2009) directly tested this hypothesis and found that time-on-task partially mediated the relationship between the degree of learner control and declarative knowledge only when the content of training was intrinsically complex in nature[2]. Time-on-task was not found to mediate the relationship between the degree of learner control and procedural and skill-based procedural knowledge for either complex or simple content. Thus, there are

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[2] Time-on-task, which was operationalized as the total amount of minutes trainees spent on course-related activities, including training modules and practice opportunities, did not mediate the relationship between the degree of learner control and any learning outcome when the content of training was simple in nature.

likely other reasons why training content complexity moderates the relationship between the degree of learner control and learning. One such possibility is the degree of cognitive load experienced by learners in these training environments (Granger & Levine, 2010).

According to CLT, complex information places a heavier burden on learners' working memory by requiring learners to attend to more unique elements and their interconnectivities simultaneously (Van Merrienboer et al., 2006). In other words, the content of two training courses differs in complexity to the extent that one presents more unique elements to be processed by learners. By increasing the number of elements that learners must attend to, the interconnectivity among those elements increases exponentially. The conceptualization of complexity in CLT is very similar to that of Wood (1986) who suggests that a manipulation of several complexity components (i.e., component complexity, coordinative complexity, and dynamic complexity) basically involves increasing the number of distinct bits of information that must be processed by the learner.

According to CLT, complex material places a high degree of intrinsic cognitive load onto learners and contributes to the overall cognitive load or mental effort experienced by learners (Ayers & van Gog, 2009). Alone, a high degree of intrinsic cognitive load (content complexity) places a heavy burden on trainees' working memory space. High degrees of learner control should present trainees with high levels of extraneous cognitive load (Scheiter & Gerjets, 2007), which again, is irrelevant to the content being learned but ultimately works to reduce the cognitive resources available for learning the training content (Bannert, 2002; Mayer, 2008). Thus, learner-controlled training environments are expected to be increasingly problematic when the intrinsic

complexity of the training content is high. The difference between high and low levels of learner control may be less dramatic when the content of training is simple in nature due to the reduced levels of cognitive load experienced by learners. This reasoning leads to the first two hypotheses to be tested in this study:

Hypothesis 1: Training content complexity will moderate the relationship between the extent of learner control and (a) declarative knowledge, (b) procedural knowledge, and (c) skill-based procedural knowledge. Outcomes will be poorer in the high learner control condition compared to the low when complexity is high, whereas the differences will not be as substantial when complexity is low.

Hypothesis 2: The moderated relationship between training content complexity and (a) declarative knowledge, (b) procedural knowledge, and (c) skill-based procedural knowledge will be differentially mediated by cognitive load such that trainees in complex, high learner-controlled environments will learn less than trainees learning simple content and with less control over their training environment due to increased cognitive load.

Individual Differences and Cognitive Load

Although much of the extant research utilizing CLT as a framework has focused on the effects of various instructional design elements that reduce or eliminate extraneous cognitive load, consideration of both intrinsic and extraneous cognitive load lead me to believe that certain individual differences predispose some learners to success and failure in learner-controlled e-learning environments. Given e-learning's ability to adapt to the individual needs of learners (Cascio & Aguinis, 2005; Long & Smith, 2004), it is important to uncover individual differences that influence training outcomes in e-learning

environments (Granger & Levine, 2010; Kraiger, 2008). In the next section, I argue that above and beyond the learner's cognitive ability and experience with the specific training content, a high degree of learning goal orientation will help some learners manage high levels of cognitive load introduced by learner-controlled, complex training environments. Moreover, I argue that a reason why high LGO learners may handle these training environments is their willingness and ability to engage in important metacognitive strategies that facilitate learning.

Goal Orientation

Although the motivational construct of goal orientation (GO) originated in the education literature (Dweck, 1975; Nicholls, 1975), GO has received substantial attention in the organizational literature in recent years (Payne, Youngcourt, & Beaubien, 2007). Because GO was conceived of independently by several researchers, there is still no consensus as to the specific nature of the construct. However, it is well recognized that GO is a motivational variable that influences how individuals approach and respond to learning/achievement tasks (Dweck & Leggett, 1998). According to DeShon and Gillespie (2005), the most common approaches to defining GO include viewing GO as the adoption and pursuit of achievement goals (e.g. Elliot, 1999; Ellliot & Church, 1997; Elliot & Harackiewicz, 2001), treating GO as a trait or individual difference variable that is responsible for certain differences in behavior (e.g. VandeWalle, 1997; VandeWalle, Cron, & Slocum, 2001; Phillips & Gully, 1997) and treating GO as somewhat dispositional, but allowing for modification based on certain situational characteristics (e.g. Button, Mathieu, & Zajac, 1996; Mangos & Steele-Johnson, 2001). Similar to

Dweck and Leggett's (1988) definition, DeShon & Gillespie (2005) treat GO as a pattern of actions that are undertaken by an individual in order to pursue goals.

Dimensionality of Goal Orientation

In addition to the definitional inconsistencies present in the extant literature, there has been debate as to the dimensionality of GO. Originally, GO was conceived of as lying along a continuum from performance orientation to learning orientation. That is, it was originally believed that individuals could not possess both a performance and learning goal orientation concurrently (Dweck, 1986). A learning goal orientation (LGO) refers to a tendency to develop competence through increasing one's ability and learning to master challenging situations (Brett & VandeWalle, 1999; VandeWalle et al., 2001; Dweck & Leggett, 1988) while a performance goal orientation (PGO) refers to a tendency to seek competence in order to validate oneself to others (VandeWalle et al., 2001). This eventually changed however, as researchers now believe that it is possible to have multiple goal orientations (Dweck, 1989; Buttons et al., 1996). Later, Elliot and colleagues and VandeWalle and colleagues suggested further dividing PGO into performance-prove (PPGO) and performance-avoid (PAGO) tendencies. While PPGO is quite similar to the original conceptualization of PGO, PAGO refers to a tendency to maintain competence in order to avoid negative judgments by others (VandeWalle et al., 2001).The most recent meta-analysis in the literature focused primarily on this three-dimensional treatment of GO since it is the most widely researched (Payne et al., 2007) and well supported (VandeWalle, 1997; Button, et. al., 1996; Deshon & Gillespie, 2005). This conceptualization of GO is thus adopted in this study.

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Again, the most common treatment of GO in the literature suggests that there are three orthogonal goal orientations that can be adopted by individuals. LGO has long been touted as the most favorable of the GO types due to its positive relationships with many favorable outcomes in work and educational settings (Payne et al., 2007). The two PGOs have often been cast in a negative light due to their less favorable relationships with important performance-related criteria, although PAGO is likely the primary driver of the negative effects found for PGO (Payne et al., 2007). As the most consistent predictor of metacognitive activity (e.g., Church et al., 2001; Ford et al., 1998; Mesmer-Magnus & Viswesvaran, 2007; Schmidt & Ford, 2003) and learning outcomes in educational and workplace settings (Brown, 2001; Ely, et al., 2009; Payne et al., 2007; Schmidt & Ford, 2003), this study focuses solely on LGO.

Learning Goal Orientation, Metacognition and Learning Outcomes

Metacognition refers to a person's awareness of and control over her own thoughts (Dinsmore, Alexander, & Loughlin, 2008; Flavell, 1979). Importantly, metacognition is an effortful process (Efklides, 2011) that some learners are willing to engage in and others are not. The behaviors associated with metacognition are often categorized into two general types of activities: monitoring and control activities. As discussed in more detail below, high LGO learners are expected to engage in a number of monitoring and control activities that will ultimately help them handle complex, learner-controlled training environments.

In addition to the empirical findings in support of the positive relationship between LGO and learning outcomes (e.g., Brown, 2001; Ely, et al., 2009; Payne et al., 2007;Schmidt & Ford, 2003), LGO is expected to impact how trainees experience

cognitive load due to differences in metacognition. For instance, by definition, high LGO learners attend more to the learning material than those lower in LGO and engage in less off-task attention (Brown, 2001). As pointed out by Brown (2001), cognitive effort plays a vital role in determining learning as it is well known that learners who engage in more on-task attention (characteristics of learners who are high in LGO) during training outperform those who focus their attention to things that are irrelevant to learning content at hand (Fisher & Ford, 1998; Kanfer & Ackerman, 1989). In CLT terms, learners high in LGO decrease their off-task attention and ultimately attend more to the learning material at hand and thus experience decreased extraneous cognitive load. High LGO learners also accomplish this by carefully monitoring their learning and controlling their allocation of resources during training (Ford et al., 1998; Metcalfe & Shimamura, 1994; Nelson & Narens, 1990; Schmidt & Ford, 2003). Specifically, high LGO learners engage in activities such as planning their approach to a learning task, continuously monitoring their progress throughout training, prioritizing learning tasks according to their learning needs and using this information to allocate resources accordingly (Ford et al., 1998; Schmidt & Ford, 2003; Nelson & Narens, 1990), thus suggesting that metacognitive strategies mediate the effects of goal orientation on learning outcomes (Payne et al., 2007; Sitzmann & Ely, 2011). Such activities are expected to help learners overcome the high levels of cognitive load introduced by complex, learner-controlled training environments.

Additionally, unlike much of the research on individual differences and performance in learner-controlled e-learning environments (e.g., Brown, 2001; Schmidt & Ford, 2003) this study explicitly compares two training courses that differ in the degree

of objective learner control granted to learners. Learner controlled e-learning requires trainees to regulate their effort during training (Bell & Kozlowski, 2008; Brown, 2001) and thus researchers have pointed to the importance of studying individual differences in self-paced learning environments (Ely et al., 2009; Kraiger, 2008). The notion of situational strength is also relevant here as learner-controlled e-learning environments generally represent weaker situations than program-controlled courses. In weak situations, individual differences are more likely to be expressed and thus influence outcomes (Mischel & Peake, 1982). In program-controlled training environments, situational cues such as the presence of instructions and pre-determined timeframes may restrict the expression of individual differences such as LGO. Thus, the effect of LGO is expected to be greater in high learner control environments v. those that offer little or no learner control. While LGO may have little impact on outcomes in program-controlled training environments, these effects are expected to be much greater in a learner-controlled environments with fewer situational cues and more room for the expression of motivational individual differences. Similar to Kraiger and Jerden (2007), I predict that trainees high in LGO will benefit more than those low in LGO from a high degree of learner control.

As discussed at length above, high levels of LGO are associated with increased meta-cognitive activity (Payne et al., 2007; Schmidt & Ford, 2003; Sitmann & Ely, 2011; Sitzmann & Ely, 2010). Using CLT as a framework, I reason that the increase in metacognitive activity (e.g., on-task attention, focused effort, self-monitoring, effective allocation of resources) that is characteristic of learners high in LGO will help facilitate trainees' efforts to counter the proposed negative effects of increased cognitive load in a

complex, learner-controlled training environment and lead to more beneficial learning outcomes. Additionally, while high levels of LGO may indeed be beneficial to trainees' learning when presented with relatively simple training content, their facilitating effect is expected to be more dramatic in complex e-learning environments. A similar pattern is expected for high v. low degrees of learner control, such that the facilitating effect of high levels of LGO is likely to be more dramatic in the learner-controlled e-learning environment (v. program-controlled) due to the increase in extraneous information that must be attended to by learning in the learner-controlled condition and the "weakness" of the condition which should allow for the expression of motivational individual differences. The hypothesized three-way interaction between learner control, content complexity and LGO, stated formally below as Hypothesis 3, reflects this rationale. Additionally, increased metacognitive activity is expected to mediate the relationship between LGO and learning outcomes and thus help explain why high LGO learners better handle complex training environments. This reasoning undergirds Hypothesis 4.

Hypothesis 3: The hypothesized interaction between the degree of objective learner control and training content complexity in influencing the degree of (a) declarative knowledge, (b) procedural knowledge, and (c) skill-based procedural knowledge will be further moderated by the extent to which learners are high v. low in LGO; such that trainees high in LGO will benefit more from a high degree of learner control when presented with complex training content compared to those low in LGO and the difference in learning outcomes between trainees high and low in LGO will be greatest in the high learner control/complex training content condition.

Hypothesis 4: Metacognition will mediate the relationship between LGO and (a) declarative knowledge, (b) procedural knowledge, and (c) skill-based procedural knowledge such that high LGO learners will experience greater metacognitive activity during training than low LGO learners.

Study Design

In this study, the focal manipulations are those of objective learner control and training content complexity. Similar to past manipulations of learner control in the literature (e.g., Orvis et al., 2011; Orvis et al., 2009), study participants were randomly assigned to one of two possible learner control conditions: high v. low control. Although low levels of learner control are typically characteristic of system or program-controlled training environments such as traditional classroom training, the aim of this dissertation is to isolate internal learner control as the variable manipulated. E-learning technology is advancing quickly and although e-learning is typically accompanied by high degrees of learner control (DeRouin et al., 2005), this is not uniformly the case (Granger & Levine, 2010). Thus, in this study, I compared high and low learner control in an e-learning environment similar to that done by Orvis and colleagues (Orvis et al., 2011; Orvis et al., 2009). This, again, is in contrast to the approach used by Granger and Levine (2009) who manipulated learner control by comparing a self-administered web-based training course to an instructor-delivered classroom training course. The training course itself consisted of a multimedia Power Point 2007 training tutorial designed to instruct trainees on the use of the software package. Additionally, CLT guided the manipulation of training content complexity, creating two complexity conditions (simple v. complex). A fully crossed design was implemented such that trainees were randomly assigned to one of four conditions: high learner control-complex, low learner control-complex, high learner control-simple and low learner control-simple.

Objective Learner Control

To bolster the generalizability of the manipulation of objective learner control in this study, learner control is operationally defined as the extent to which trainees have control over (1) the pacing, (2) the sequencing, (3) the amount of time spent on the course as well as various portions of the course, and (4) the content they choose to cover or skip. Trainees in the high learner control condition were explicitly instructed to pace their learning of the material as they see fit, allocate as much time as is necessary for each training module, skip any content in the training that they feel they do not need to cover and go through the training modules in whatever order they choose. Trainees in the low learner control condition were presented with the same content but were instructed to follow along with the pre-created visual presentation and pre-determined time frames for each training module. Finally, while the actual PowerPoint presentation used to deliver training material allowed for a high degree of learner control in the high control condition, the course used in the low control condition did not (e.g., course contained pre-set timing for each PowerPoint page in the tutorial). For simplicity, the high learner control and low learner control conditions will henceforth be referred to as the learner controlled (LC) and program controlled (PC) conditions respectively.

Training Content Complexity

The manipulation of training content complexity involved varying the number of distinct bits of information that must be processed by learners in the training course. This manipulation is consistent with the tenets of CLT which suggest that a learning task becomes more complex as the number of elements that must be attended to simultaneously by learners is increased (Van Merrienboer & Ayres, 2005). Perhaps most

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importantly, however, increasing the number of elements that must be attended to by learners dramatically increases the interconnectivities among the elements which ultimately increase the intrinsic complexity of the training content and should lead to an increase in the intrinsic cognitive load experienced by learners. Specifically, the manipulation of training content complexity in this study is similar to that of Granger and Levine (2009) such that the complex training condition requires trainees to learn operations in PowerPoint 2007 that are more advanced and require a more sophisticated understanding of PowerPoint than the simple training condition. For example, learners in the complex condition are required to learn the same skills taught in the simple condition in addition to several more advanced functions, without the benefit of much more time (at least in the PC condition since trainees are given control over this aspect in the LC condition).

A pilot study was conducted in advance of the main study for several reasons. These included ensuring the effectiveness of the key manipulations, the appropriateness of the measures and the appropriateness of all study protocols and procedures. A brief summary of its results follows.

Pilot Study

Despite evidence for the content complexity manipulation used in the study (see Granger & Levine, 2009) and the similarity of the learner control manipulation with other such manipulations in the e-learning literature (i.e., Orvis et al., 2009) a full trial of the study was piloted. A total of 50 undergraduate students signed up for the study through the online experiment recruitment website. Students were randomly assigned to one of four conditions: LC-complex (n = 15), PC-complex (n = 12), LC-simple (n = 10) and PC-simple (n = 13).

First, to ensure the effectiveness of the learner control protocols and manipulation, I conducted an independent samples t-test comparing the two learner control conditions on perceptions of learner control. As expected, results suggest that the trainees in the LC condition ($M = 4.53$, $SD = .40$) perceived having significantly more learner control than trainees in the PC condition ($M = 1.49$, $SD = .89$), $t(48) = -15.62$, $p < .0001$. Second, to ensure the effectiveness of the complexity protocols and manipulation, I conducted an independent samples t-test comparing the two complexity conditions on the perceived complexity measure. As anticipated, results suggest that the trainees in the complex condition ($M = 2.28$, $SD = .64$) perceived the training content to be significantly more complex than trainees in the simple condition ($M = 1.25$, $SD = .49$), $t(48) = -6.24$, $p < .0001$. Based on the results described above and observations that the protocols and materials were operating as expected, no changes were made to the protocols or study materials.

Main Study

Participants

Study participants consisted of 308 undergraduate students, virtually all

psychology majors at a large university in the southeastern United States. Students

registered for the study through an online experiment recruitment website. Participants

received extra credit in exchange for their participation in the study. An *a priori* power

analysis was conducted using G*Power 3.1.2 (Faul, Erdfelder, Lang, & Buchner, 2007)

and the estimated total sample size for a three way interaction for a small to medium

effect size (Cohen, 1988) with alpha set at .05 and power at .80 was 308 (N = 77

participants per cell). Of the 308 cases, nine were removed from the analyses due to

having missing data for all survey items. Two additional cases were removed for having

impossible values for several survey items and aberrant responding to many of the survey

items. Thus, data for a total of 297 participants were included in the analyses. Upon

signing up for the study, individuals were randomly assigned to one of four conditions:

LC-Complex (n = 74), PC-Complex (n = 76), LC-Simple (n = 76) and PC-Simple (n =

71).

The demographics of the sample are as follows: The sample consisted of 79.5%

females; the average age was 20.89 years (*SD* = 3.85); their races/ethnicities were

reported as being either White (58.2%), Black or African American (17.2%), Hispanic or

Latino (14.5%), Asian (9.8%), or American Indian or Native Alaskan (.3%), and their

levels in college were reported as being either a freshman (31%), sophomore (19.5%), junior (16.5%), senior (31.6%) or other (1.3%).

Independent Variables and Manipulation Checks

Perceived learner control. Though not identical, objective and perceived learner control are expected to covary positively (Kraiger & Jerden, 2007). Using an adaptation of the scale developed by Granger and Levine (2009) and similar to that used by Park and Kraiger (2005) to assess trainees overall perceptions of the degree of learner control, trainees were asked to what extent they perceived that they have control over the various dimensions of control granted to them in the e-learning course. Trainees responded to the items on a 5 point Likert scale ranging from *Strongly Disagree* to *Strongly Agree* (Appendix A). An example item includes: "Overall, I was in control of the time I spent learning the material in the training course". The measure showed excellent internal consistency ($\alpha = .96$).

