An Exploration of High-Fidelity Virtual Training Simulators on Learners’ Self-Efficacy: 
A Mixed Methods Study 

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Keywords: high-fidelity, simulators, self-efficacy 

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Abstract

In this world of fast-paced learning, training agencies often require their learners to acquire the knowledge and skills needed for a job at an expedited rate. Because of this rapid form of training, learners are sometimes uncertain about their abilities to execute task-based performances. This uncertainty can lead to a decrease in learners’ self-efficacy on expected task performance. In order to help with this training, trainers are using a variety of simulations and simulators to provide learners’ valuable and necessary training experiences. This mixed methods study explored the influence of high-fidelity virtual training simulators on learners’ self-efficacy. It used pre- and post-simulation-use surveys that combined general self-efficacy questions (Schwarzer & Jerusalem, 1995) and task-specific self-efficacy questions (Bandura, 1977, 1997, 2006; Bandura, Adams, Hardy, & Howells, 1980). This study had a sample size of 18 participants. It was assumed that the intent of providing learners with the vital experience needed to perform specific tasks in a high-fidelity virtual training simulator was to increase their self-efficacy on task-specific criteria. Instead, through surveys, observations, and interviews, the research revealed a decrease in learners’ self-efficacy due to heightened emotional arousal stemming from the learners’ experiences with the level of realism the simulator provide, as well as with breakdowns within the simulator. The breakdowns and the realism were the most influential aspects that influenced self-efficacy in this study. The significance of these findings shows that despite learners wanting to use high-fidelity virtual training simulators, improperly
functioning simulators can negatively influence learners’ self-efficacy in task-based performances.

Keywords: high-fidelity, simulator, self-efficacy
Dedication

To Eric
You mean the world to me.
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It seems trite to write what so many have written before me, but I could not have gotten through this process without God. Recalling the words in the Methodist hymnal regarding baptism, "With God's help we will so order our lives after the example of Christ, that this child, surrounded by steadfast love, may be established in the faith and confirmed and strengthened in the way that leads to life eternal." I am forever thankful to those strangers who prayed for me on that fateful day as my grandfather Christened me, and my family set me free to “climb the highest mountain.”

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I miss them so much, along with Tim and Uncle Bill. I am certain they are proud. To my long-
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Chapter I: Introduction

Introduction to the Study

Self-efficacy is an important aspect of the multifaceted characteristics of individuals’ lives. As human beings we draw from our self-efficacy in order to complete seemingly minute tasks such as cooking or learning to ride a bike, but we also dive into our well of self-efficacy to learn and perform more complex tasks like flying a plane or even writing a dissertation. Over time, instructional designers and other experts have provided us with ways in which to learn and complete each of these tasks. We use recipes for cooking, directions for riding a bike, practice for flying planes, and models for writing a dissertation. Ultimately, it is our level of motivation and our own perceived self-efficacy that contribute to the desired outcome of completing any of these performance-based tasks “successfully.” What steps must I take to taxi an aircraft down a runway? How can I prevent myself from overcooking a pie?

The answers to these questions come to us through experience in learning and doing, and in learning and doing, we heighten our levels of self-efficacy. Learners’ self-efficacy, as Bandura (1997) explained, is concerned with one’s perceptions of personal capabilities in task performance. What, then, are the best ways of going about increasing learners’ self-efficacy so they may master skills and perform desired outcomes successfully? The use of training simulations and tools is one means by which learners can practice the skills needed to perform necessary tasks (Gagné, 1954; Kameg, Howard, Clochesy, Mitchell, & Suresky, 2010) like learning to taxi an airplane before learning to fly it, or learning how to separate an egg before you make your grandmother’s pumpkin chiffon pie.

Empirical studies have shown that media such as simulators provide more than just
motivation and engagement; they are learning tools that aid in the transfer of knowledge and
skills (Gee, 2007; Halverson, 2005; Oblinger, 2006; Peirce, Conlan, & Wade, 2008; Salen &
Zimmerman, 2003; Schwabe & Göth, 2005; Wilson, 2009), as well as opportunities for
experiential learning that enhance learner self-efficacy (Bandura, 1971, 1977; Boydell, 1976).

Through an exploratory study, this dissertation explored the influence of using a high-
fidelity virtual training simulator in a learning environment and its influence on users’ perceived
self-efficacy. The findings were based upon learners’ self-reports on perceived self-efficacy
response scales, observations, and open-ended interviews of learners who participated in
simulation training as a part of a law enforcement training academy.

Problem Statement

Several careers require workers to quickly develop job-related skills and complete job-
related tasks where “expedient training in proper technique is an essential element of
[workers’] initial employment” (Whetstone, 1996, p. 21). Because of fast-paced training,
learners are sometimes uncertain in what they think they can do with their performance-based
tasks; ultimately this leads to lower self-efficacy in the individual workers, which also
decreases efficiency in the workplace (Bandura, 1977; Zimmerman, 2000).

A few research studies have shown that using simulators as learning tools helps to
increase learners’ perceived self-efficacy (Davis, Fedor, Parsons, & Herold, 2000; Goldenberg,
Andrusyszyn, & Iwasiw, 2005; Halverson, 2005; Kameg, Howard, Clochesy, Mitchell, &
Suresky, 2010; Peirce, Conlan, & Wade, 2008; Schwabe & Göth, 2005). These studies
combined and explored simulations and self-efficacy, but they used general self-efficacy scales
to measure learners’ perceived self-efficacy (See Davis et al., 2000; Goldenberg et al., 2005;
Kameg et al., 2010), which Bandura (1997, 2006) and others disavowed (Pajares, 1996).
Bandura and others (See Pajares, 1996; Zimmerman, 2000) argued that in order to properly and appropriately measure or investigate self-efficacy, the self-efficacy scale used must be task-specific based on expected performance outcomes. It should also be administered within a reasonable amount of time before and after the task completion. The researchers in these studies did not use task-specific scales. Moreover, Goldenberg, Andrusyszn, and Isasiw (2005) administered the follow-up self-efficacy scale months after their participants were involved in their role-play simulations, which, as they disclosed, made for a less reliable study.

Additionally, the studies that combined and explored simulations and self-efficacy failed to address the role of the simulator or simulation or how participants responded to it as a part of their training. Kameg, et al (2010) included one open-ended question in a section of their self-efficacy scales, where they asked participants how they felt about using SimMan, a human-like simulator used in nursing schools. The responses varied from “It was fun” and “I learned a lot,” to “It was a good experience.” These answers to open-ended questions on a survey or scale did not provide the researchers, past or future, with in depth, informative responses that could be used to inform the use of simulations in teaching. (See Appendix A for a table of these studies.) With that said, a more robust exploration of the influence of simulators on learners’ perceived self-efficacy is needed to help better inform the literature and researchers of the instructional design and technology community.

**Purpose of the Study**

The purpose of this study was to explore learners’ perceived self-efficacy regarding “task-specific performance outcomes” (Bandura, 1997, 2006) after using a high-fidelity virtual training simulator.

A convergent parallel mixed methods design was used for this research study.
(Creswell, 2009; Creswell & Plano Clark, 2011). This involved the simultaneous collection of quantitative and qualitative data. A quantitative, task-specific perceived self-efficacy scale (Bandura, 2006; Pajares, 1996; B. J. Zimmerman, 2000) was used to investigate learners’ perceived self-efficacy; additionally, qualitative observations and interviews were used to explore users’ self-reported perceptions of their performance-based capabilities. The purpose for using a mixed methods study was to elaborate on quantitative results of a survey scale (Creswell & Plano Clark, 2011; Patton, 2002), to provide “a better understanding of the research problem” (Creswell & Plano Clark, 2011, p. 5), and to provide a more enriching study for a field as open to interdisciplinary and cutting-edge research as that of instructional design and technology.

**Definition of Terms**

- **Perceived Self-efficacy** – the belief one has about his or her capabilities to successfully perform a specific task; a person’s perceived self-efficacy about his or her ability to perform one task often influences his or her ability to perform other tasks, as well.

- **Task-based performance** – denotes an explicit task in expected performance outcomes, versus a generalized, overall performance.

- **Simulator** – a device that represents conditions most likely to be experienced in the actual performance

- **Simulation** – the imitation by a system or process of the way in which another system or process works (Merriam-Webster, n.d.)