Perceived content complexity. The degree to which learners perceived that the training content is complex in nature was measured and used to assess whether the manipulation of objective content complexity was successful. Though objective complexity and perceptions of the complexity of the training content are distinct constructs (Campbell, 1988), they are expected to covary positively. A measure developed by Granger and Levine (2009) was used in this study, which asks trainees to rate the extent to which they perceive the training content to be complex in nature using a 5 point Likert type, five item scale ranging from *Strongly Disagree* to *Strongly Agree* (Appendix B). An example item includes: "Overall I thought that the training course was difficult". The measure showed good internal consistency ($\alpha = .75$).

Potential Control Variables

  PowerPoint familiarity. Because prior experience with the training content is expected to covary with the post-course measures of learning, a measure of trainees' self-reported familiarity with PowerPoint was used in order to control for its potential effects on learning outcomes. This 12 item scale required participants to rate their familiarity with several specific operations common to PowerPoint on a five point scale ranging from *Extremely Unfamiliar* to *Extremely Familiar* (Appendix C). Each of the 12 operations included in the scale were covered in the complex version of the training course[3]. Example items include "Opening a blank PowerPoint presentation" and "Including Footers into a PowerPoint presentation". The measure showed very good internal consistency ($\alpha = .86$).

  Cognitive ability. As is common in the e-learning literature (e.g., Fisher et al., 2010; Orvis et al., 2009; Sitzmann et al., 2009) a measure of cognitive ability was used to control for its effects on learning outcomes. Specifically, participants were asked to self-report their highest composite ACT or SAT (Verbal + Quantitative) scores[4]. Participants who were unsure of their exact scores, were asked to estimate them to the best of their knowledge (Appendix D). Participant ACT and SAT scores were then placed on the same scale by transforming them to z-scores, using national data reported by the respective testing companies. Research by Koenig, Frey & Detterman (2008) and Frey and Detterman (2004) has shown that both the ACT and SAT have large general mental ability components and correlate highly with other common measures of cognitive

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[3] Due to the complexity manipulation, some but not all of the operations listed in the PowerPoint familiarity measure were covered in the Simple version of the training course.

[4] Research by Cassady (2001) suggests that college student self reports of scholastic achievement (e.g., GPA, SAT scores) are very highly correlated with actual scores.

ability. Moreover, ACT scores, as well as SAT scores, are often used as measures of

cognitive ability for college admissions decisions (Stark, Chernyshenko, & Drasgow,

2004).

Individual Difference Measures

Learning goal orientation. Learning goal orientation (LGO) was measured using

a variation of Elliot and Church's (1997) state GO measure. Because the focus of this

study is on trainees' goal orientation in a specific training setting, the items were tailored

to the PowerPoint training course. The LGO measure included six items measured on a

five point Likert scale ranging from *Strongly Disagree* to *Strongly Agree*. An example

item includes "I want to learn as much as possible from this course". The measure

showed very good internal consistency ($\alpha = .89$).

Metacognitive activity. The specific metacognitive strategies used by trainees

during training were measured using Schmidt and Ford's (2003) 15 item measure of

metacognitive activity which is adapted from Ford et al.'s (1998) scale. An example item

includes "During this training program, I carefully selected what to focus on to improve

on weaknesses I identified". Trainees responded to these items on a five point scale

ranging from *Almost Never* to *Almost Always*. The measured showed excellent internal

consistency ($\alpha = .93$).

Dependent Measures

Cognitive load. The degree of cognitive load experienced by trainees in the

various training courses was measured with an adaptation of Cierniak, Scheiter, and

Gerjet's (2009)[5] subjective measures of extraneous and intrinsic cognitive load. Because

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[5] Ayers and van Gog (2009) note that this approach to the measurement of cognitive load has been more supportive of the tenets of cognitive load than split-attention/ dual-task methodologies.

both dimensions of cognitive load are expected to unfavorably influence trainees'

cognitive resources during training and the hypothesis regarding mediation of the

moderated relationship between the degree of learner control and content complexity,

these dimensions were combined to represent a single measure of *detrimental* cognitive

load. Participants responded to these two items on a six point Likert-type scale with

responses ranging from *Not at all* to *Extremely*. The measure showed very good internal

consistency ($\alpha = .82$).

 Declarative and procedural knowledge. Upon completion of the training course,

participants completed a 20 item multiple choice exam (Appendix E). Trainees were

required to close out the training course while taking the post-course examination and

were explicitly instructed to "treat it like an actual college level examination". Each

question included four possible options. Ten of the questions on the final exam measured

declarative knowledge by requiring trainees to demonstrate an understanding of the

different definitions and concepts associated with PowerPoint (e.g., Which of the

following options best describes the purpose of the Ribbon within PowerPoint?). The

additional 10 questions measured procedural knowledge by requiring participants to have

an understanding of the steps required for the successful completion of certain tasks

common to PowerPoint (e.g., Which of the following is the correct sequence for using the

Ribbon to insert pictures into your slideshow?). The final examinations for all conditions

were identical. However, it was expected that trainees in the complex condition, who

received training on more advanced PowerPoint functions, would perform better than

trainees in the simple conditions. Since this represents a potential confound, declarative

and procedural knowledge gain were operationalized as the percentages of relevant

questions answered correctly. For example, the complex courses prepared trainees for all 20 questions in the examination. Thus, their total percentages for declarative and procedural knowledge were calculated by summing the number of correct answers and dividing this number by 10 (for each learning measure). On the other hand, only 11 of the 20 questions were covered in the simple condition. Thus, for participants in the simple condition, total percentages were calculated by summing the number of correct answers to the relevant questions and dividing the total number of relevant questions. The internal consistency estimates of the declarative and procedural knowledge sub-sections of the exam were quite low (*KR-20* = .37 and .49 for declarative and procedural knowledge respectively). Because trainees in the simple condition were not trained on some of the operations covered by several items in the exam, I analyzed the internal consistency of the measures for trainees in the simple and complex conditions separately. For trainees in the simple condition, the internal consistency of the declarative and procedural measures was .46 and .50 respectively. For trainees in the complex condition, the internal consistency of the declarative and procedural measures was .40 and .52 respectively. Overall, only a very minor improvement was observed when calculated separately for the simple and complex conditions. Additionally, item-analysis and item deletion based on item-total correlations and the internal consistency when items are deleted was explored, but no meaningful increase in reliability was observed. Thus, I determined that there was little value in removing items from the declarative and procedural knowledge measures.

Overall cognitive learning. Due to the low reliabilities observed for the individual learning measures, I combined the measures into an overall cognitive learning measure to improve the reliability of the learning outcome and thus potentially increase the

likelihood of detecting important relationships with cognitive learning[6]. Similar to the

operationalization of declarative and procedural knowledge, scores for overall cognitive

learning were calculated separately for trainees in the complex and simple conditions. As

such, the total percentages of the cognitive learning measure were calculated by summing

the number of correct answers to relevant questions and dividing by the total number of

relevant questions. As expected, the internal consistency improved considerably once the

two measures were combined (KR-$20 = .61$).

    Skill-based procedural knowledge. A skill-based procedural knowledge task

similar to that used by Granger and Levine (2009) was used to measure the effectiveness

with which trainees *demonstrated* their learning of the training content. Specifically,

participants were instructed to create a 3 slide, PowerPoint presentation from scratch. A

limited number of parameters were provided to trainees (as may be the case in a real

educational or organizational setting) and trainees were instructed to use the skills that

they learned in the training course to successfully complete the task. Participants were

instructed to create a presentation on how to prepare for a college-level examination

(Appendix F). The effectiveness of the participants' PowerPoint presentations was

assessed independently by three trained research assistants. The research assistants

consisted of two female and one male, white/ Caucasian undergraduate students. Each of

the raters was put through a one hour frame of reference training in which raters first

completed the complex version of the training course to orient them to the content. Raters

were then given the complex and simple training scripts as well as short lists of the

operations/ skills taught in each version of the training course. Finally they were oriented

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[6] As is shown in the Results, the correlation between the two learning measures was positive and strong in magnitude ($r = .48$, $p < .0001$) further supporting the combination of the measures into an overall cognitive learning measure.

to the rating key. Following the training, raters scored each presentation from the simple

condition[7], using a five point, anchored rating key ranging from *Very Poor* to *Excellent*

(Appendix G). Once raters completed their ratings for the simple condition, they then

provided ratings for the complex condition. It is important to note that raters were

specifically instructed to rate presentations based on the skills demonstrated by the

creator as opposed to the actual content of the presentation. The presentations' quality,

measuring the degree of skill-based procedural knowledge gained during training, was

indexed as the sum of the three raters' scores. Inter rater reliability was estimated by

averaging the inter rater correlations and then applying the Spearman-Brown correction

to the average r. The resulting reliability coefficient was .92.

Additional Measures

   Motivation to learn. While not a focal variable in this study, I included a

variation of Noe and Schmitt's (1986) eight item motivation to learn scale. One of the

potential limitations of the use of an all-student sample is that the results may not

generalize to employees completing job-relevant training, partially because there may

important motivational differences between students completing training for extra credit

and employees taking training to enhance their job-relevant knowledge and skills. Thus, I

included Noe & Schmitt's (1986) pre-training motivation to learn measure to offer insight

into this potential limitation. Item wording was tailored slightly to the PowerPoint

training course. Two of the original scale items were removed (e.g., "The reason I

decided to participate in this course was to learn how I can improve my PowerPoint

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[7] Because the skills taught in the simple and complex versions of the course differed, it was necessary for the raters to know which complexity condition the creator of each PowerPoint course was in. However, raters were blind as to whether the creator participated in the LC or PC condition. Moreover, the study purpose and hypotheses were not shared with raters until after they completed their ratings.

skills") because participants signed up for the study without prior knowledge of the nature of the experiment or the training course. Thus, these items were not relevant in the current study. Not surprisingly, these two items also had very low item-total correlations and the internal consistency of the scale improved considerably when these items were removed. Ultimately, motivation to learn was measured via a six item scale. Each item was measured on a five point Likert scale ranging from *Strongly Disagree* to *Strongly Agree.* An example item includes "I am motivated to learn the skills emphasized in the training program". The six item measure showed very good internal consistency ($\alpha = .85$).

Trainee satisfaction. Although trainee satisfaction is not a key outcome of interest in this study, trainee satisfaction (or affective reactions) is a very commonly measured outcome variable in practice and research. The design of this study allows for the exploration of several, potentially interesting findings related to trainee satisfaction. For example, Brown (2005) and Orvis et al. (2009) have recently argued that the relation between trainee satisfaction and learning outcomes is (and should be) stronger in learner-controlled training than in program-controlled training environments. They argue further that past research finding weak relationships between trainee satisfaction and learning have been primarily based on studies utilizing training courses that would be considered program-controlled. Because the design of this study allows for the exploration of this resurging issue in the e-learning literature, trainee satisfaction was measured using Brown's (2005) measures of enjoyment and relevance. Brown's (2005) research suggests that although these components of trainee reactions are related through an overall satisfaction construct, they should be considered distinct. Each measure consists of two

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items and participants responded to each item on a five point Likert scale ranging from *Strongly Disagree* to *Strongly Agree*. Example items include "I enjoyed the training course" and "the training course was relevant to my education" (for enjoyment and relevance respectively). The measure of enjoyment showed excellent internal consistency ($\alpha = .90$), while the relevance measure's internal consistency was only moderate at .65.

Procedure

Upon signing up for the study, participants were randomly assigned to one of four conditions; LC-complex, PC-complex, LC-simple and PC-simple. Unlike many e-learning studies, trainees completed the course in computer labs alongside other trainees. Between 4 and 20 students participated during a single study session. While many e-learning courses allow trainees to control the time and location of their training (e.g., Karim & Behrend, 2012; Sitzmann et al., 2009), the focus of this study is learners' control over dimensions of learner control that are internal (i.e., instructional control) (v. external, e.g., location of training, time of day) to the training course that are likely to affect trainees' exposure to the training material. Before entering the study session, each participant was emailed a document that included instructions, a pre-training survey, the embedded training course corresponding to the condition he/she was assigned to, a post-course examination and instructions on completing the skill-based procedural knowledge activity. As part of the pre-training survey, participants first reported demographic information, including their highest composite ACT or SAT (verbal + quantitative) score. Participants then completed the PowerPoint familiarity, LGO and motivation to learn measures. Trainees then completed the embedded training course accompanying the condition to which they were assigned. The training courses in the two learner control

conditions were identical in the visual content presented. In total, the training course included three separate modules covering various operations in PowerPoint. Each training module was accompanied by a practice session which provided trainees with an opportunity to practice the skills that were taught in the preceding module.

Trainees in the LC conditions were instructed to allocate their time as they saw fit, complete the training course at their own pace, and skip or speed through any training material that they do not feel is necessary for them to cover (See Appendix H for a screenshot from the training course). Trainees in the PC condition were required to follow along with the instructions and pre-determined time frames embedded within the training course (See Appendix I for a screenshot from the training course). The degree of learner control was applied to the practice sessions as well as the training modules. In other words, trainees in the LC conditions were given full control over the amount of time they spent practicing the skills, whether they practiced the skills at all, etc. Trainees in the PC conditions were instructed to practice all skills in the allotted time (no more, no less). Thus, trainees in the PC condition spent approximately the same amount of time on each training module and the entire training course as a whole. The predetermined time frames used in the program-controlled condition were based on those used in Granger and Levine's (2009) study. Specifically, the predetermined pacing for the PC-complex condition is as follows: 6 minutes for module 1, 6 minutes for practice session 1, 9 minutes for module 2, 5 minutes for practice session 2, 7 minutes for module 3 and 5 minutes for practice session 3. The total time predetermined for the PC-complex condition was 38 minutes. The predetermined pacing for the PC-simple condition is as follows: 4 minutes for module 1, 4 minutes for practice 1, 7 minutes for module 2, 5

minutes for practice session 2, 8 minutes for module 3 and 4 minutes for practice session 3. The total time predetermined for the PC-easy condition was 32 minutes. Although the total time spent by trainees in the PC condition was predetermined, it was not recorded for trainees in the LC condition. Thus, time-on-task was not fully controlled for due to its minimal influence on learning in recent studies (e.g., Granger & Levine, 2009).

The simple and complex conditions differed in the amount of advanced PowerPoint operations covered in the training course. Trainees in the simple condition were required to learn only basic PowerPoint operations such as creating and saving a slideshow, entering text and text boxes, manipulating slide themes and display options, etc (See Appendix J for a screenshot from the simple condition). The complex condition covered these same operations in relatively less time (in the PC condition) and required trainees to learn more advanced operations such as applying SmartArt graphics, utilizing the Master Slide function, etc (See Appendix K for a screenshot from the complex condition). The LC and PC versions of complex course presented identical information visually to the learner. This was also the case for the LC and PC versions of the simple training course.

Throughout the training course, a research assistant was available to aid all participants with technical problems or questions. Immediately following their completion of the training course, participants completed the perceived content complexity, perceived learner control and satisfaction measures. Participants then completed the cognitive load and metacognitive activities measures. Finally, participants completed the twenty item post-course examination and the skill-based procedural

knowledge activity. Participants then emailed their completed documents and skill-based

procedural knowledge activity to the researcher.

Results

Means, standard deviations and correlations among the focal variables are presented in Table 1. The descriptive statistics reported in Table 1 suggest that across the experimental conditions, trainees tended to score high on the post-course declarative ($M = .88$, $SD = .14$) and procedural knowledge examinations ($M = .85$, $SD = .16$). These findings suggest that the post-course exam was relatively easy for the average trainee. It should be noted, however, that when learning is operationalized as the total percentage of items correctly endorsed on the post-course examination, without regard to which complexity condition participants were in, participants in the complex condition ($M = .84$, $SD = .12$) scored several percentage points higher, on average, than participants in the simple condition ($M = .78$, $SD = .12$). This, of course, was expected since trainees in the complex condition were trained on all of the operations covered in the post-course examination while trainees in the simple condition were not.

Table 1. Means, SDs, and Intercorrelations Among the Focal Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Objective Learner Control	(--)														
2. Training Content Complexity	-.24	(--)													
3. Perceived Learner Control	.88**	-.03	(.96)												
4. Perceived Content Complexity	.09	.56**	.06	(.75)											
5. PowerPoint Familiarity	-.06	.06	.00	-.12*	(.86)										
6. Cognitive Ability	-.03	-.08	-.06	-.14*	-.05	(--)									
7. LGO	-.11*	.07	-.08	.02	.20**	-.12*	(.89)								
8. Metacognitive Activity	.21**	.21**	.23**	.17**	-.13*	-.14*	.35**	(.93)							
9. Cognitive Load	.23**	.43**	.17**	.70**	-.21**	-.03	-.04	.21**	(.82)						
10. Declarative knowledge	-.13*	-.04	-.14*	-.13*	-.03	.29**	-.04	-.02	-.16**	(.37)					
11. Procedural Knowledge	-.14*	-.22**	-.15*	-.20**	.04	.20**	-.02	-.03	-.18**	.48**	(.49)				
12. Overall Cognitive Learning	-.15**	-.16**	-.17**	-.19**	.01	.28**	-.03	-.03	-.20**	.82**	.89**	(.61)			
13. Skill-based Procedural	.00	-.48**	.07	-.19**	.00	.14	.03	.01	-.21**	.17*	.21**	.21**	(.92)		
14. Motivation to Learn	-.10	.09	-.07	.02	.14*	-.16**	.81**	.37**	-.01	-.03	-.04	-.03	.01	(.85)	
15. Satisfaction - Enjoyment	.21**	.21**	.24**	.10	-.06	-.14*	.32**	.46**	.15*	-.03	-.01	-.03	.00	.33**	(.90)
16. Satisfaction - Relevance	.20**	.20**	.23**	.14*	-.01	-.13*	.24**	.49**	.17**	-.05	-.08	-.08	.00	.33**	.64**
Mean	.51	.51	3.23	1.53	3.7	.55	3.89	2.83	1.4	.88	.85	.87	9.84	3.78	3.13
SD	.50	.50	1.69	.64	.63	.78	.79	.94	.66	.14	.16	.13	2.37	.71	1.16

Note: For Objective Learner Control, program control was coded as 0 and learner control was coded as 1. For Training Content Complexity, simple was coded as 0 and complex was coded as 1. Reliability estimates are reported on the diagonals.
N = 297 for all correlations except for those with Skill-based Procedural Knowledge (N = 196)

* p < .05   ** p < .01

Although PowerPoint familiarity was expected to relate positively with learning outcomes, the results suggest that self-reported familiarity with PowerPoint was not significantly correlated with performance on the post-course learning measures[8]. Specifically, PowerPoint familiarity was unrelated to declarative knowledge, $r = -.03$, *n.s.* ($r_c = -.05$), procedural knowledge, $r = .04$, *n.s.* ($r_c = .06$), overall cognitive learning, $r = .01$, *n.s.* ($r_c = .02$), and skill-based procedural knowledge, $r = .00$, *n.s.* Thus, the bivariate relationships among PowerPoint familiarity and the learning outcomes indicate that it would not be useful as a covariate in the primary analyses. These results are very similar to those reported by Granger and Levine (2009) and are consistent with research suggesting that trainees are not always accurate assessors of their own knowledge (e.g., Bjork, 1994; Koriat & Bjork, 2005). In general, this finding has interesting implications for granting high levels of control to trainees based on the assumption that trainees *know* what they are already know and/or what they need to know. These implications will be discussed further in the Discussion.