- **Fidelity** – (adjective) the degree to which something represents accuracy in presenting details; fidelity encompasses user experience and how real that user perceives his or
her experience to be.

**Research Questions**

A concurrent parallel study was used. This method of research incorporated both quantitative and qualitative strands of data, where the merging of quantitative and qualitative data occurred during all stages of this research study (Creswell & Plano Clark, 2011). In order to discover users’ perceived self-efficacy prior to and after receiving training on high-fidelity virtual training simulation tools, this mixed method study was guided by the following research questions:

*Quantitative Research Question:*

1. Is there a difference between learners’ perceived self-efficacy prior to and after using a high-fidelity virtual training simulator to perform specific tasks?

*Qualitative Research Questions:*

2. What are learners’ perceptions of their training experience with the high-fidelity virtual training simulator?

3. What aspects of the training experience with the high-fidelity virtual training simulator influenced learners’ perceived self-efficacy?

**Benefits of the Study**

The purpose of this investigation was to explore how the use of a high-fidelity virtual training simulator influenced learners’ perceived self-efficacy. Identifying themes and patterns can inform possible improvements to curriculum design and instruction with high-fidelity virtual training simulators; therefore, this study sought to improve the understanding of the influences of high-fidelity virtual simulations on learners’ self-efficacy in performing tasks in the work place.
Organization of the Study

Chapter 1 provides the background information of the study, the statement of the problem, the purpose statement, and the three research questions.

Chapter 2 provides a review of the literature related to the topic of this research study. This chapter has two main sections. The first section focuses on simulators and simulations, as well as standards, uses, and key terms describing them. The second section focuses on self-efficacy theory on which this study is grounded. The chapter concludes with a summary.

Chapter 3 provides information on the methodological approaches that were used to carry out this research study. It discusses in more detail the purpose statement and research questions for the proposed study. It also includes the research design and procedure for the study. The procedure includes participants, materials used, data collection, and data analysis.

Chapter 4 provides the results of the research findings. The chapter is organized according to the research questions. If first reviews the quantitative strand findings. It then discusses the importance of the six predetermined categories used in coding the data; and then reviews and answers the two qualitative research questions, followed by a summary.

Chapter 5 provides the discussion and intended contributions of the research study to the field of instructional design and technology.
Chapter II: Review of the Literature

The topic of simulations is no stranger to research, nor is self-efficacy; however, investigations of the combination of simulation and self-efficacy have the potential to lead to more meaningful learning, more effective learning outcomes, and a heightened sense of learner self-efficacy in performing task-based outcomes. This review of literature discusses the many facets of simulators and simulations. It highlights standards and classifications of simulators and simulations; it also discusses confounding issues that permeate many of the domains that use simulators and simulations for training purposes. Because this study explored the influence of simulators and simulations on self-efficacy for learners who engage in simulated learning experiences with high-fidelity virtual training simulators, a review of Bandura’s self-efficacy theory (1977, 1999) is presented and discussed in this chapter. In addition, an explanation of Bandura’s self-efficacy scales and their uses, misuses, and measuring procedures is also presented herein.

Simulations

Simulators and simulations are versatile learning devices. Because of their versatility (See Carron, Trueb, & Yersin, 2011; Walsh, 2005) and their ability to enhance learners’ skills “regardless of content knowledge” (Adcock, Duggan, Watson, & Belfore, 2010), simulations lend themselves to use in a variety of disciplines. At the same time, however, a learning device with such multifaceted characteristics in so many learning domains can often be generalized to the point where the device and its intended use are often misconstrued throughout the literature (e.g. “high-fidelity” simulations through role-play versus “high-fidelity” computer-based flight simulations) leading to confounding research issues regarding
how simulations are classified, used, and described (Feinstein, Mann, & Corsun, 2002; Gagné, 1954; Gray, 2002; Weitz & Adler, 1973). As such, it is no wonder that simulators and simulations have such assorted purposes and definitions.

One of the largest fields in which the use of simulators is found exists in medical training. Nurses and doctors learn with a myriad of simulations. Another noteworthy field using simulators and simulations is aviation and aeronautics. Aside from these two fields in which simulators and simulations are used, almost every field imaginable employs the use of these learning devices in some way, shape, or form. The U. S. Department of Agriculture’s Forest Services (Crookston & Havis, 2008) employs a Forest Vegetation Simulator to predict long-term management of forestation with regard to climate change, controlled burns, and analysis of fuel management. Another simulation analyzes food quality and environmental load for the food supply chains known as supply chain management (van der Vorst, Tromp, & Zee, 2009) in the Global Supply Chain (Lambert and Cooper, 2000, as cited in van der Vorst). Nuclear physicists use simulators to analyze and evaluate irradiation damage in nuclear material (Serruys et al., 2004), as well as run large-scale tests on nuclear weapons within the confines of a safe environment (Dobranich & Blanchat, 2008).

The most reoccurring motifs for why developers and educators employ the use of simulations can be summed up in three main areas: to test and analyze experimental tools and models (Crookston & Havis, 2008; Harmon, 2011; Kuhl, Evans, Papelis, Romano, & Watson, 1995; Serruys et al., 2004; van der Vorst et al., 2009), to enhance users’ meaningful learning experiences (Adcock et al., 2010; Gagné, 1954; Hunter & Ravert, 2010; Rieber, 1996; Rodgers & Moraga, 2011; Weitz & Adler, 1973), and to provide a safe environment in which to experiment and to fail (See Carron et al., 2011; Dobranich & Blanchat, 2008;
In addition to the vast scenarios in which simulations are used, there seems to exist a variety of confounding definitions of the simulators and simulations. For example, Gallagher and Satava (2002) define simulation as a “supervised operative experience” (p. 1746). Adcock, et al. (2010) describe a simulation as a “system” that enhances a certain skill set “regardless of content knowledge” (p. 397). Perhaps the most general definition among the majority of the medical and nursing literature is that of McGaghie (1999) who defines simulation as “a person, device, or set of conditions which attempts to present problems authentically” (p. 9). In their empirical study on the optimal use of simulation, Weitz and Adler (1973) described simulation as merely “a part of a training system to be designed for particular requirements” (p. 220) with an expectation of the transfer of learning. Gagné (1954) also discussed transfer of learning as an important defining component of simulation; he defined simulator as,

a kind of training device which has a high degree of resemblance to operational equipment, particularly with respect to the display, the controls, and the way one affects the other when in operation (p. 96).

As Gagné noted, the use of simulations has been around since World War II. For over seventy years, the use of simulations as training devices has not changed, only the standards and definitions by which they have been described.

**Standards**

A review of the literature did not reveal a standard definition for simulators and simulations. Several researchers from the field of medicine adopted a general definition from Larew, Lessans, Spunt, Foster, and Covington (2006) who put forth, “Simulation is the artificial representation of a phenomenon or activity” (p. 17). Rather than supporting a
universal standard, the literature indicates that researchers have instead chosen to interpret simulators and simulations in such a variety of ways that it has lead to misaligned and ill-matched analysis and evaluation. For example, Havighurst, Fields and Fields (2010) and Dobranich and Blanchat (2008) both researched high-fidelity simulations; however, Havighurst, Fields, and Fields focused on live simulations, whereas Dobranich and Blanchat focused on computer-based simulations. Clark (1983) would argue that the media delivering the learning is of little matter; however, in these cases, Havighurst, Fields and Fields ran a live high-fidelity simulation with firefighters and live fire for training purposes. Dobranich and Blanchat also ran a high-fidelity full-scale fire test. The difference between the two studies is that one included live fire with real flames and real people; the other included a computer-based nuclear weapon system with no flames and only people working the computer. These two studies are indicative of media mattering most. Even though the researchers of both studies refer to them as “high-fidelity,” there is a grave difference in the media delivering the message.