As expected, cognitive ability was positively and significantly related to the learning outcomes. For instance, cognitive ability was significantly correlated with declarative knowledge, $r = .29$, $p < .0001$ ($r_c = .48$), procedural knowledge, $r = .20$, $p < .001$ ($r_c = .29$), overall cognitive learning, $r = .28$, $p < .0001$ ($r_c = .36$), and marginally significantly correlated with skill-based procedural knowledge, $r = .14$, $p = .06$. Interestingly, cognitive ability tended to have negative, albeit relatively weak relationships with the motivational variables and affective outcomes measured.

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[8] Because of the low reliability estimates observed for the declarative and procedural knowledge measures, corrected correlations with these variables are also presented throughout the Results section. In each case, I used Spearman's correction-for-attenuation formula to correct for attenuation in both variables, unless reliability information was not available for the predictor (e.g., cognitive ability).

Specifically, cognitive ability was significantly and negatively related to LGO, $r = -.12$, $p < .05$, motivation to learn, $r = -.16$, $p < .001$, metacognitive strategies, $r = -.14$, $p < .05$, enjoyment, $r = -.14$, $p < .05$, and relevance, $r = -.13$, $p < .05$. Although cognitive ability was measured in order to control for its effects on the learning outcomes, the correlation between cognitive ability and the independent variables was explored as well as the interactions among cognitive ability and the independent variables for predicting learning outcomes, to provide a tests of the appropriateness of treating cognitive ability as a covariate. The latter of these addresses a critical assumption of ANCOVA: the homogeneity of regression slopes (Glass, Peckham, & Sanders, 1972). Results indicated that for all learning outcomes, cognitive ability had a significant interaction with at least one of the independent variables. This suggests that the slopes when regressing the learning outcomes onto cognitive ability for the four groups are not parallel (Glass, et al., 1972)[9]. Thus, I did not treat cognitive ability as a covariate in the subsequent analyses.

As expected, the motivational individual differences measured in this study were moderately to strongly correlated with each other. For example, LGO was positively related to motivation to learn, $r = .81$, $p < .0001$, and metacognitive activity, $r = .35$, $p < .0001$. These motivational individual differences were also quite strongly related to satisfaction, suggesting that trainees higher in LGO and motivation to learn enjoyed the training course and found the material to be more relevant than trainees lower in LGO and motivation to learn. Similarly, there were moderately strong, positive relationships between metacognitive activity and satisfaction, suggesting that trainees who engaged in

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[9] This essentially means that the adjustments made to the groups being compared when controlling for the effects of cognitive ability would not be uniform.

more metacognitive activities enjoyed training more and found the content to be more relevant than trainees who engaged in fewer metacognitive activities.

Cognitive load also had the expected relationships with other variables in the study. For example, cognitive load was strongly related to the content complexity condition, r_{pb} = .43, p < .0001, with which trainees were assigned as well as perceptions of content complexity, r = .70, p < .0001. Cognitive load was also positively and significantly related to the learner control condition, r_{pb} = .23, p < .001 with which trainees were assigned and perceptions of learner control, r = .17, p < .01. Finally, cognitive load was negatively correlated with declarative knowledge, r = -.16, p < .01 (r_c = -.29), procedural knowledge, r = -.18, p < .01 (r_c = -.29), overall cognitive learning, r = -.20, p < .01 (r_c = -.28), and skill-based procedural knowledge, r = -.21, p < .01 suggesting that, on average, trainees who perceived more cognitive load due to the training course acquired less declarative and procedural knowledge than trainees who experienced less cognitive load. Additionally, as would be expected by CLT, trainees reporting more familiarity with PowerPoint perceived less cognitive load, r = -.21, p < .001.

Yet another finding worth noting is the positive relationship between learner control and metacognitive activity. Both objective learner control, r_{pb} = .21, p < .001 and perceptions of learner control, r = .23, p < .001 were positively and significantly related to metacognitive activity. This finding suggests that while program-controlled environments may inhibit a learner's ability to engage in metacognitive or self-regulatory activity due to the constraints of the training environment, learner-controlled environments may be more conducive, as they offer trainees the freedom to engage in

these types of activities. Nevertheless, the bivariate correlations suggest that objective learner control and perceptions of learner control were negatively related to the cognitive learning outcomes.

Additionally, several other important results are shown in Table 1, including the non-significant relations between trainee satisfaction and learning outcomes. While it has been recently argued that trainee satisfaction is an important predictor of learning in learner-controlled, computer-based training (Orvis, et. al., 2009), these results suggest that neither enjoyment nor relevance were correlated with the learning outcomes. For instance, the relationships between enjoyment and declarative knowledge, $r = -.03$, *n.s.* ($r_c = -.05$), procedural knowledge, $r = -.01$, *n.s.* ($r_c = -.02$), overall cognitive learning, $r = -.03$, *n.s.* ($r_c = -.05$), and skill-based procedural knowledge, $r = .001$, *n.s.* were small in magnitude and non-significant. Likewise, the relevance was not significantly related to declarative knowledge, $r = -.05$, *n.s.* ($r_c = -.10$), procedural knowledge, $r = -.08$, *n.s.* ($r_c = -.14$), overall cognitive learning, $r = -.08$, *n.s.* ($r_c = -.13$), or skill-based procedural knowledge, $r = -.002$, *n.s.* Interestingly, however, enjoyment was positively related to the complexity condition, $r_{pb} = .21$, $p < .01$ and the learner control condition, $r_{pb} = .21$, $p < .01$, suggesting that trainees in the complex and LC conditions enjoyed their training experience more than trainees in the simple and PC conditions respectively. Similarly, relevance was positively related to the complexity condition, $r_{pb} = .20$, $p < .01$ and the learner control condition, $r_{pb} = .20$, $p < .01$ suggesting that trainees in the complex and LC conditions found the training course to be more relevant to their education than trainees in the simple and PC conditions respectively. These findings have interesting

implications for the use of post-training learner reactions for justifying the use of learner-controlled e-learning. These implications will be addressed in the Discussion.

Manipulation Checks

To test the effectiveness of the learner control manipulation, an independent samples t-test was conducted, comparing the LC and PC conditions on the participants' perceptions of learner control. Consistent with the results of the pilot, the results suggest that the learner control manipulation was indeed effective, $t(295) = -32.43$, $p < .0001$, such that trainees in the LC condition ($M = 4.70$, $SD = .43$) perceived significantly more control over their learning than trainees in the PC condition ($M = 1.72$, $SD = .43$). I also ran an independent samples t-test to compare the LC and PC conditions on the cognitive load experienced by trainees. As expected, trainees in the LC condition ($M = 1.55$, $SD = .75$) reported experiencing significantly more detrimental cognitive load than trainees in the PC condition ($M = 1.25$, $SD = .52$), $t(295) = -4.02$, $p < .001$. An independent samples t-test was also conducted to test the effectiveness of the complexity manipulation, comparing the complex and simple conditions on the participants' perceptions of the complexity of the training content. Again, consistent with the results of the pilot, the results suggest that the complexity condition was effective, $t(295) = -11.59$, $p < .0001$, such that trainees in the complex condition ($M = 1.88$, $SD = .69$) perceived the training content to be significantly more complex than trainees in the simple condition ($M = 1.16$, $SD = .31$). Additionally, I ran an independent samples t-test to compare the complex and simple conditions on the cognitive load reported by trainees. As expected, trainees in the complex condition ($M = 1.68$, $SD = .75$) reported experiencing significantly more

detrimental cognitive load than trainees in the simple condition (M = 1.12, SD = .39),

$t(295) = -8.09, p < .0001$.

Although participants were randomly assigned to the four conditions, I tested whether there were systematic differences among the experimental groups on the demographic variables measured. ANOVAs were conducted to determine if there were any differences between the conditions on age, cognitive ability and PowerPoint familiarity. Chi-square tests were used to determine differences between the groups on gender and race/ ethnicity. Interestingly, there was a significant difference among the four conditions for age, $F(3, 291) = 3.30, p < .05$. Post hoc analyses[10] were conducted, indicating that the average age of participants in PC-simple ($M = 19.76, SD = 1.64$) condition was significantly lower than that of the LC-simple condition ($M = 21.54, SD = 4.33$). Although the post hoc analyses suggest that there was no significant differences, the average age of participants in the PC-simple condition was also lower than that of the LC-complex ($M = 21.42, SD = 3.76$) and PC-complex ($M = 20.77, SD = 4.65$) conditions. Thus, I considered treating age as a covariate in the subsequent analyses. However, age was significantly correlated with the learner control condition, $r_{bp} = .16, p < .01$ and thus was not included as a covariate due to its significant relationship with an independent variable. There were no significant differences across the conditions on self-reported familiarity with PowerPoint $F(3, 293) = 1.81, n.s.$ or cognitive ability $F(3, 276) = .91, n.s.$

A marginally significant difference was found for race/ ethnicity, $\chi^2 (12, N = 297) = 19.91, p = .07$. A comparison of the racial breakdown of the conditions revealed that the PC-complex condition had a disproportionate number of Asian/ Pacific Islander

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[10] To control for the family-wise type I error rate, a Bonferroni adjustment was applied to all post hoc analyses

participants compared to the other conditions. In addition, the PC-simple condition had fewer Black/ African American participants than the other three conditions. ANOVAs were run for each of the learning outcomes to determine if there were any significant racial/ ethnic differences on the DVs. No significant differences among the group were observed for declarative knowledge, $F(4, 292) = .74$, $n.s.$, procedural knowledge, $F(4, 292) = 1.02$, $n.s.$, or skill-based procedural knowledge, $F(4, 191) = .27$, $n.s.$ Also, there were no significant differences across the conditions regarding the proportion of males and females, $\chi^2 (3, N = 297) = 4.33$, $n.s.$

Finally, of the 297 participants, only 196 participants submitted a completed exercise for the skill-based procedural knowledge measure. Several ANOVAs were conducted to compare participants who completed and failed to complete the skill-based procedural knowledge measures on the demographic variables as well as motivational, satisfaction and other learning measures. No significant or notable differences were found between these groups on any of the relevant variables. Thus, it was determined that there were no systematic differences between trainees who completed the skill-based procedural knowledge exercise and those who chose not to.

Hypothesis Tests

As discussed above, cognitive ability, PowerPoint familiarity, participant age and race/ ethnicity were considered as potential covariates but cognitive ability interacted significantly with the independent variables and the remaining variables were unrelated to learning. Thus, no covariates were used in the subsequent analyses. In addition to the hypotheses regarding (a) declarative, (b) procedural, and (c) skill-based procedural knowledge, each hypothesis was tested for overall cognitive learning. To test hypothesis

1, that training content complexity moderates the relationship between the degree of learner control and (a) declarative knowledge, (b) procedural knowledge, and (c) skill-based procedural knowledge, factorial ANOVAs were conducted for each of the learning outcomes. As shown in Table 2, a significant main effect was observed for learner control such that those in the PC condition ($M = .89$, $SD = .13$) outperformed learners in the LC condition ($M = .86$, $SD = .15$) on the declarative knowledge measure. Moderation of this main effect by complexity was also found, $F(1, 293) = 3.71$, $p = .05$, $\eta_p^2 = .012$ and as illustrated in Figure 2, the interaction between learner control and training content complexity for predicting declarative knowledge acquisition was in the expected direction.

Table 2. ANOVA Results for Declarative Knolwedge

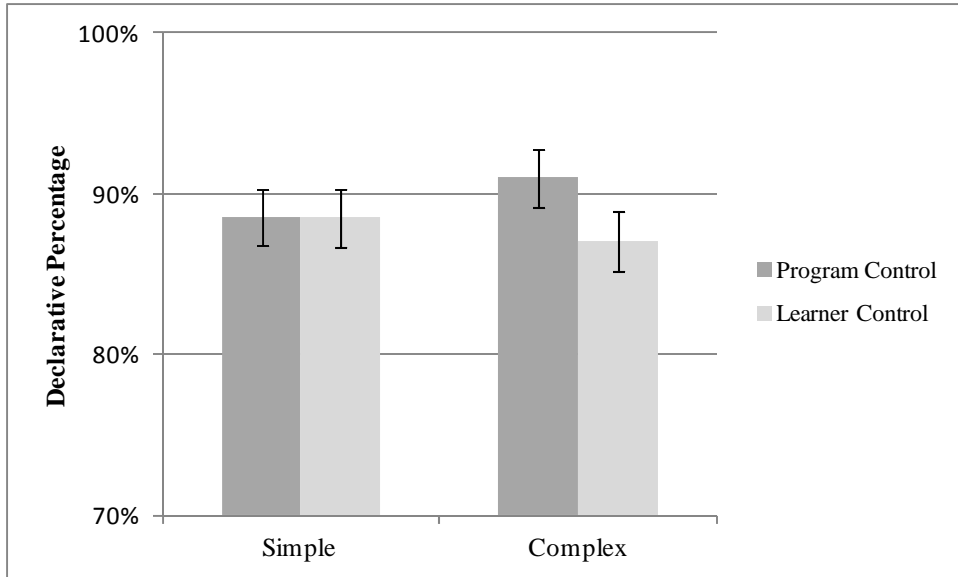|	Sum of Square	df	Mean Square	F	p	η_p^2
Intercept	227.37	1	227.37	11838.57	.00**	.976
Learner Control	.10	1	.10	5.15	.02*	.017
Complexity	.01	1	.01	.64	.43	.002
Learner Control*Complexity	.07	1	.07	3.71	.05+	.012
Error	5.63	293	.02			
Total	233.42	297				

+p < .10   * p < .05   ** p < .01

Figure 2. Interaction between Learner Control and Training Content Complexity for Predicting Declarative Knowledge

Similarly, as shown in Table 3, there were significant main effects for both learner control and complexity, and consistent with hypothesis 1(b) there was a significant interaction between learner control and training content complexity for predicting procedural knowledge acquisition, $F(1, 293) = 12.80, p < .0001, \eta_p^2 = .042$. As illustrated in Figure 3, the interaction was in the expected direction. The main effects revealed again that those in the PC condition ($M = .88, SD = .16$) outperformed learners in the LC condition ($M = .83, SD = .16$) and those in the Simple condition ($M = .89, SD = .16$) outperformed learners in the Complex condition ($M = .82, SD = .15$) on the procedural knowledge measure. Interestingly, according to the effect size estimates, the interaction between learner control and training content complexity appears to account for more variance in procedural knowledge than for declarative knowledge.

Table 3. ANOVA Results for Procedural Knowledge

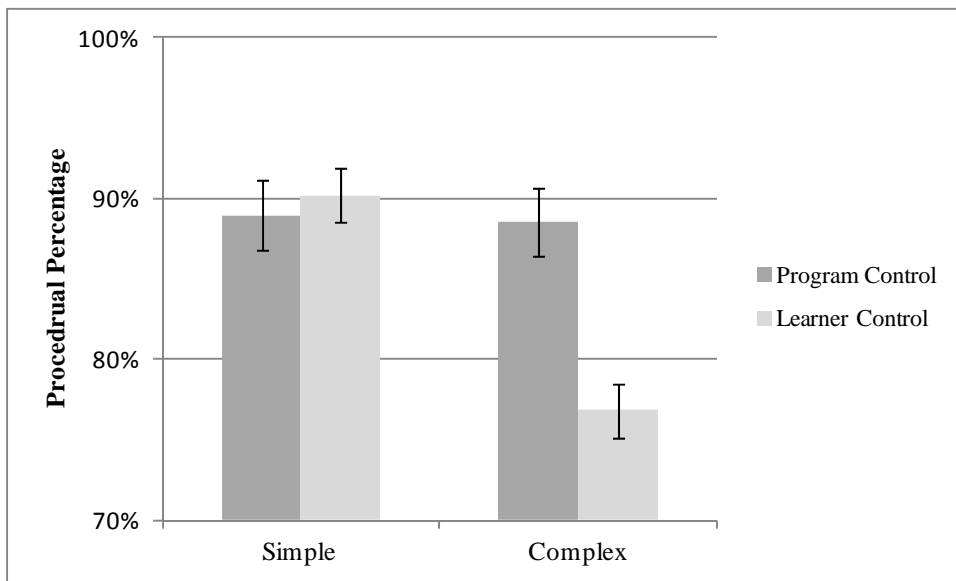|	Sum of Square	df	Mean Square	F	p	η_p^2
Intercept	216.52	1	216.52	9357.50	.00**	.970
Learner Control	.15	1	.15	6.30	.01*	.021
Complexity	.38	1	.38	16.20	.00**	.052
Learner Control*Complexity	.30	1	.30	12.80	.00**	.042
Error	6.78	293	.02			
Total	224.37	297				

* p < .05   ** p < .01

Figure 3. Interaction between Learner Control and Training Content Complexity for Predicting Procedural Knowledge

As shown in Table 4, support was not found for hypothesis 1(c) such that there was a non-significant interaction between learner control and content complexity $F(1, 192) = 1.39$, *n.s.* for predicting skill-based procedural knowledge. Mean differences amongst the conditions on skill-based procedural knowledge are shown in Figure 4. The significant main effect for complexity revealed that those in the Simple condition ($M = 11.08$, $SD = 1.60$) received higher ratings on the skill-based procedural knowledge exercise than learners in the Complex condition ($M = 8.79$, $SD = 2.41$).

Table 4. ANOVA Results for Skill-based Procedural Knowledge

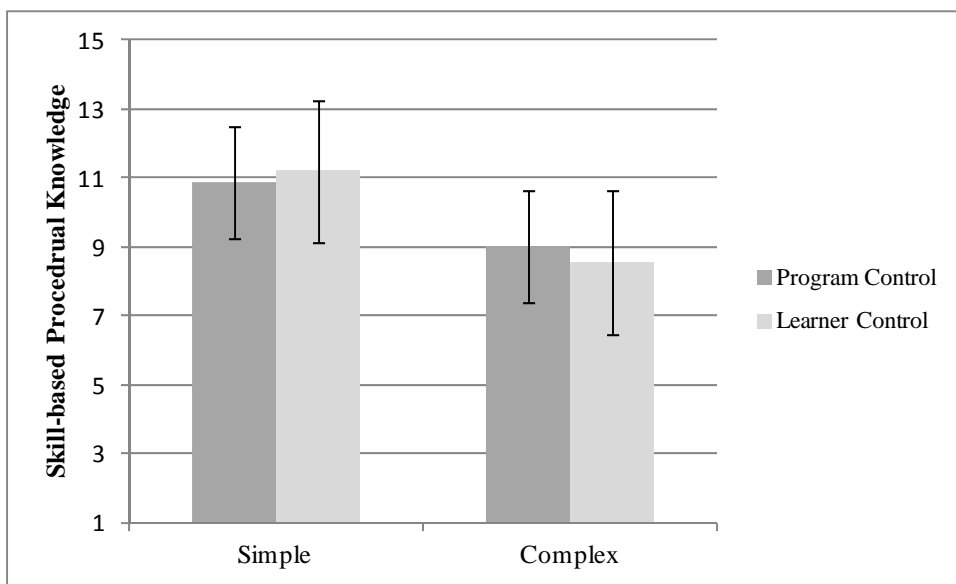|	Sum of Square	df	Mean Square	F	p	η_p^2
Intercept	19189.41	1	19189.41	4428.98	.00**	.958
Learner Control	.06	1	.06	.01	.91	.000
Complexity	257.02	1	257.02	59.32	.00**	.236
Learner Control*Complexity	6.01	1	6.01	1.39	.24	.007
Error	831.88	192	4.33			
Total	20077.00	196				

** p < .01

Figure 4. Interaction between Learner Control and Training Content Complexity for Predicting Skill-based Procedural Knowledge

As mentioned above, the interaction between learner control and content complexity for predicting overall cognitive learning was also tested to offer additional insight into this relationship. As shown in Table 5, a significant main effect was observed for learner control such that those in the PC condition ($M = .88$, $SD = .13$) outperformed learners in the LC condition ($M = .85$, $SD = .13$) on the overall cognitive learning measure. A significant main effect was also observed for complexity such that those in the Simple condition ($M = .89$, $SD = .14$) scored a higher percentage on the post-course

exam on average than those in the Complex condition ($M = .84$, $SD = .12$). Most importantly, a significant interaction between learner control and complexity also observed, $F(1, 293) = 10.80$, $p < .001$, $\eta_p^2 = .036$, and as illustrated in Figure 5, the interaction was in the expected direction. Conditional means and standard deviations for all learning outcomes are included in Table 6. Overall, the results largely support hypothesis 1, with only the results for skill-based procedural knowledge not attaining significance.

Table 5. ANOVA Results for Overall Cognitive Learning

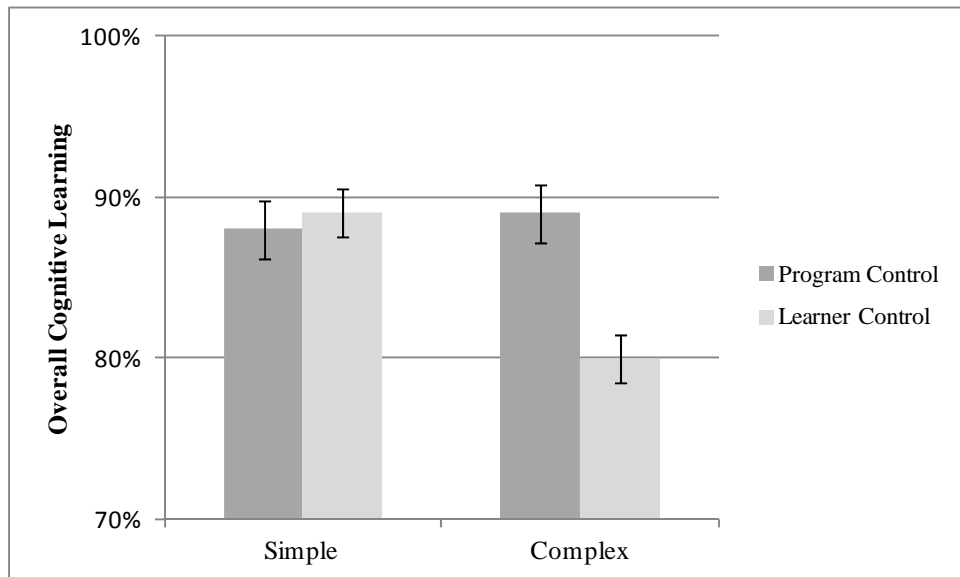|	Sum of Squares	df	Mean Square	F	p	η_p^2
Intercept	222.01	1	222.01	14248.20	.00**	.980
Learner Control	.12	1	.12	7.57	.01*	.025
Complexity	.13	1	.13	8.53	.00**	.028
Learner Control*Complexity	.17	1	.17	10.80	.00**	.036
Error	4.57	293	.02			
Total	227.24	297				

* p < .05   ** p < .01

Figure 5. Interaction between Learner Control and Training Content Complexity for Predicting Overall Cognitive Learning

Table 6. Conditional Means and SDs on the Learning Outcomes

Variable	Simple Condition				Complex Condition			
	LC-Simple		PC-Simple		LC-Complex		PC-Complex	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Declarative Knolwedge	.88	.16	.88	.15	.84	.14	.90	.11
Procedural Knolwedge	.90	.14	.88	.19	.76	.15	.87	.13
Overall Cognitive Learning	.89	.13	.88	.15	.80	.12	.89	.10
Skill-based Procedural Knolwedge	11.28	1.58	10.89	1.60	8.63	2.04	8.95	2.72

Note: Values for Declarative Knowledge, Procedural Knowledge and Overall Cognitive Learning represent percentages of relevant questions answered correctly

Because hypothesis 1(c) was not supported I proceeded to test hypothesis 2 for declarative knowledge, procedural knowledge and overall cognitive learning only. To test hypothesis 2, that the moderated relationship between training content complexity and (a) declarative, (b) procedural knowledge and overall cognitive learning is differentially mediated by cognitive load, I utilized a procedure developed by Preacher, Rucker, and Hays (2007). Preacher et al. (2007) developed an SPSS macro that allows for testing indirect conditional relationships (or moderated mediation). As was done for hypotheses 1, separate tests were conducted for each of the learning outcomes. Cognitive load was mean centered prior to the analyses. As shown in Table 7, although the mediating effect of cognitive load for predicting declarative knowledge acquisition was marginally significant for the complex condition, the interaction between content complexity and cognitive load was not statistically significant. This means that the conditional indirect effects should not be interpreted. Thus, hypothesis 2(a) was not supported.

Table 7. Conditional Indirect Effects for Declarative Knolwedge

Variable	B	SE	t	p
Declarative Knolwedge regressed on Learner Control	-.03	.02	-1.63	.10
Declarative Knowledge regressed on Cognitive Load	-.01	.03	-.35	.73
Declarative Knowledge regressed on Complexity	.00	.02	.02	.98
Declarative Knolwedge regressed on the cross product of Cognitive load and Complexity	-.03	.03	-.82	.41

Level of moderator	Boot indirect effect	Boot *SE*	LL 95% CI	UL 95% CI	Boot *z*	Boot *p*
Conditional indirect effects of cognitive load at levels of moderator						
Simple	-.004	.01	-.01	.01	-.41	.68
Complex	-.012	.01	-.02	-.01	-1.84	.07[+]

Note: N = 279. LL - Lower Limit; UL = Upper Limit; CI = Confidence Interval. Unstandardized regression coefficients are reported. Bootstrap sample = 5000

[+]$p < .10$

As shown in Table 8, a significant interaction between content complexity and cognitive load was observed ($\beta = -.08$, $t = -2.23$, $p < .05$). Moreover, the mediating effect of cognitive load for predicting procedural knowledge acquisition was marginally significant for both the simple and complex conditions. Despite the marginally significant indirect effects, according to Preacher et al.'s (2007) recommendations, the indirect effects can be interpreted because the confidence intervals for the indirect effect at both levels of the moderator do not include zero. Interestingly, the mediating effect of cognitive load was in the opposite direction for the complexity conditions. This suggests that the increased cognitive load induced by the complex condition led to decreased procedural learning for trainees in the complex condition as expected, while the cognitive load induced in the simple conditions appears to have had a positive impact on procedural learning.

Table 8: Conditional Indirect Effects for Procedural Knolwedge

Variable	B	SE	t	p
Procedural Knolwedge regressed on Learner Control	-.04	.02	-2.21	.03*
Procedural Knowledge regressed on Cognitive Load	.05	.03	1.49	.14
Procedural Knowledge regressed on Complexity	-.08	.02	-3.66	.00**
Procedural Knolwedge regressed on the cross product of Cognitive load and Complexity	-.08	.04	-2.23	.03*

Level of moderator	Boot indirect effect	Boot SE	LL 95% CI	UL 95% CI	Boot z	Boot p
Conditional indirect effects of cognitive load at levels of moderator						
Simple	.02	.01	.01	.03	1.72	.09[+]
Complex	-.01	.01	-.02	-.004	-1.66	.09[+]

Note: N = 279. LL - Lower Limit; UL = Upper Limit; CI = Confidence Interval. Unstandardized regression coefficients are reported. Bootstrap sample = 5000

[+] $p < .10$ * $p < .05$ ** $p < .01$

As a final test of hypothesis 2, I applied the same analytical approach, treating overall cognitive learning as the outcome variable. As shown in Table 9, a significant interaction between content complexity and cognitive load was observed ($\beta = -.06$, $t = -1.99$, $p < .05$). Moreover, the mediating effect of cognitive load for predicting overall cognitive learning was significant for the complex condition only. Similar to the results for procedural knowledge, the mediating effect of cognitive load suggests that the increased cognitive load induced by the complex condition led to impaired cognitive learning. Overall, some support was found for hypothesis 2, specifically for procedural knowledge and overall cognitive learning.

Table 9: Conditional Indirect Effects for Overall Cognitive Learning

Variable	B	SE	t	p
Cognitive Learning regressed on Learner Control	-.04	.02	-2.23	.03*
Cognitive Learning regressed on Cognitive Load	.02	.03	.81	.42
Cognitive Learning regressed on Complexity	-.04	.02	-2.29	.02*
Cognitive Learning regressed on the cross product of Cognitive load and Complexity	-.06	.03	-1.99	.04*

Level of moderator	Boot indirect effect	Boot SE	LL 95% CI	UL 95% CI	Boot z	Boot p
Conditional indirect effects of cognitive load at levels of moderator						
Simple	.01	.01	.00	.02	1.01	.31
Complex	-.01	.01	-.02	-.01	-1.98	.04*

Note: N = 279. LL - Lower Limit; UL = Upper Limit; CI = Confidence Interval. Unstandardized regression coefficients are reported. Bootstrap sample = 5000

* $p < .05$

Finally, although hypothesis 1(c) was not supported, a large main effect for the complexity condition was observed, such that learners in the Simple condition significantly outperformed those in the Complex condition on the skill-based procedural knowledge exercise. Thus, I tested whether cognitive load mediates the relationship between content complexity and skill-based procedural knowledge. To test this, I utilized the steps outlined by Preacher and Hays (2004) for testing simple mediation models. As shown in Table 10, cognitive load did not mediate the relationship between training content complexity and skill-based procedural knowledge. The most likely explanation for this main effect is that because the Simple and Complex conditions differed substantially in the PowerPoint operations covered, raters of the skill-based procedural knowledge exercises considered participants' use of different operations when rating their exercises.

Table 10. Simple Mediation for Skill-based Procedural Knolwedge as Dependent Variable

Variable	B	SE	t	p
Cognitive Load regressed on Complexity (a path)	.47	.09	5.12	.00**
Skill-based Procedural regressed on Cognitive Load (b path)	-.16	.23	-.70	.48
Skill-based Procedural regressed on Complexity (c path)	-2.29	.30	-7.67	.00**

	Value	SE	LL 95% CI	UL 95% CI	z	p
		Indirect effect and significance test				
Sobel	-.08	.11	-.19	.03	-.70	.49
	M	SE	LL 95% CI	UL 95% CI		
		Bootstrap results for indirect effect				
Effect	-.08	.13	-.21	.05		

Note: N = 297. LL - Lower Limit; UL = Upper Limit; CI = Confidence Interval. Unstandardized regression coefficients are reported. Bootstrap sample = 5000
** $p < .01$

To test hypothesis 3, that there is a three-way interaction between learner control, content complexity and LGO, such that learners high in LGO will outperform learners low in LGO in the LC-complex condition, but less so in the PC conditions, I utilized the PROC GLM Univariate procedure in SPSS. The two manipulated variables, learner

control and content complexity, were entered as fixed factors. LGO was mean centered

prior to analysis and was entered as a covariate in the model. Main effect, two-way and

three-way interaction terms among learner control, content complexity and LGO were

also entered into the model. Separate analyses were run for (a) declarative, (b) procedural

knowledge and overall cognitive learning. In support of hypothesis 3(a) and as shown in

Table 11, there was a significant three-way interaction between learner control, content

complexity and LGO for predicting declarative knowledge, $F(1, 289) = 5.02$, $p < .05$, η_p^2

$= .017$. Utilizing procedures outlined by Aiken and West (1991), the interaction between

content complexity and LGO for each learner control condition was plotted to examine

the nature of the three way interaction. As recommended by Cohen and Cohen (1983),

values of LGO are plotted at +/-1 SDs from the mean. As illustrated in Figure 6, LGO

appears to positively predict declarative knolwedge, but only for learners in the LC-

complex condition. The slopes for the remaining conditions appear to be flat to slightly

negative. Additionally, I used procedures outlined by Preacher, Curran and Bauer (2006)

to investigate the simple slopes for each group. Results of these simple slope analyses

indicate that none of the slopes differed significantly from 0. Nevertheless, I considered

the possibility that the regression slopes for the conditions differ significantly from one

another. To test this, I used an application developed by Dawson and Richter (2006).

Results of this analysis suggest that the regression slope for the LC-complex condition,

when regressing declarative knowledge on LGO, was marginally significantly different

from the slope for the LC-simple condition, $t = 1.76$, $p = .08$, but the regression slope for

the LC-complex condition was not significantly different from the slopes of the PC

conditions.

Table 11. Three Way Interaction Results for Declarative Knowledge

	Sum of Squares	df	Mean Square	F	p	η_p^2
Intercept	218.12	1	218.12	11693.79	.00**	.976
Learner Control	.14	1	.14	7.74	.01*	.026
Complexity	.01	1	.01	.55	.46	.002
LGO	.01	1	.01	.38	.54	.001
Learner Control*Complexity	.06	1	.06	2.95	.08[+]	.010
Learner Control*LGO	.05	1	.05	2.69	.10	.009
Complexity*LGO	.08	1	.08	4.17	.04*	.014
Learner Control*Complexity*LGO	.09	1	.09	5.02	.03*	.017
Error	5.39	289	.02			
Total	233.42	297				

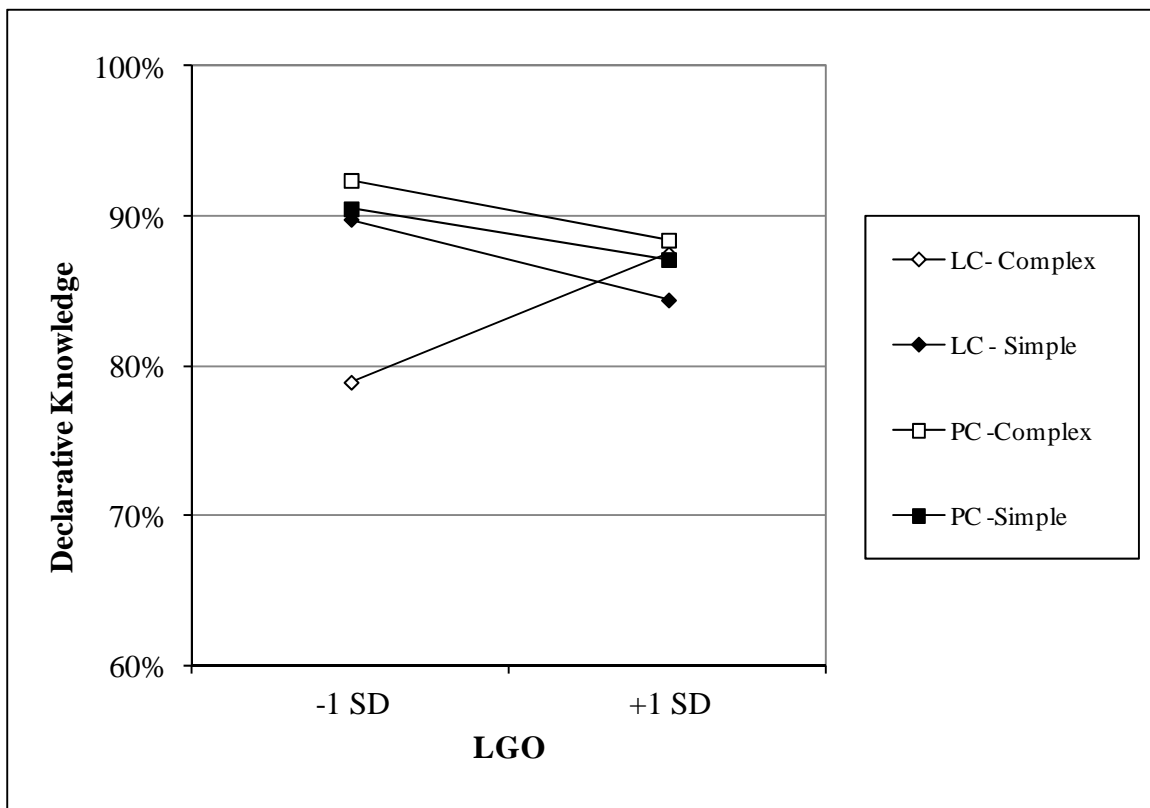[+]$p < .10$ * $p < .05$ ** $p < .01$

Figure 6. Interaction between Learner Control, Training Content Complexity and LGO for Predicting Declarative Knowledge

Despite finding a significant three-way interaction for declarative knowledge, a non-significant three-way interaction was observed for procedural knowledge, $F(1, 289) = 1.74$, *n.s.* As shown in Table 12, the three-way interaction among learner control,

content complexity and LGO does not predict procedural knowledge above and beyond

the main effects and two-way interactions.