There are two fields in particular that hold a definitive set of standards for simulations: The United States Department of Defense (DoD) and The Institute of Electrical and Electronics Engineers (IEEE, read I triple E). The DoD (Leonard, 2001) defines simulation as “the implementation of a model over time...,[which] brings a model to life and shows how a particular object or phenomenon will behave” (p. 117). In a similar fashion, the IEEE (1990) defines a simulation as “a model that behaves or operates like a given system when provided a set of controlled inputs” (p. 66). Drawing from these standards, it is proposed that a standard definition be adopted for instructional design purposes; in such, this paper defines simulation as a model of real-life experiences that will predict how a learner will behave in future scenarios based on his or her simulated experience.
Classifications

As indicated, having so many variations on a theme has created uncertainty in the classification of simulations. There are face-to-face role-play and case study examinations (Goldenberg, Andrusyszyn, & Iwasiw, 2005; Hunter & Ravert, 2010; Reilly & Spratt, 2007), web-based role-play (Adcock et al., 2010), and even virtual reality simulations (Gallagher & Satava, 2002). The Department of Defense has defined three separate classes of simulations: virtual, constructive, and live (Defense Acquisition University, 2005). The aforementioned will be discussed and defined below.

Role-play as simulation.

In what is perhaps the oldest definition of role-play, Aristotle (1961) believed that role-play involved imitation in which a learner would create a likeness that was most true to life. Several millennia later, Guyot and Honiden (2006) described role-play as a type of simulation where human participants control a specified agent; Feinstein, Mann, and Corsun (2002) explained that role-play allows learners to “immerse themselves in a learning environment” (p. 735). Other definitions described role-play as brief episodes lasting no longer than 20 minutes (Gredler, 1996) that provided live samples of human behavior (Goldenberg, Andrusyszyn, & Iwasiw, 2005).

Because part of the purpose of using simulations is for the learner to take on a particular role (Gredler, 1996), it seems almost natural that face-to-face role-playing is a form of simulation. Role-play allows learners to act out spontaneously to a variety of situations that may incorporate a myriad of challenges (Goldenberg et al., 2005). In their empirical study, Goldenberg et al. found that role-play simulations allowed nursing students to apply classroom theory to real-life scenarios in a simulated environment. The results of Etienne’s (2003)
empirical study on role-playing to assess learners’ negotiation skills in management revealed that learners were able to alternate roles in order to better understand and appreciate others’ views (See also Rau and Heyl, 1990 as cited in Mintz, 1996).

Tompkins’ empirical study (1998) explored how face-to-face role-playing increased critical thinking and encouraged language learners to practice speaking in the target language in a nonthreatening environment. Tompkins put forth that through simulation, the students were more motivated and engaged in their learning tasks with other speakers than students in previous classes who did not engage in role-play.

Adcock, Duggan, Watson, and Belfore (2010) empirically assessed a web-based interview simulation “to meet the needs of distance education students practicing helping skills” (p. 389). Learners were able to practice verbal and nonverbal helping skills through a web-based simulator called Computer Agents Teaching Helping Interactions Effectively (CATHIE). Although CATHIE was still in its developmental stages, Adcock et al. believed that one of the important aspects of the CATHIE simulator was its ability to help improve meaningful learning “regardless of content knowledge” (p. 397).

Case study simulations used for role-play allowed for learner analysis and discussion of specific case-related material (Goldenberg et al., 2005) through role-play simulation. In their empirical study, Goldenberg et al. conducted sessions where nursing students played the roles of doctors, nurses, and patients from actual case studies. Through their acquired roles, the nursing students were able to learn about a myriad of medical scenarios from the points of view of other role-players. Additionally, Reilly and Spratt’s (2007) empirical study on nursing students who used case studies for role-play found that the students valued the ability to explore beginning nursing topics in a safe environment.
**Computer modeling as simulation.**

The use of simulations provides a safe environment not only for users’ learning purposes, but also for users’ testing purposes. With a few mathematical formulas, a computer scientist can adjust expected outcomes depending on any of a number of variables for a given scenario. One example of computer modeling as simulation is the JANNUS Project (Joint Accelerators for Nano-science and Nuclear Simulation) (Serruys et al., 2004). JANNUS was created to combine experimental tools with experienced nuclear scientists for the purpose of building an irradiation facility in nuclear power plants. Serruys et al. needed to understand the long-term effects of radiation on materials used to build nuclear power plants; they also investigated additional ways of producing less nuclear waste. According to Serruys et al., testing irradiations produced unhealthy radioactive samples, so they used a computer model (JANNUS) of an experimental simulation to assess the effects of irradiation damage and gas production in nuclear reactors. Their empirical study found,

The process of “modelling [sic] and experimentation” through simulation was “appropriate [in the] gathering of competences and experimental techniques working at the suitable time and space scales to explore, enrich, parameterise [sic] and validate models and simulations” (pp. 167-168).