Table 12. Three Way Interaction Results for Procedural Knowledge

	Sum of Squares	df	Mean Square	F	p	$\overline{\eta_p^2}$
Intercept	207.79	1	207.79	8916.92	.00**	.969
Learner Control	.14	1	.14	5.98	.02*	.020
Complexity	.33	1	.33	14.20	.00**	.047
LGO	.00	1	.00	.10	.75	.000
Learner Control*Complexity	.30	1	.30	12.83	.00**	.043
Learner Control*LGO	.00	1	.00	.07	.79	.000
Complexity*LGO	.00	1	.00	.19	.67	.001
Learner Control*Complexity*LGO	.04	1	.04	1.74	.19	.006
Error	6.74	289	.02			
Total	224.37	297				

* $p < .05$ ** $p < .01$

Similar to the results for declarative knowledge knowledge and as shown in Table

13, there was a significant three-way interaction between learner control, content

complexity and LGO for predicting overall cognitive learning, $F(1, 289) = 4.28$, $p < .05$,

$\eta_p^2 = .015$. Again, I utlized procedures outlines by Aiken and West (199) to plot the three

way interaction. As illustrated in Figure 7, the pattern of results looks very similar to that

of declarative knowledge. That is, LGO appears to positively predict cognitive learning,

but only for learners in the LC-complex condition. Again, I used procedures outlined by

Preacher et al., (2006) to investigate the simple slopes for each group. Results of these

simple slope analyses indicate that none of the slopes differed significantly from 0.

Additionally, the slope for the LC-complex condition did not differ signitncaly from the

regression slope for any other condition. Thus, partial support was found for hypothesis

3, and the interactions suggest that LGO may matter most by facilitating cognitive

learning in complex, learner-controlled environments.

Table 13. Three Way Interaction Results for Overall Cognitive Learning

	Sum of Square	df	Mean Square	F	p	η_p^2
Intercept	212.96	1	212.96	13746.26	.00**	.979
Learner Control	.14	1	.14	8.80	.00**	.03
Complexity	.12	1	.12	7.51	.01*	.025
LGO	.00	1	.00	.00	.96	.000
Learner Control*Complexity	.16	1	.16	10.22	.00**	.034
Learner Control*LGO	.01	1	.01	.50	.48	.002
Complexity*LGO	.01	1	.01	.59	.44	.002
Learner Control*Complexity*LGO	.07	1	.07	4.28	.04*	.015
Error	4.48	289	.02			
Total	227.24	297				

$* \ p < .05 \quad ** \ p < .01$
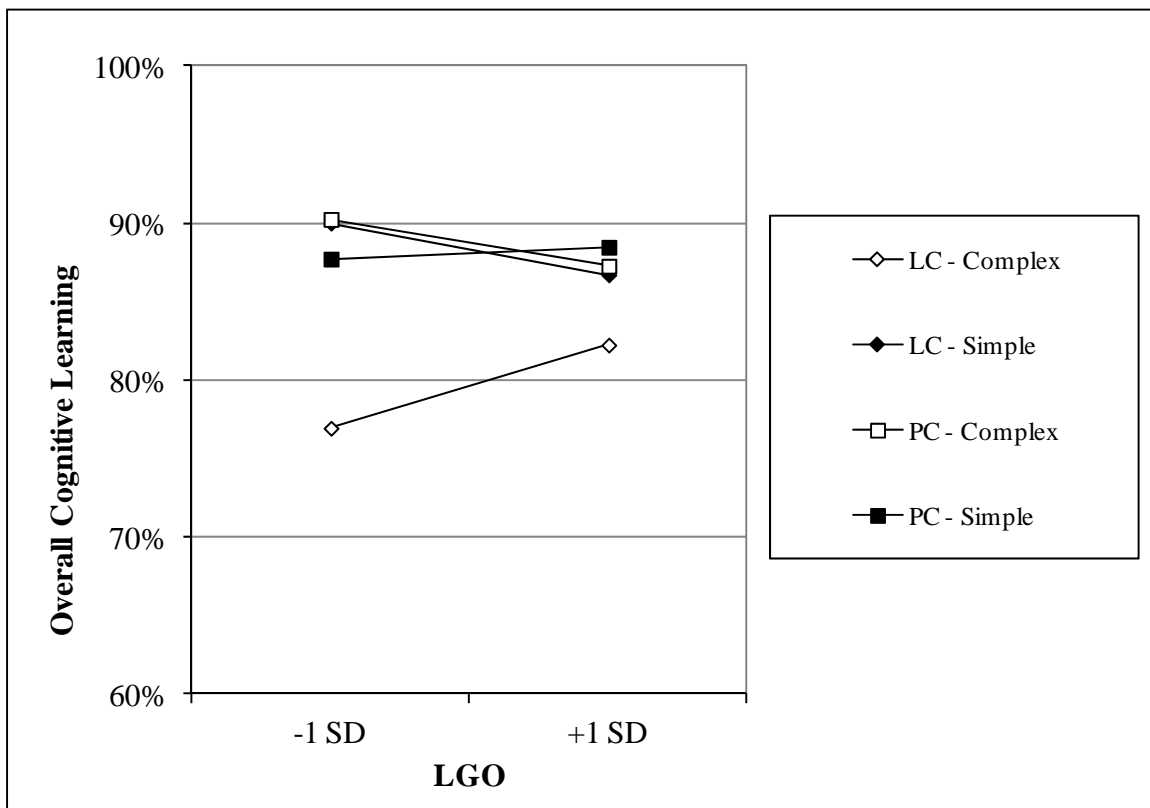
Figure 7. Interaction between Learner Control, Training Content Complexity and LGO for Predicting Overall Cognitive Learning

Finally, because the importance of LGO for predicting learning in the complex, learner-controlled condition is of particular interest in this study, I explored the correlation between LGO and the learning outcomes when selecting only trainees in the LC-complex condition. Results revealed that LGO was positively and signficantly related

to declarative knowledge, $r = .32$, $p < .01$ ($r_c = .56$) and overall cognitive learning, $r = .23$, $p < .05$ ($r_c = .31$), but not significantly related to procedural knowledge, $r = .06$, *n.s.* ($r_c = .09$), or skill-based procedural knowledge, $r = .05$, *n.s.*

Because hypothesis 3(b) and 3(c) were not supported I proceeded to test hypothesis 4 only for declarative knowledge and overall cognitive learning. To test hypotheses 4(a), that metacognition mediates the relationship between LGO and declarative knowledge and overall cognitive learning such that high LGO learners engage in more metacognitive activity during training than low LGO learners, I used the steps outlined by Preacher and Hays (2004) who developed an SPSS macro designed to test simple mediation models. As shown in Tables 14 and 15, metacognitive activity did not mediate the relationship between LGO and either declarative knowledge or overall cognitive learning. While this finding is somewhat surprising given the extant research in support of this relationship, I considered the possibility that the PC condition repressed the expression of LGO and metacognition. Thus, I used the same simple mediation procedure for trainees in the LC condition only. However, the results suggest that even for trainees in the LC conditions, metacognitive activity did not mediate the relationship between LGO and declarative or cognitive learning. Overall, hypothesis 4 was not supported.

Table 14. Simple Mediation for Declarative Knolwedge as Dependent Variable

Variable		B	SE	t	p
Metacognitive Activity regressed on LGO (a path)		.42	.07	6.50	.00**
Declarative Knowledge regressed on Metacognitive Activity (b path)		-.002	.01	-.17	.86
Declarative Knowledge regressed on LGO (c path)		-.01	.01	-.63	.53
	Value	SE	LL 95% CI	UL 95% CI	z	p
Indirect effect and significance test						
Sobel	-.001	.004	-.005	.003	-.17	.86
	M	SE	LL 95% CI	UL 95% CI		
Bootstrap results for indirect effect						
Effect	-.001	.004	-.004	.003		

Note: N = 297. LL - Lower Limit; UL = Upper Limit; CI = Confidence Interval. Unstandardized regression coefficients are reported.
Bootstrap sample = 5000
** $p < .01$

Table 15. Simple Mediation for Overall Cognitive Learning as Dependent Variable

Variable		B	SE	t	p
Metacognitive Activity regressed on LGO (a path)		.42	.07	6.50	.00**
Cognitive Learning regressed on Metacognitive Activity (b path)		-.004	.01	-.43	.69
Cognitive Learning regressed on LGO (c path)		-.004	.01	-.45	.65
	Value	SE	LL 95% CI	UL 95% CI	z	p
Indirect effect and significance test						
Sobel	-.002	.004	-.006	.002	-.43	.67
	M	SE	LL 95% CI	UL 95% CI		
Bootstrap results for indirect effect						
Effect	-.002	.004	-.006	.002		

Note: N = 297. LL - Lower Limit; UL = Upper Limit; CI = Confidence Interval. Unstandardized regression coefficients are reported.
Bootstrap sample = 5000
** $p < .01$

Additional Analyses

In addition to testing the formal hypotheses presented in this paper, there were several opportunities to explore important research questions that are resurging in the e-learning and learner control literatures. For instance, recent work by Brown (2005) and Karin Orvis and her colleagues (e.g., Fisher, et al, 2010; Orvis, et al., 2009) suggests that trainee satisfaction should be more strongly (and positively) related to learning in learner-controlled environments (v. program-controlled environments). However, the results of this study suggest that trainee satisfaction (both enjoyment and relevance) is not

necessarily positively related to learning. Across the conditions, enjoyment showed non-significant relationships with declarative, $r = -.03$, $n.s.$ ($r_c = -.03$) and procedural knowledge gain, $r = -.01$, $n.s.$ ($r_c = -.02$) as well as skill-based procedural knowledge ($r = .00$, $n.s.$). Likewise, relevance showed non-significant relationships with declarative, $r = -.05$, $n.s.$ ($r_c = -.10$) and procedural knowledge gain, $r = -.08$, $n.s.$ ($r_c = -.14$) and skill-based procedural knowledge ($r = .00$, $n.s.$). More interestingly, the interaction between learner control and the satisfaction components was explored. To directly test Brown (2005) and Orvis et al.'s (2009) prediction that trainee satisfaction is more strongly related to learning in learner-controlled environments (v. program-controlled environments), I conducted multiple regression analyses for all learning outcomes. The interactions between enjoyment and learner control and relevance and learner control were explored separately for each DV. Continuous variables were mean-centered prior to analysis. Main effects for learner control and the satisfaction component and the interaction term between the variables were entered in the model. All interactions were plotted using the procedures outlined by Aiken and West (1991). For declarative knowledge there was a non-significant interaction between learner control and learner enjoyment for predicting declarative knowledge, $F(1, 293) = 1.62$, $n.s.$ As would be predicted by Orvis and colleagues, the relationship between enjoyment and the learning outcomes should be more positive for the LC condition. As is shown in Figure 8, this was not the case.
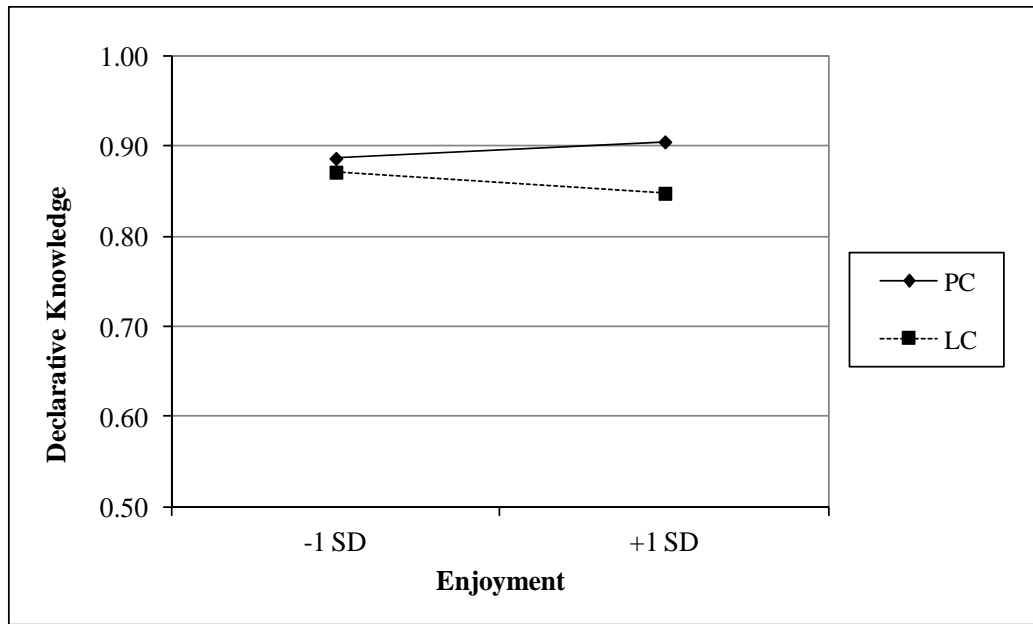
Figure 8. Interaction between Learner Control and Enjoyment for Predicting Declarative Knowledge

Similarly, the interaction between learner control and relevance was explored. Results revealed a significant interaction between learner control and relevance for predicting declarative knowledge, $F(1, 293) = 7.33$, $p < .01$, $\eta_p^2 = .02$. However, when the interaction was plotted (see Figure 9), the results run contrary to Brown (2005) and Orvis et al.'s (2009) prediction. That is, while there appears to be no meaningful relationship between perceptions of relevance and declarative knowledge in the PC condition, the relationship between relevance and declarative knowledge was actually negative in the LC condition.
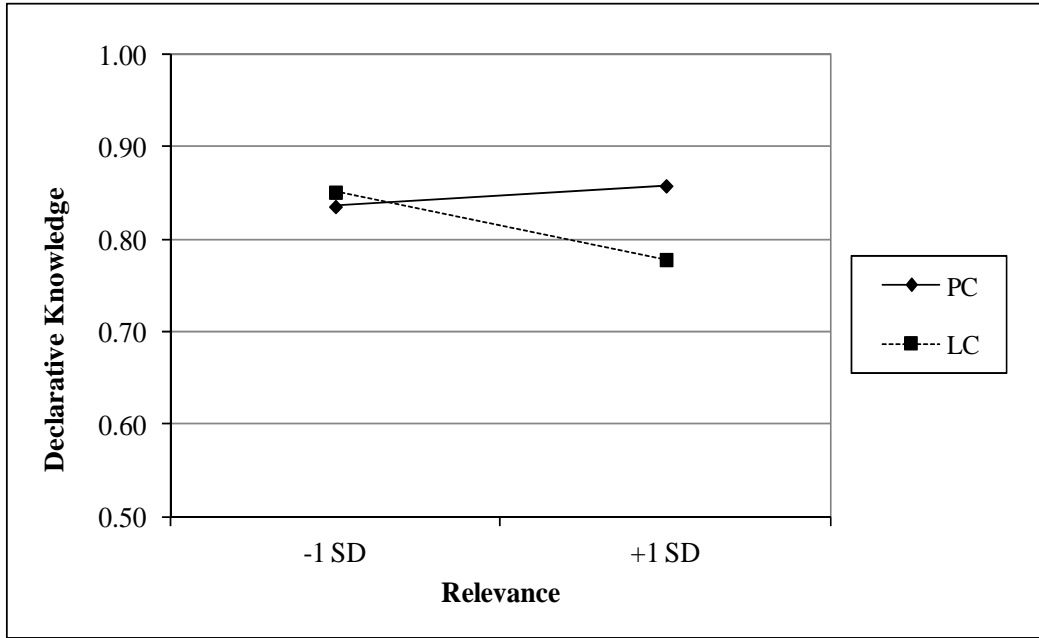
Figure 9. Interaction between Learner Control and Relevance for Predicting Declarative Knowledge

Similar to the results for declarative knowledge, while there was a significant interaction between learner control and enjoyment for predicting procedural knowledge, $F(1, 293) = 4.97$, $p < .05$, $\eta_p^2 = .02$, the interaction was not in the predicted direction (see Figure 10). Brown (2005) and Orvis, et al.'s (2009) prediction that satisfaction is more positively and strongly related to learning outcomes was not supported. Likewise, a significant interaction between learner control and relevance was observed for predicting procedural knowledge was observed, $F(1, 293) = 4.00$, $p < .05$, $\eta_p^2 = .013$, but the nature of the interaction suggests that perceptions of relevance are actually negatively related to procedural knowledge for trainees in the LC condition (see Figure 11). Non-significant interactions were observed between enjoyment and learner control, $F(1, 192) = .14$, $n.s.$, and relevance and learner control, $F(1, 192) = .42$, $n.s.$, for predicting skill-based procedural knolwedge.
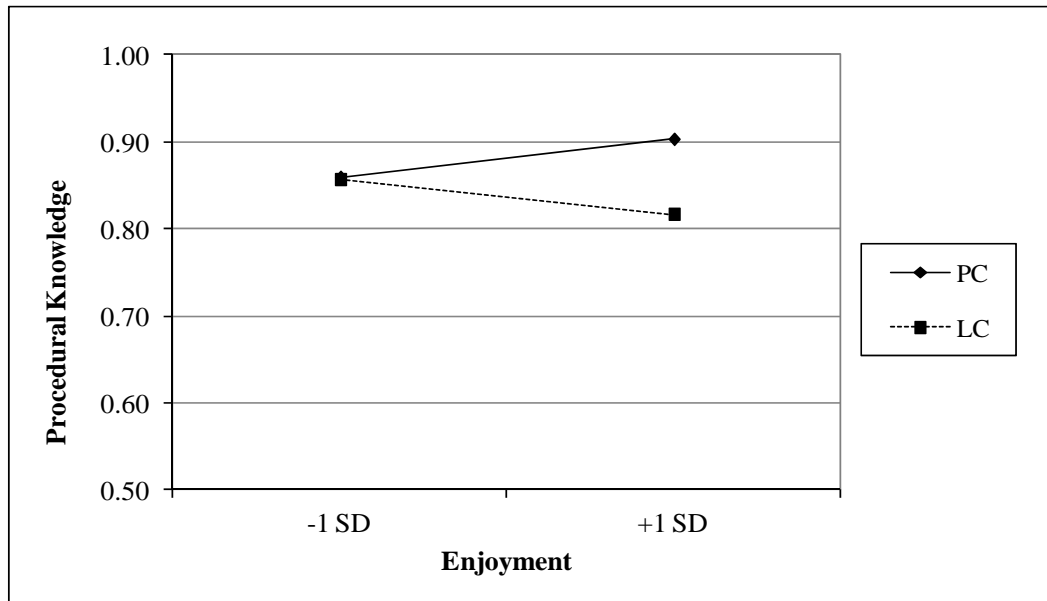
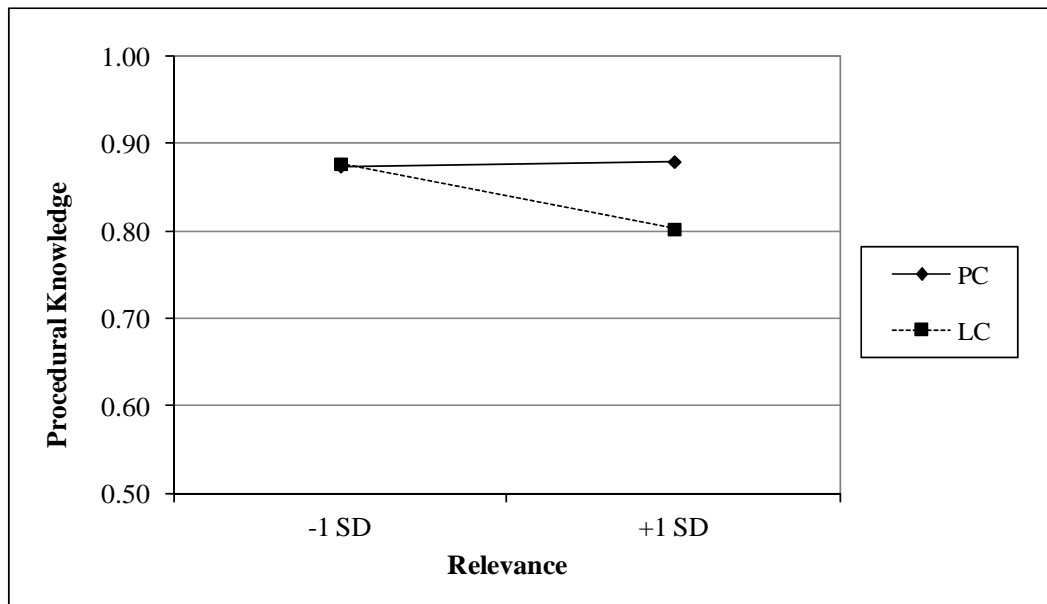Figure 10. Interaction between Learner Control and Enjoyment for Predicting Procedural Knowledge

Figure 11. Interaction between Learner Control and Relevance for Predicting Procedural Knowledge

Additionally, I conducted simple comparisons of the LC and PC conditions on the affective, cognitive and behavioral outcomes. The results of independent samples t-tests,

comparing the LC and PC conditions on several outcome variables, suggests that overall, trainees in the LC condition enjoyed and found the content to be more relevant to their education than trainees in the PC condition ($t(295) = -3.77$, $p < .0001$. for enjoyment and $t(295) = -3.47$, $p < .001$ for relevance). Despite these more positive affective reactions to the LC condition, trainees in the PC condition actually showed better scores on the cognitive learning measures[11]. Specifically, and as shown above, trainees in the PC condition outperformed trainees in the LC condition on both the declarative, $t(295) = 2.26$, $p < .05$, and procedural knowledge, $t(295) = 2.35$, $p < .05$, measures. However, there was a non-significant difference between trainees in the LC and PC conditions for skill-based procedural knowledge, $t(194) = .01$, *n.s.* Taken together, these results suggest that trainee satisfaction is not necessarily a reliable or positive predictor of learning, even in learner controlled training environments.

It has also been argued in the e-learning literature that learner control allows for (cognitively) active learning (Mayer, 2008) which is expected to be beneficial to learning. For example, trainees in learner-controlled training environments are free to learn at their own pace and engage in metacognitive activities that they may not have had the opportunity to engage in during program-controlled training due to the constraints of these environments. Simply stated, learner control opens the door for metacognition and self-regulation. To explore this research question, an independent samples t-test was conducted, comparing the learner control conditions on metacognitive activity. As expected, trainees in the LC condition reported engaging in more metacognitive activities

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[11] It should be noted that this main effect is largely driven by the interaction between learner control and training content complexity. In other words, the difference between trainees in the LC and PC conditions is due primarily to the fact that trainees in the LC-complex condition suffered the most in terms of the learning of the training material.

than trainees in the PC condition, $t(295) = -3.60$, $p < .0001$. Although the results of hypothesis 4 suggests that metacognitive activity did not mediate the relationship between LGO and learning outcomes, and the presumptive increased metacognitive activity did not mirror the amount of learning, where PC conditions were superior on declarative and procedural knowledge measures, the well established relationship between metacognitive activity leads to optimism about the role of metacognition/ self-regulation in e-learning environments. The implications of these additional findings are discussed below.

Discussion

This dissertation adds to the e-learning and learner control literatures in several important ways. First and foremost, this study builds on the seminal work of Granger and Levine (2009) by exploring the interactive relationship between learner control and training content complexity for predicting multiple cognitive and behavioral learning outcomes. Unlike Granger and Levine (2009), the manipulation of learner control did not confound learner control with the presence (absence) of an instructor, which is known to influence trainees' affective reactions (Sitzmann, et al., 2008) and potentially other variables that may predict learning (e.g., self-regulatory activity, metacognition). Thus, this study provides a more robust test of the interaction between learner control and training content complexity in e-learning. This study also found that cognitive load mediates this complex relationship suggesting that complex, learner controlled environments are detrimental to cognitive learning, at least partially, because they place a high level of cognitive load onto trainees, which consumes important cognitive resources during training. Additionally, this study answers Granger and Levine's (2010) call for research on individual differences that may help learners cope with the heavier cognitive demands that complex, learner-controlled training environments place on learners. Moreover, the mechanism through which these individual differences influence learning was explored (i.e., metacognitive activity). Finally, this dissertation addressed several resurging issues in the e-learning literature such as the relative importance of trainee satisfaction for predicting learning outcomes in learner- and program-controlled

environments (e.g., Orvis, et al., 2009) and the isolation of specific components of learner control (e.g., Karim & Behrend, 2012; Kraiger & Jerden, 2007).

Summary of Findings

As noted above, the first and arguably most important contribution of this study is the replication of Granger and Levine's (2009) findings regarding training content complexity. To date, e-learning research has been heavily focused on design characteristics and individual differences that predict affective and cognitive outcomes. Much less attention has been paid to characteristics of the training content itself. The results of this dissertation are consistent with Granger and Levine's conclusion that the complexity of the content being trained is an important intervening variable in the learner control-learning relationship. While there does not appear to be any meaningful difference, in terms of learning, between learner- and program-controlled e-learning for the training of relatively simple content, learners who are placed in complex learner-controlled environments show poorer cognitive learning outcomes than learners in complex, program-controlled environments. This study, however, did not replicate this interaction for skill-based procedural knowledge. While the general pattern of group means for skill-based procedural knowledge is supportive of the hypotheses in this study, and consistent with the findings of Granger and Levine (2009), the group means did not differ significantly from one another. It is possible that the task required to assess skill-based procedural knowledge was insufficiently sensitive to capture the differences among trainees.

While Granger and Levine (2009) found limited support for time-on-task as a mediator, this study identified cognitive load as a potential mediator of the moderated

relationship between learner control and training content complexity for predicting procedural and overall cognitive learning. The results of this study suggest that complex, learner-controlled training environments require greater cognitive resources and introduce a greater level of intrinsic and extraneous cognitive load onto the average learner. This increased (detrimental) cognitive load consumes trainees' valuable mental resources throughout training and thus leads to decreased cognitive learning outcomes in complex environments. Despite these unfavorable findings for complex, learner-controlled training environments, the results also suggest that increased cognitive load actually aids in procedural learning in simple conditions. It is possible that trainees who perceived the simple course to be very easy became disengaged and/or skipped over training content that ultimately inhibited their learning. In addition, these findings suggest that instructional features designed to reduce the complexity of intrinsically complex content or (perhaps more realistically) reduce the extraneous cognitive load introduced to learners via complex, learner-controlled e-learning, may help ameliorate these issues (Krischner, 2002; Mayer, 2008).

This study also investigated LGO as a potentially important individual difference variable that may help trainees overcome the high cognitive demands introduced by complex, learner-controlled environments. While the three way interaction between learner control, content complexity and LGO did not predict procedural learning above and beyond the main effects and two-way interactions, there was a significant three-way interaction for predicting declarative knowledge and overall cognitive learning. Specifically, the predicted means suggest that a high LGO facilitates cognitive learning in complex, learner-controlled environments relative to less demanding training

environments. Indeed, LGO was found to be a strong predictor of declarative learning for trainees in the LC-complex condition. This suggests that high LGO learners acquire more knowledge than low LGO learner in complex, learner-controlled environments.

Finally, metacognitive activity was explored as a mediator to explain why high LGO learners are able to more effectively learn, especially in complex, learner-controlled environments. Despite research is support of this mediated relationship (Schmidt & Ford, 2003), no evidence for this was found, even when the relationship was tested for only trainees in the LC-complex condition, where the constraints of the PC condition were not present and the expression of motivational individual differences is more likely. While high LGO learners acquired more declarative knowledge than low LGO learners in the complex, learner-controlled condition, self-reported metacognitive activity does not mediate this relationship. It has been surmised that self reports measures of metacognitive activity may not actually reflect the degree to which trainees use metacognitive strategies. While the measure used here showed very strong internal consistency, it may be overly presumptive to assume that undergraduates, especially those not trained, or primed to engage in one or more of these strategies, could recognize that they were doing so.

Summary of Additional Findings

This design of this study allowed for the exploration of a resurging issue in the training literature: the relative importance of trainee satisfaction for predicting cognitive and behavioral learning outcomes. Despite the large volume of research suggesting that trainee satisfaction (or at least enjoyment) and learning outcomes are weakly related (Alliger, et al., 1997; Colquitt et al., 2000; Sitzmann et al., 2008), Brown (2005) and Orvis et al. (2009) have recently argued that trainee satisfaction may play a more

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important role for predicting learning when trainees are in learner-controlled v. program-controlled environments. Although their reasoning suggests that trainee satisfaction leads learners to be more engaged in the learning process and thus is a stronger predictor in learner-controlled environments due to the greater discretion afforded to learners in these environments, the results of this study do not support these expectations. In fact, the results of this dissertation echo the findings of past research (e.g., Alliger, et al., 1997; Colquitt et al., 2000) that suggest that trainee affective reactions are not reliable (or necessarily positive) predictors of learning outcomes.

Implications and Future Research

While learner control is often touted as a key advantage of e-learning (Kinzie & Sullivan, 1986) and often goes hand-in-hand with it (Granger & Levine, 2010), the results of this study clearly suggest that learner control can be divorced from e-learning and in complex training environments, doing so may actually be beneficial to learning. Adopting learner-controlled e-learning without consideration of the potential complexity of the content to trainees may lead to decreased learning and perhaps ultimately lower levels of transfer of training. On the other hand, when the content of training is relatively simple (e.g., annual refresher training on content that employees are very familiar with, training with few interconnected pieces of novel information), presenting training material via learner-controlled e-learning can be just as effective and perhaps more efficient than program-controlled e-learning.

While this study focused on detrimental (intrinsic and extraneous) cognitive load, it has been argued in the CLT literature that germane cognitive load (or generative processing) actually leads to enhanced learning outcomes. This is quite similar to the

findings in some of the training literature in support of self-regulatory and self-evaluative prompting (Sitzmann et al., 2009; Sitzmann & Ely, 2010). When learners engage in these types of activities (e.g., goal setting, self-testing) they are contributing to their learning of the training material. Interestingly, although learner-controlled environments do appear to 'open the door' to metacognitive activity, it is clear that not all trainees are willing/ able to engage in these deeper strategies (Brown, 2001) without prompting. As suggested by Granger and Levine (2010), research should explore self-regulatory prompting and other training design features/ techniques that may increase germane cognitive load as these interventions may help trainees in learner-controlled environments better handle the high degree of cognitive load induced. And while metacognitive activity was measured as an individual difference with a self-report scale in this study, there appear to be limitations to measuring it as such (Whitebread, et al., 2009). One important area of future research is to determine the relative effectiveness of self-regulatory prompting or other similar design features that are employed in relatively simple v. highly complex e-learning environments. Other interventions that work to reduce the intrinsic and extraneous cognitive load experienced by learners should also be explored in the research. In practice, for example, if the training content is expected to be novel to most trainees, providing trainees with preparatory materials (e.g., outlines, flow charts) may assist trainees in building mental models of the processes or operations during training. Another potential avenue to avoid negative learning outcomes in high learner control conditions might be to intersperse quizzes to test mastery of training segments, and require that trainees review tested material when they answer incorrectly. This could help trainees

avoid the error of assuming mastery when it has not been achieved (e.g., Bjork, 1994; Granger & Levine, 2010).

From an individual difference perspective, the results of this study suggest that high LGO learners are able to acquire more declarative knowledge than low LGO learners in complex, learner-controlled e-learning. As discussed earlier in this paper, state LGO can be induced (Button et al., 1996; Locke & Latham, 2006) and positively influenced prior to and during training (Chiaburu et al., 2010; Heckhausen & Kuhl, 1985; Kozlowski & Bell, 2006). In an organizational training setting, trainers and instructional designers may include simple framing cues or instructions such as error encouragement and describing errors during training as learning opportunities (Bell & Kozlowski, 2008) and describing learners' abilities as malleable as opposed to being fixed. Similarly, eliminating error avoidance instructions during training can help learners adopt a learning goal orientation. For example, the results of Keith and Frese's (2008) meta-analysis on error management training (similar to error encouragement) led them to conclude that placing an emphasis on within-training performance (e.g., performance on practice exercises throughout training) is not necessarily beneficial. It is also likely that employees who work in organizations that foster a climate of learning in training environments will be more likely to adopt a learning goal orientation. These simple and time-efficient interventions can ultimately help buffer trainees to the high cognitive demands that are characteristic of complex, learner-controlled environments. More research on the effectiveness of such interventions in complex, learner-controlled environments is needed to confirm these propositions.

Additionally, this study focused on the training of a software package. The ultimate objective of the PowerPoint training course was cognitive and behavioral learning and ultimately transfer or training. However, cognitive and behavioral learning is not *always* the ultimate objective of training programs. For example, there are numerous examples of training courses that are designed to train affective outcomes, such as self-efficacy, motivation, etc. (Kraiger, et al., 1993), as well as psychomotor skills. It is unclear whether the interaction between learner control and complexity holds when the key outcomes of training is affective or psychomotor in nature. Moreover, there is very little research on the differential effectiveness of learner- and program-controlled training for the training of affective and psychomotor learning outcomes. In the latter case providing a high degree of learner control may result in accidents and injuries. Additional research should investigate these differences for training programs that differ in their ultimate learning objectives.

Beyond the primary hypotheses tested in this study, several additional findings have interesting implications for e-learning research and practice. For instance, the finding that trainees' self-reported familiarity with PowerPoint was not related to learning may also speak to the findings that trainee self-assessments and judgments of knowledge are not always accurate (Koriat & Bjork, 2005), especially in web-based training environments (Sitzmann et al., 2010). Interestingly, while many self assessments of knowledge are very general (e.g., How much do you know about ___?), the PowerPoint familiarity measure that was used in this study asked participants to rate their familiarity with very specific operations in PowerPoint. It can be reasonably argued that a more precise measure, such as the one used in this study, would more accurately reflect what

the trainee actually *knows* about PowerPoint compared to a global measure. Nevertheless, the findings suggest that trainees' self-reported familiarity with the content being trained is not necessarily a good indication of what they actually know about a topic.

It has been argued that one of the advantages of learner-controlled e-learning is that it places the learner in the driver's seat of training (Kozlowski & Bell, 2006) and the learner is ultimately the best judge of what he/she knows and needs to know (Niemiec, Sikorski, & Walberg, 1996). Consistent with Granger and Levine's (2010) argument, the results of this study suggest that while learner-controlled e-learning environments do indeed offer trainees more control, the assumption that learners are uniformly the best judges of their own learning needs is likely misguided and may lead to inferior cognitive learning outcomes. It is quite possible that trainees who scored very high on the PowerPoint familiarity measure and felt that they were already familiar with the operations in the course, sped through some of the training modules and practice sessions and/or engaged in more off-task attention and thus reduced their exposure to the training material. This is likely a common scenario in organizational training environments, where employees have some baseline knowledge but are given the freedom to skip or speed through content that they are already familiar with or 'already know'. Moreover, these environments may increase the cognitive load placed on learners which further inhibits their ability to learn the material.

Additionally, it has been argued recently that trainee satisfaction is an important predictor of learning when trainees are in learner-controlled environments (Brown, 2005; Orvis et al., 2009). The results of this study do not support this position. Rather, the results suggest that while the average trainee may be more satisfied with learner-

controlled training environments, their learning can suffer in these environments when the content of training is complex in nature. While affective reactions are some of the most commonly measured outcomes in organizational training environments, these results imply that justifying the use of learner-controlled e-learning based on positive trainee reactions to these environments is likely misguided, as learning and transfer may inadvertently suffer.

A similar issue that deserves additional attention from researchers is the issue of whether trainee preferences for learner control are reliable predictors of important training outcomes (e.g., Kraiger & Jerden, 2007). For example, does the practice of tailoring the degree of learner control to each learner based on their preferences for control lead to improved affective and learning outcomes? As there is little research on how trainees' preferences for learner control relate to affective, cognitive and behavioral learning outcomes (see Fisher et al., 2010 for an exception), additional research is needed to explore how trainees' conscious (or subconscious) preferences for learner control impact their learning when their preferences are matched with objective levels of learner control. Additionally, as suggested by Kraiger and Jerden's (2007) model of learner control, individual factors such as cultural factors (e.g., power distance; uncertainty avoidance) may predict learner preferences for control as well as learning outcomes in these environments. Researchers should explore these issues as they may have important implications for the delivery of e-learning in multi-national organizations.

Limitations

There are several limitations of this study that should be addressed. First, it is possible that the use of a college student sample may reduce the generalizability of these

findings. Despite this possibility, it has been well argued (e.g., Greenberg, 1987) and empirically demonstrated (e.g., Locke, 1986) that student samples are not necessarily less representative than samples of working adults. In fact, recent meta-analytic work by Sitzmann and Ely (2011) suggests that the effects of self-regulatory processes (e.g., metacognition) in training do not differ substantially across employee and student populations. Perhaps a more important potential limitation is that college students completing a training course for extra credit may not be as motivated to learn as employees completing job-relevant or perhaps job-impacting (e.g., required certification course) training. Allaying this concern, trainees scored rather high on the motivation to learn ($M = 3.8$, on a 5 point scale) and relevance scales ($M = 4.0$, on a 5 point scale). This suggests that overall, trainees were motivated to learn the content being trained (prior to completing the course) and found the training content to be relevant to their education (after completing the course).

A second potential limitation of this study is that, although there this evidence for the success for the complexity manipulation, even trainees in the complex conditions ($M = 1.9$, on a 5 point scale) did not report that they found the course overly complex. While it is possible that these low ratings may partially reflect trainees' overconfidence immediately following the training course, this may also suggest that the results of this study are conservative. It is possible that a more extreme manipulation of training content complexity would show more dramatic effects. Likewise a multi-module, time extended training course would conceivably demonstrate more substantial effects than observed here. Such effects would have important implications for post training performance and safety behavior, etc. Additionally, according to CLT, intrinsic complexity is partially

determined by the ability and expertise of the learner. Thus, what is *complex* to one trainee may be rather simple for a smarter and/or more experienced trainee. Future research should investigate these possibilities.

It is also important to mention that overall, trainees performed quite well on the declarative and procedural knowledge post course examination (See Figures 1 and 2). Although this may lead to some concern that the post course measures was perhaps too easy for undergraduate students, some of whom were apparently very familiar with PowerPoint prior to taking the training course. It should be noted, however, that the declarative and procedural knowledge were operationalized as the percentage of relevant items correctly endorsed. Thus, trainees in the simple condition were not expected to be prepared for all questions on the test. In terms of raw scores, the number of test items correctly endorsed by trainees in the simple condition was significantly lower than those in the complex condition. Ultimately, this provides evidence that the training course was necessary for trainees' successful completion of the learning measures. Similarly, the "easiness" of several items on the post-course exam may have contributed to the low reliabilities observed in the declarative and procedural knowledge. Overall, this suggests that the relationships with these learning outcomes in this study were likely attenuated. And while attention was paid to the reliability of the criterion measures in this study, a cursory review of the most pertinent e-learning and learner control research studies reveals that many training researchers apparently do not report/ attend to this characteristic of their criterion measures. Training researchers should take greater care in reporting these critical characteristics of their criterion measures.

Additionally, some cognitive and educational researchers have questioned the appropriateness of self-report measures of metacognitive activity (Schraw & Moshman, 1995; Whitebread et al., 2009). Indeed, researchers have noted the challenges to measuring this construct because it is not directly observable (Sperling, Howard, Miller & Murphy, 2002). Individual difference measures and "think aloud" measures of metacognition do not capture implicit cognitive processing (Whitebread et al., 2009). Although Schmidt and Ford's (2003) measure is commonly used in the literature, self-report measures such as the one developed by Schmidt and Ford may suggest activities that individuals may or may not have engaged in during training. For example, it is possible that a trainee could endorse an item that speaks to a specific metacognitive activity but would not have been able to articulate or explain that he/she engaged in such an activity without being prompted by a questionnaire. Moreover, while other individual difference measures, such as the LGO measure, ask respondents to endorse items that are related to their preferences for certain types of achievement environments, which trainees are likely cognizant of, higher-order cognitive activities may not be as salient or retrievable. In the pilot study, participants were asked to describe the learning strategies that they used during the training course. Participants answered this item before they completed the metacognitive activity scale. A review of the comments suggests that many trainees described very simplistic activities that would not fall under the metacognitive or self-regulatory umbrella (e.g., "I just read and reread the material so I could familiarize myself with it", "I mostly looked at illustrations"). In most of these cases, participants tended *not* to endorse many items on the metacognitive activity scale. In several other cases, trainees described higher level learning strategies (e.g., "I tried to

connect the content on the slides to the learning objectives", "I determined what content on each page I was not proficient with, and focus my time on those things", "I tried to test myself on what I already knew and then focus on things I did not previously know. I visualized a real power point and taking each step to create each new learned thing"). As expected, trainees who described these types of activities tended to endorse more items on the metacognitive activity scale. Nevertheless, the failure of this study to detect the established relationship of metacognition mediating the relationship between LGO and learning, leads to concerns about the appropriateness of the self-report measurement approach used in this study. Alternately it may be that the nature of the particular training content, coupled with the fact that it was a one-time occurrence of relatively short duration, mitigated against the potentially favorable impact of LGO and accompanying metacognitive strategies. Finally, time-on-task was not measured in this study. Thus, any differences in time-on-task across the learner control conditions could not be completely controlled. As suggested by past research, trainees in learner-controlled environments tend to spend less time-on-task compared to trainees in program-controlled training environments (Granger & Levine, 2009; Kulik & Kulik, 1991). Nevertheless, Granger and Levine (2009) found only limited support for time-on-task as a mediator of the interaction between learner control and complexity.

Conclusions

Despite the limitations described above, this dissertation provides data that draw attention to the criticality of complex training content, a heretofore little researched factor in the e-learning literature. When learners are provided with great discretion in handling relatively complex cognitive training content their learning suffers. This has both

theoretical and practical implications. From a theoretical perspective, the detrimental learning outcomes observed in complex, learner-controlled appear to be at least partially due to the heavier cognitive demands placed on trainees throughout training. This issue can be ameliorated by motivational individual differences, such as LGO, that help facilitate learning in these cognitively demanding environments. From a practical perspective, these findings offer several important considerations that should be made in determining the appropriateness of affording trainees a high degree of discretion in e-learning. They also offer insight into motivational states that can be induced by trainers and instructional designers prior to and during training. Additionally, these study suggests that training developers and trainers should not make the mistake of assuming that a trainee's likely greater enjoyment and judgments of greater relevance ascribed to training courses when they are given more control of their training will result in better learning outcomes. The findings of this study should be extended in future research to training whose content is both far more complex than that studied here, and whose content focuses on affective outcomes and psychomotor skills. Overall, this research adds to our collective understanding of how, when and for whom e-learning is effective, and points to critically needed avenues for future research to ensure that the burgeoning popularity of e-learning will be of optimum benefit to the diverse populations of learners who will use it.

References

Ackerman, P.L. (1988). Determinants of individual differences during skill acquisition: Cognitive abilities and information processing. *Journal of Experimental Psychology: General*, *117*, 288–318.

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Thousand Oaks: Sage.

Alliger, G.M., & Janak, E.A. (1989). Kirkpatrick's levels of training criteria: Thirty years later. *Personnel Psychology, 42*, 331-342.

Alliger, G.M., Tannenbaum, S.I., Bennett, W., Jr., Traver, H., & Shotland, A. (1997). A meta-analysis of the relations among training criteria. *Personnel Psychology, 50*, 341-358.

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*(3), 261-271.

Arthur, W., Jr., Bennett, W. Jr., Edens, P.S., & Bell, S.T. (2003). Effectiveness of training in organizations: A meta-analysis of design and evaluation features. *Journal of Applied Psychology, 88*, 234-245

Avner, A., Moore, C. & Smith, S. (1980). Active external control: A basis for superiority of CBI. *Journal of Computer-based Instruction, 6*, 115-118.

Baddeley, A.D. (1992). Working Memory. *Science, 255*, 556-559.

Bell, B.S., & Kozlowski, S.W.J. (2008). Active learning: Effects of core training design Elements on self-regulatory processes, learning, and adaptability. *Journal of Applied Psychology, 93*(2), 296-316.

Bell, B.S., & Kozlowski, S.W.J. (2002). Adaptive guidance: Enhancing self-regulation, Knowledge, and performance in technology-based training. *Personnel Psychology, 55*, 267-306.

Bjork, R. A. (1994). Memory and metamemory considerations in the training of human beings. In J. Metcalfe & A. P. Shimamura (Eds.), *Metacognition: Knowing about knowing* (pp. 185-206). Cambridge, MA: MIT.

Blume, B.D., Ford, J.K., Baldwin, T.T., & Huang, J.L. (2010). Transfer of training: A meta-analytic review. Journal of Management, 36(4), 1065-1105.

Brett, J.F., & VandeWalle, D. (1999). Goal orientation and specific goal content as predictors of performance outcomes in a training program. *Journal of Applied Psychology, 84*, 863-873.

Brown, K.G. (2005). An examination of the structure and nomological network of trainee reactions: A closer look at "smile sheets". *Journal of Applied Psychology, 90*, 991-1001.

Brown, K.G. (2001). Using computers to deliver training: Which employees learn and why? *Personnel Psychology, 54*, 271-296.

Brown, K.G., & Ford, J.K. (2002). Using computer technology in training: Building an infrastructure for active learning. In K. Kraiger (Ed.), *Creating, implementing, and managing effective training and development* (pp. 192-233). San Francisco: Jossey-Bass.

Brown, K.G., & Klein, H. (2008). Third-generation instruction: "Tools in the toolbox" rather than the "latest and greatest". *Industrial and Organizational Psychology, 1*, 472-476.

Campbell, D.J. (1988). Task Complexity: A review and Analysis. *Academy of Management Review, 13*, 40-52.

Cascio, W.F. & Aguinis, H. (2005). *Applied Psychology in Human Resource Management* (6th ed.) Upper Saddle River: Prentice Hall.

Cassady, J.C. (2001). Self-reported GPA and SAT: A methodological note. *Practical Assessment, Research & Evaluation, 7*(12).

Charness, N., Schumann, C., & Boritz, G. (1992). Training older adults in word processing: Effects of age, training technique and computer anxiety. *International Journal of Technology and Aging, 5*, 79–105.

Church, M.A., Elliot, A.J., & Gable, S.L. (2001). Perceptions of classroom environment, achievement goals, and achievement outcomes. *Journal of Educational Psychology, 93*(1), 43-54.

Chiaburu, D.S., Van Dam, K., & Hutchins, H.M. (2010). Social support in the workplace and training transfer: A longitudinal analysis. *International Journal of Selection and Assessment, 18*(2), 187-200.

Cierniak, G., Scheiter, K. & Gerjets, P. (2008). Explaining the split-attention effect: Is the reduction of extraneous cognitive load accompanied by an increase in germane cognitive load? *Computers in Human Behavior, 25*, 315-324.

Clark, R.C., & Mayer, R.E. (2007). *E-Learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning* (2nd ed.). New York: Wiley.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). New Jersey: Lawrence Erlbaum Associates.

Cohen, J., & Cohen, P. (1983). *Applied multiple regression/correlation analyses for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaunm.

Cronbach, L. & Snow, R. (1977). *Aptitudes and instructional methods: A handbook for research on interactions*. New York: Irvington.

Czaja, S. J. & Lee, C. C. (2001). The internet and older adults: Design challenges and opportunities. In N. Charnes, D. C. Parks, & B. A. Sabel (Eds.), Communication, technology and aging: Opportunities and challenges for the future (pp. 60–80). NY: Springer Publishing.

DeRouin, R.E., Fritzsche, B.A., & Salas, E. (2005). E-learning in organizations. *Journal of Management, 31*, 920-940.

DeRouin, R.E., Fritzsche, B.A., Salas, E. (2004). Optimizing E-learning: Research based guidelines for learner-controlled training. *Human Resource Management, 43*, 147-162.

DeShon, R.P. & Gillepsie, J.Z. (2005). A motivated action theory account of goal orientation. *Journal of Applied Psychology, 90*, 1096-1127.

Dweck, C.S. (1986). Motivational processes affecting learning. *American Psychologist, 41*, 1040-1048.

Dweck, C.S. (1975). The role of expectations and attributions in the alleviation of learned Helplessness. *Journal of Personality and Social Psychology, 31*, 674-685.

Dweck, C.S., & Leggett, E.L. (1988). A social cognitive approach to motivation and personality. *Psychological Review, 95*, 256-273.

Eddy, E.R., & Tannenbaum, S.I. (2003). Transfer in an e-learning context. In: Holton, E.F., Baldwin, T.T. (Eds.), Improving Learning Transfer in Organizations (pp. 161-194). Jossey-Bass, San Francisco.

Elliot, A.J., & Church, M.A. (1997). A hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology, 72*, 218-232.

Elliot, A. J., & McGregor, H. A. (1999). Test anxiety and the hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology, 76,* 628–644.

Ely, K., Sitzmann, T., & Falkiewicz, C. (2009). The influence of goal orientation dimensions on time to train in a self-paced training environment, *Learning and Individual Differences,19*, 146-150.

Eveland, W. P., Jr., & Dunwoody, S. (2001). User control and structural isomorphism or disorientation and cognitive load? Learning from the Web versus print. *Communication Research, 28,* 48-78.

Faul, F., Erdfelder, E., Lang, A.-G. & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191.

Fisher, S.L. & Ford, J.K. (1998). Differential effects of learner control and goal orientation on two learner outcomes. *Personnel Psychology, 51*, 397-420.

Fisher, S.L., Wasserman, M.E., & Orvis, K.A. (2010). Trainee reactions to learner control: An important link in the e-learning equation. *International Journal of Training and Development*, *14*(3), 198-208.

Ford, J.K., Smith, E.M., Weissbein, D.A., Gully, S.M., & Salas, E. (1998). Relationships of goal orientation, metacognitive activity, and practice strategies with learning outcomes and transfer. *Journal of Applied Psychology, 83*, 218-233.

Frese, M. & Altmann, A. (1989). The treatment of errors in learning and training. In L. Bainbridge and S.A.R. Quintanilla (Eds.), *Developing skills with new technology* (pp. 65-86). Chichester, England: Wiley.

Frey M, & Detterman D. (2004). Scholastic assessment or *g*? The relationship between The scholastic assessment test and general cognitive ability. *Psychological Science, 15*, 373–378.

Galagan, P.A. (2000). E-learning revolution. *Training and Development, 54*(12), 25-30.

Gerjets, P., & Scheiter, K. (2003). Goal configurations and processing strategies as moderators between instructional design and cognitive load: Evidence from hypertext-based instruction. *Educational Psychologist, 38*(1), 33-41.

Gilbert, J., Morton, S., & Rowley, J. (2007). e-Learning: The student experience. *British Journal of Educational Technology, 38*(4), 560-573.

Glass, G.V., Peckham, P.D., & Sanders, J.R. (1972). Consequences of failure to meet assumptions underlying the fixed effects analyses of variance and covariance. *Review of Educational Research, 42*(3), 237-288.

Granger, B.P. & Levine, E.L. (2010). The perplexing role of learner control in e-learning: Will learning and transfer benefit or suffer? *International Journal of Training and Development*, *14*(3), 180-197.

Granger, B.P., & Levine, E.L. (2009). Moderating role of content complexity on the relation between training media and training outcomes. Paper presented at the 69th annual conference of the Academy of Management, Chicago, IL.

Gray, S. H. (1987). The effect of sequence control on computer assisted learning. *Journal of Computer-Based Instruction 14*, 54-56.

Greenberg, J. (1987). The college sophomore as guinea pig: Setting the record strait. *Academy of Management Review*, *12,* 157-159.

Hara, N., & Kling, R. (2001). Student distress in web-based distance education. *Educause Quarterly, 24*(3), 68-69.

Kalyuga, S. (2009). Instructional design for the development of transferable knowledge and skills: A cognitive load perspective. *Computers in Human Behavior, 25*, 332-338.

Kanfer, R., & Ackerman, P.L. (1989). Motivation and cognitive abilities: An integrative/aptitude-treatment interaction approach to skill acquisition. *Journal of Applied Psychology, 74*, 657-690.

Karim, M. N., & Behrend, T. S. (2012). A Multidimensional Framework of Learner Control. Paper presented at the 27th annual conference of the Society of Industrial & Organizational Psychology, San Diego, CA.

Keith, N., & Frese, M. (2008). Effectiveness of error management training: A meta-analysis. *Journal of Applied Psychology, 93*(1), 59-69.

Kinzie, M.B., & Sullivan, H.J. (1989). Continuing motivation, learner control, and CAI. *Educational Technology Research and Development, 37*, 5-14.

Kinzie, M.B., Sullivan, H.J., & Berdel, R.L. (1988). Learner control and achievement in science computer-assisted instruction. *Journal of Educational Psychology, 80*, 299-303.

Kirkpatrick, D.L. (1976). Evaluation of training. In R.L. Craig (Ed.), *Training and Development Handbook* (pp. 18.1-18.27). New York: McGraw-Hill.

Kirkpatrick, D.L. (1959). Techniques for Evaluating Training Programs", *Journal of American Society for Training and Development*, *13* (11-12).

Koenig, K.A., Frey, M.C., & Detterman, D.K. (2008). ACT and general cognitive ability. *Intelligence*, *36*(2), 153-160.

Koriat, A., & Bjork, R.A. (2005). Illusions of competence in monitoring one's knowledge during study. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 31*(2), 187-194.

Kozlwoski, S.W.J., & Bell, B.S. (2006). Disentangling achievement orientation and goal setting: Effects of self-regulatory processes. *Journal of Applied Psychology, 91*(4), 900-916.

Kraiger, K. (2008a). Transforming our models of learning and development: Web-based instruction as enabler of third-generation instruction. *Industrial and Organizational Psychology: Perspectives on Science and Practice, 1,* 454-467.

Kraiger, K. (2008b). Third-generation instructional models: More about guiding development and design than selecting training methods. *Industrial and Organizational Psychology: Perspectives on Science and Practice, 1*, 501-507.

Kraiger, K., & Jerden, E. (2007). A new look at learner control: Meta-analytic results and directions for future research. In S.M. Fiore & E. Salas (Eds.), *Towards a science of distributed learning* (pp. 65-90). Washington, DC: American Psychological Association.

Kraiger, K. (2002). Decision-based evaluation. In K. Kraiger (Ed.), *Creating, implementing, and managing effective training and development. State-of-the-art lessons for practice* (pp. 331-375). San Francisco: Jossey-Bass.

Kraiger, K., Ford, J.K., Salas, E. (1993). Application of cognitive, skill-based, and affective theories of learning outcomes to new methods of training evaluation. *Journal of Applied Psychology*, *78*, 311-328.

Lee, S.S. & Wong, S.C.H. (1989). Adaptive program vs. learner control strategy on computer-aided learning of gravimetric stoichiometry problems. *Journal of Research on Computing in Education, 21*, 367-379.

Levinson, A.J., Weaver, B., Garside, S., McGinn, H., & Norman, G.R. (2007). Virtual reality and brain anatomy: A randomized trial of e-learning instructional designs. *Medical Education, 41*, 495-501.

Liff, J., & Kraiger, K. (2007). *An examination of learner control: conceptual and empirical distinctions between objective and perceived control*. Paper presented at the 22nd annual meeting of the Society for Industrial Organizational Psychology. New York City, NY.

Locke, E.A. (1986). Generalizing from laboratory to field: Ecological validity or abstraction of essential elements. In E. A. Locke (Ed.), *Generalizing from laboratory to field settings* (pp. 3-9). Lexington, MA: Lexington Books.

Locke, E.A., & Latham, G.P. (2006). New directions in goal-setting theory. *Current Directions in Psychological Science, 15*(5), 265-268.

Long, L.K., Smith, R.D. (2004). The role of Web-based distance learning in HR development. *Journal of Management Development*, *23*, 270-284.

Mathieu, J. E. & Martineau, J. (1997). *Individual and situational influences on training motivation*. In J.K. Ford (Ed.), Improving Training Effectiveness in Work Organizations. pp. 193-222. Mahwah, NJ: LEA.

Mayer, R. E. (2008). Applying the science of learning: Evidence-based principles for the design of multimedia instruction. *American Psychologist, 63*(8), 760-769.

MacGregor, S. K. (1988). Instructional design for computer-mediated text systems: Effects of motivation, learner control, and collaboration on reading performance. *Journal of Experimental Education, 56*, 142-147.

McGregor, H. A., & Elliot, A. J. (2002). Achievement goals as predictors of achievement-relevant processes prior to task engagement. *Journal of Educational Psychology, 94,* 381–395.

Mesmer-Magnus, J. & Viswesvaran, C. (2007). Inducing maximal versus typical learning through the provision of a pretraining goal orientation. *Human Performance, 20*(3), 205-222.

Mischel, W., & Peake, P.K. (1982). Beyond déjà vu in the search for cross-situational consistency. *Psychological Review, 89*, 730-755.

Narayan, A. & Steele-Johnson, D. (2007). Relationships between prior experience with training, gender, goal orientation, and training attitudes. *International Journal of Training and Development, 11,* 166-180.

Niemiec, R.P., Sikorski, C. & Walberg, H. J. (1996). Learner-control effects: a review of reviews and a meta-analysis. *Journal of Educational Computing Research, 15*, 157–74.

Nicholls, J.G. (1975). Causal attributions and other achievement-related cognitions: Effects of task outcome, attainment value, and sex. *Journal of Personality and Social Psychology, 31*, 379-389.

Noe, R.A. (2008). *Employee Training and Development* (4th ed.). Boston: McGraw Hill.

Orvis, K.A., Brusso, R.C., Wasserman, M.E., & Fisher, S.L. (2011). E-nabled for e-learning? The moderating role of personality in determining the optimal degree of learner control in an e-learning environment. *Human Performance, 24*, 60-78.

Orvis, K.A., Fisher, S.L., & Wasserman, M.E. (2009). Power to the people: Using learner control to improve trainee reactions and learning in web-based instructional environments, *Journal of Applied Psychology, 94,* 960-971.

Park, S., & Kraiger, K. (2005). *Relationship between perceived and objective learner control*. Paper presented at the 65th annual meeting of the Academy of Management. Honolulu, Hawaii.

Preacher, K. J., Curran, P. J., & Bauer, D. J. (2006). Computational tools for probing interaction effects in multiple linear regression, multilevel modeling, and latent curve analysis. *Journal of Educational and Behavioral Statistics*, *31*, 437-448.

Preacher, K.J., & Hayes, A.F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, and Computers*, *36*, 717- 731.

Preacher, K.J., Rucker, D.D., & Hayes, A.F. (2007). Addressing moderated mediation hypotheses: Theory, Methods, and Prescriptions**.** *Multivariate Behavioral Research*, *42*, 185-227.

Ree, M.J., Carretta, T.R., & Teachout, M.S. (1995). Role of ability and prior knowledge in complex training performance. Journal of Applied Psychology, 80, 721-730.

Ree, M.J., & Earles, J.A. (1991). Predicting training success: Not much more than *g*. *Personnel Psychology*, *44*, 321–332.

Rovai, A.P. (2004). A constructivist approach to online college learning. *The Internet and Higher Education, 7*, 79-93.

Rovai, A.P., & Barnum, K.T. (2003). On-line course effectiveness: An analysis of student interactions and perceptions of learning. *Journal of Distance Education, 18*(1), 57-73.

Salas, E., & Cannon-Bowers, J.A. (2001). The Science of Training: A decade of progress. *Annual Review of Psychology, 52*, 471-499.

Saks, A.M., & Haccoun, R.R. (2008). Is the "third generation model" new and is it the holy grail of adaptive learning? *Industrial and Organizational Psychology, 1,* 480-483.

Scheiter, K. & Gerjets, P. (2007). Learner control in hypermedia environments. *Educational Psychological Review, 19*, 285-307.

Schmidt, A.M. & Ford, J.K. (2003). Learning with a learner control training environment: The interactive effects of goal orientation and metacognitive instruction on learning outcomes. *Personnel Psychology, 56*, 405-429.

Schmidt, F., & Hunter, J. (1998). The validity and utility of selection methods in personnel psychology: Practical and theoretical implications of 85 years of research findings. *Psychological Bulletin, 124*, 262-274.

Schraw, G. & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review, 7*(4), 351-371.

Sitzmann, T., & Ely, K. (2011). A meta-analysis of self-regulated learning in work-related training and educational attainment: What we know and where we need to go. *Psychological Bulletin, 137*(3), 412-442.

Sitzmann, T., & Ely, K. (2010). Sometimes you need a reminder: The effects of prompting self-regulation on regulatory processes, learning and attrition. *Journal of Applied Psychology, 95*(1), 132-144.

Sitzmann, T., Ely, K., Brown, K.G., & Bauer, K.N. (2010). Self-assessments of knowledge: A cognitive learning or affective measure? *Academy of Management Learning & Education, 9*(2), 169-191.

Sitzmann, T., Bell, B.S., Kraiger, K., & Kanar, A.M. (2009). A multilevel analysis of the effects of prompting self-regulation in technology delivered instruction. *Personnel Psychology, 62*(4), 697-734.

Sitzmann, T., & Ely, K. (2008). Do second generation models have more to offer? *Industrial and Organizational Psychology, 1,* 494-495.

Sitzmann, T., Kraiger, K., Stewart, D., Wisher, R. (2006). The comparative effectiveness of web-based and classroom instruction: A meta-analysis. *Personnel Psychology, 59*, 623-664.

Snow, R. E. (1992). Aptitude theory: Yesterday, today, and tomorrow. *Educational Psychologist, 27*, 5-32.

Snow, R.E. (1991). Aptitude-treatment interaction as a framework for research on individual differences in psychotherapy. *Journal of Consulting and Clinical Psychology, 59*(2), 205-216.

Spector, P. (2008). Industrial and organizational psychology: Research and practice (5th ed). New York, NY: John Wiley & Sons, Inc.

Sperling, R. A., Howard, B. C., Miller, L. A., & Murphy, C. (2002). Measures of children's knowledge and regulation of cognition. *Contemporary Educational Psychology, 27*, 51-79.

Stark, S., Chernyshenko, O.S., & Drasgow, F. (2004). Examining the effects of differential item (functioning and differential)test functioning on selection decisions: When are statistically significant effects practically important? *Journal of Applied Psychology, 89*(3), 497-508.

Sugrue, B., & Rivera, R.J. (2005). *State of the industry: ASTD's annual review of trends in workplace learning and performance*. Alexandria, VA: ASTD.

Sweller, J. (2005). *The redundancy principle in multimedia learning*. In R. E. Mayer (Ed.), The Cambridge handbook of multimedia learning (pp. 159–167). New York: Cambridge University Press.

Sweller, J., van Merrienboer, J.J.G., & Paas, F.G.W.C. (1998). Cognitive architecture and instructional design. *Educational Psychology Review, 10*, 251-269.

Tennyson, R.D., Park, O.C., & Christensen, D.L. (1985). Adaptive control of learning time and content sequence in concept learning using computer-based instruction. *Journal of Educational Psychology, 77*, 481-491.

Towler, A.J. & Dipboye, R.L., (2001). Effects of trainer expressiveness, organization, and trainee goal orientation on training outcomes. *Journal of Applied Psychology, 86*(4), 664-673.

Tziner, A., Fisher, M., Senior, T., & Weisberg, J. (2007). Effects of trainee characteristics on training effectiveness. *International Journal of Selection and Assessment, 15*(2), 167-174.

VandeWalle, D., Cron, W.L., & Slocum, J.W., Jr. (2001). The role of goal orientation following performance feedback. *Journal of Applied Psychology, 86*, 629-640.

Van Merrienboer, J.J.G., Kester, L., & Paas, F. (2006). Teaching complex rather than simple tasks: Balancing intrinsic and germane load to enhance transfer of learning. *Journal of Applied Cognitive Psychology, 20*, 343-352.

Welsh, E.T., Wanberg, C.R., Brown, K.G., Simmering, M.J. (2003). E-learning: Emerging uses, Empirical results and future directions. *International Journal of Training and Development, 7*(4), 245-258.

Whitebread, D., Coltman, P., Pasternak, D. P., Sangster, C., Grau, V., Bingham, S., Almeqdad, Q., & Demetriou, D. (2009). The development of two observational tools for assessing metacognition and self-regulated learning in young children. *Metacognition and Learning, 4*(1), 63-85.

Wood, R.E. (1986). Task complexity: Definition of the construct. *Organizational Behavior and Human Decision Processes, 37*(1), 60-82.

Appendices

Appendix A: Perceived Learner Control Scale

1. Overall, I was in control of the time I spent learning the material in the training course

2. I was in control of the training content that I chose to skip, speed through and spend additional time on

3. I was in control of the sequencing of the training content

4. I was in control of the pace of my learning

Appendix B: Perceived Content Complexity Scale

1. Overall, I thought that the training course was difficult

2. I had no trouble following along with the training material

3. The large amount of information presented in the training course made it difficult for me to learn

4. The training course was <u>not</u> very complex

Appendix C: Familiarity with PowerPoint Scale

1. Opening a blank PowerPoint presentation

2. Creating multiple slides within a PowerPoint presentation

3. Inserting text into a PowerPoint presentation

4. Choosing different visual layouts for a presentation

5. Choosing different color schemes for a presentation

6. Inserting pictures and visual aids into a presentation

7. Identifying and using the Ribbon within PowerPoint

8. Inserting slide transitions within a slideshow

9. Using and manipulating SmartArt

10. Inserting Footers into a PowerPoint presentation

11. Including Action buttons into a PowerPoint presentation

12. Utilizing the master slide function

Appendix D: Cognitive Ability Measure

In the space below, please indicate your highest composite ACT or SAT (verbal + quantitative) score and then indicate the test score that you are reporting by checking the appropriate box. If you do not remember your exact score, please estimate to the best of your knowledge.

My highest composite score was _____

The scholastic achievement score I am reporting is…

___ACT
___SAT

Instructions: Please select the best answer to each of the following questions. There are a total of 20 Multiple Choice questions in this examination. There is only <u>**one**</u> correct answer to each question. **You should treat this examination as an actual college-level course exam - you may not reopen the PowerPoint training course or use any additional tools, such as your mobile device or computer to assist you in answering the questions.** *Your performance on the examination will have no bearing on the number of extra credit point you receive.*

1). Which of the following includes the three major areas on any PowerPoint page? (Choose only one answer)

     a). Slide plane, Text box and Title space

     b). Slide plane, Notes, and Plane slide view

     c). Notes, the Ribbon, and Blank presentation

     d). Notes, Home tab, and the Ribbon

2). Which of the following is the correct sequence for moving a text box around a PowerPoint page? (Choose only one answer)

     a). Left click inside the text box and use the arrow keys to move the box

     b). Left click on the edge of the text box and drag it to its next location

     c). Left click anywhere on the PowerPoint page and drag your cursor across the

     d). Right click on the text box that you want to move and follow the instructions provided by PowerPoint

3). Which of the following options best describes the purpose of the Ribbon within PowerPoint? (Choose only one answer)

     a). The Ribbon is PowerPoint's text box creation center

     b). The Ribbon is PowerPoint's new slide creator

     c). The Ribbon is PowerPoint's Command Center

     d). The Ribbon is PowerPoint's Slide plane view organizer

4). Which of the following is a common tab located on the Ribbon? (Choose only one answer)

      a). Slide Organization tab

      b). Slide Plane view tab

      c). Home tab

      d). Advanced Functions tab

5). Which of the following represents the easiest way to include text into a PowerPoint page? (Choose only one answer)

      a). Left click inside a text box and type in the desired text

      b). Right click inside a text box and type in the desired text

      c). Place your cursor anywhere on the PowerPoint page and type in the desired text

      d). Left click on the edge of a text box and enter the desired text inside the cursor

6). Which of the following represents the easiest way to navigate through many slides in a slideshow? (Choose only one answer)

      a). Access the Notes area of a PowerPoint page and scroll through slides

      b). Access the Slides Tab on the PowerPoint page and scroll through slides

      c). Access the View tab on the Ribbon and scroll through slides

      d). Access the Home slide and navigate through your slides using the Tab key on your keyboard

7). Which of the following include the correct steps you would take when selecting a Theme for your slideshow? (Choose only one answer)

a). Select the Design tab on the Ribbon and left click on a theme you like

b). Select the Home tab on the Ribbon and select New Slide from the dropdown menu

c). Select a theme of your choice in the Plane slide view

d). Select the Format tab on the Ribbon and select the Slide view tab from the dropdown menu

8). Why would you want to include slide transitions into your PowerPoint presentation? (Choose only one answer)

a). They allow you to easily navigate through multiple slides

b). They allow you to easily access the Design tab on the Ribbon

c). They allow you to make a presentation flow more smoothly

d). They give you the option to add additional animations to your presentation

9). Which of the following is the correct sequence for using the Ribbon to insert pictures into your slideshow? (Choose only one answer)

a). Access the Home tab on the Ribbon, move your cursor over the insert option of your choice and left click on the insert option

b). Access the View tab on the Ribbon and left click on the slide view tab

c). Access the Insert tab on the Ribbon, move cursor over the insert option of your choice, and left click on the insert option

d). Access the Layout tab, move your cursor to the insert option from the dropdown menu, and left click on the insert option

10). Why is it useful to include pictures into a slideshow? (Choose only one answer)

a). Pictures can help keep the audience interested and can complement the text you are presenting

b). Pictures can overload your slides and take away from the point you are trying to make

c). Pictures allow you to move from slide to slide more smoothly

d). Pictures are useful, but only when they are included in the Clip Art library

11). What is the primary difference between custom animation and slide transitions? (Choose only one answer)

a). Custom animations make movements from slide to slide smooth, but slide transitions do not

b). Custom animations can be applied to individual lines of text or objects but slide transitions are usually applied to all slides in the slideshow

c). Custom animations are only available under the Home tab, but slide transitions are accessible under most tabs on the Ribbon.

d). Custom animations are always applied to every slide of the slideshow, unlike slide transitions.

12). What is the primary function of the Slide Master in PowerPoint? (Choose only one answer)

a). It allows you to access every tab on the Ribbon quickly

b). It allows you to insert text only into your PowerPoint presentation

c). It allows you to include text or any icons into every slide of your presentation

d). It allows you to use SmartArt for inserting graphics into your presentation

13). Which of the following is the correct sequence for accessing the Slide Master?
(Choose only one answer)

a). Select the View tab on the Ribbon and choose the Slide Master option

b). Select the Home tab on the Ribbon, select view from the dropdown menu and choose the Slide Master option

c). Right click on the slide plane, select view and choose Slide Master from the dropdown menu.

d). Select the Applications tab on the Ribbon and choose the Slide Master option.

14). When would you be <u>less</u> likely to use SmartArt in your PowerPoint presentation? (Choose only one answer)

a). SmartArt graphics would help enhance the information you are trying to present

b). SmartArt graphics would add to the visual appeal of your presentation

c). SmartArt graphics would help your audience better understand complex information

d). SmartArt graphics would possibly distract your audience from the main point

15). Which of the following is the easiest way to access SmartArt graphics? (Choose only one answer)

a). Access the Home tab on the Ribbon, choose the view options and select the SmartArt option

b). Create a new slide and select the green arrow out of the six possible icons shown in the middle of the slide

c). Create a new slide and select the charts options out of the six possible icons shown in the middle of the slide

d). Access the Home tab on the Ribbon and simply select applications which then accesses SmartArt

16). Which of the following represents the correct steps for inserting sounds into your presentation? (Choose only one answer)

a). Select the Insert tab on the Ribbon and then click the arrow next to the Sound option

b). Select the Home tab on the Ribbon, choose the Insert option and select the Sound option

c). Select the Insert tab on the Ribbon and select the multimedia option under the Sound dropdown menu

d). Select the View tab and left click on the Applications menu

17). Which of the following is <u>not</u> a possible option when including sounds into a PowerPoint presentation? (Choose only one answer)

a). Can make sounds within slides start automatically

b). Can insert sounds from both CDs and microphones

c). Can choose the sounds option by selecting the Home tab in the Ribbon

d). Can choose sounds by accessing the Insert tab on the Ribbon

18). Which of the following would not be a common use for a Footer within a PowerPoint presentation? (Choose only one answer)

a). Including the date of the presentation on all slides

b). Including an organization or company name on all slides

c). Including the sounds options on the bottom of all slides

d). Including the name of the presenter on all slides

19). What is the correct way to insert a footer into your slideshow? (Choose only one answer)

       a). Select the Insert tab on the Ribbon and select the Header and Footer option

       b). Right click on a new PowerPoint slides and select the Header and Footer option

       c). Select the Home tab on the Ribbon, choose the Insert option and select Footers from the dropdown menu

       d). Create a new slide and select the green arrow from the sex possible icons shown in the middle of the slide

20). What are the proper steps for saving a PowerPoint presentation? (Choose only one answer)

       a). Access the View tab on the Ribbon and select the save icon

       b). Access the circular window icon at the top left hand corner of the PowerPoint screen and select the Save As option from the dropdown menu

       c). Move cursor to the circular window icon which is located within the Home tab and select the Save option

       d). Choose the desktop option from the Home tab on the Ribbon and select Save As

Appendix F: Skill-based Procedural Knowledge Activity Instructions

Instructions: Please follow the guidelines below to create a new PowerPoint presentation from scratch. **<u>Please note that you are not allowed to communicate with anyone else in the room during this assessment except for the graduate assistant overseeing the study</u>**. Please follow the guidelines below to the best of your ability. *Your performance on this assessment will have no bearing on the number of extra credit points you receive.*

<u>Guidelines</u>

1). Create a new presentation/ slideshow from scratch using PowerPoint.

2). The content or purpose of your presentation will be how to study for a college-level course. For example, you may create a presentation that you would share with new college students who are unfamiliar with studying for college-level courses.

3). Your presentation should be exactly 3 slides long.

4). Your PowerPoint Skills will be rated on the extent to which you utilized the PowerPoint operations taught in the training course.

5). Once you have completed the 3 slide presentation, email the presentation AND this completed document to the lead researcher.

Tips for emailing documents to researcher:
- Save this completed document and the PowerPoint presentation to your desktop
- Please do not include your name in any of these documents
- Login to you USF webmail account
- Email both documents to the researcher

Once you have emailed these documents, you are free to leave the testing room. Thank you for your participation in this study!

Appendix G: Skill-based Procedural Knowledge Rating Scale

Please rate each presentation based on the creator's use of the PowerPoint operations applied to the presentation (Please refer to the list of trained skills/ operations for the appropriate condition)

Note: Do not rate the PowerPoint presentation on the content itself. Rate only on the extent to which the creator applied the skills taught in the training course.

_____

1 – Very Poor	2 - Poor	3 - Fair	4 - Good	5 - Excellent
Creator did an extremely poor job of demonstrating the skills trained, in the presentation	Between 1 and 3	Creator did a fair job of demonstrating the skills trained, in the presentation	Between 3 and 5	Creator did an excellent job of demonstrating the skills trained, in the presentation
Creator applied **few or no** PowerPoint operations taught in the training course		Creator applied **several** PowerPoint operations taught in the training course		Creator applied **all** of the PowerPoint operations taught in the training course

About the Author

Dr. Benjamin Granger earned his Bachelor of Science in Psychology from the University of Louisiana at Lafayette (Ragin' Cajuns). He earned his M.A. and Ph.D. in Industrial Organizational Psychology from the University of South Florida. He is the author of several peer-reviewed publications in journals such as the *Journal of Business and Psychology*, the *International Journal of Training and Development* and the *International Journal of Sociological Research* and has presented his research at professional conferences across the country. He currently works as a consultant for the Verizon HR Operations and Strategy Team.