Using computer modeling as a means of simulation, Serruys et al. were able to find defects in their materials; they then recalculated the simulation and were able to determine “the effects of significant amounts of solute that the simulation has shown to have the desired effect at vanishing concentrations” (p. 168). The simulation testing allowed for experimentation in a safe environment.

In a similar manner, Perumalla and Sundaragopalan (2004) conducted an empirical
study on the GTNetS (Georgia Tech Network Simulator). They tested various computer
network environments by introducing malware into the simulated system. With the GTNetS,
Perumalla and Sundaragopalan were able to “look at the issue of incorporating live
monitoring/defense systems into a large simulated network” (p. 1). They postulated that
computer model simulations, in this case the GTNetS, “[hold the] potential to sustain Internet-
scale experiments without great loss of flexibility or accuracy” (p. 2). Perumalla and
Sundaragopalan conducted a quantitative study that examined the limits of the network
environments. The GTNetS simulator allowed for an “arbitrary subject network configuration
to be specified, where they were then able to introduce simulated malware into the GTNetS
and follow it with “complex scripts of attack/detection/defense scenarios” (p. 3) that were later
enacted. Their conclusions showed that using the computer modeling simulations allowed for a
safe approach to observing the effects of malware on various computer systems and computer
network platforms – from Windows to Linux (pp. 9 – 10).

Other computer modeling simulator examples include the M5 general purpose
computer modeling simulator developed for researchers to safely explore research in TCP/IP
networking (See Binkert et al., 2006) and a Fire Dynamics Simulator created to model fires in
order to predict combustion dispersion and heat effects, as well as the ability to examine
characteristics of chemical and smoke plumes (See Ryder, Sutula, Schemel, Hamer, & Van
Brunt, 2004); additionally, the Fire Dynamics Simulator enabled the researchers to create and
suggest applications for safety methods regarding fires. Other computer modeling simulators
formulate possible e-business strategies (See Xirogiannis & Glykas, 2007), model cellular
networks (See Voigt, Steil, & Fettweis, 1998), conduct financial analyses and predict financial
risks (See Kugel, 2008).
Virtual, constructive, and live simulations.

The Department of Defense (DoD) defined a set of standards that outlined and defined simulations (Leonard, 2001). Three distinctive classes were acknowledged: virtual simulations, constructive simulations, and live simulations. The DoD classification system will be used to categorize and define simulations in this paper.

Virtual simulations.

Virtual simulations are created to perform as if they were real. Contrary to popular belief, not all virtual environments are three-dimensional (3D). According to the Department of Defense (DoD) (2001), a virtual simulation is one that places the person “in the loop.” Learning occurs *virtus in situ*, or almost in its original place, where the learner “is subjected to an environment that looks, feels, and behaves like the real thing” (Leonard, 2001, p. 118). The virtual simulation is usually a computer-based prototype “with a degree of functional realism that is comparable to that of a physical prototype” (p. 118). The degree to which a simulation is real involves fidelity, which will be discussed in a later section of this paper.

An example of a virtual simulation can be found in Mól, Aghina, Jorge, and Couto’s (2008) study on radiological dose assessment. Mól et al. used a gaming engine as a virtual simulation device to assess doses of radiation in nuclear power plants. In their empirical study, they were able to monitor radioactive conditions in the virtual environment that aided in the training and support of emergency response teams. Unlike the JANNUS project (Serruys et al., 2004), Mól et al. used a simulated network of gaming engines and real monitors from a real nuclear power plant to test the quantity of acceptable toxicity of radiation. The simulation was carried out as if dangerous levels of radiation were actually present in the nuclear power plants. Fortunately, the simulation provided a safe environment
in which to test toxicity levels.

**Constructive simulations.**

Constructive simulations allow for more in depth analysis in the earlier parts and versions of a model’s design (Leonard, 2001). Constructive simulations allow for “improved communication because data can be disseminated rapidly to several individuals concurrently, and because design changes can be incorporated and distributed expeditiously” (p. 118). Constructive simulations include computer-modeling simulations discussed earlier. They are, however, a little bit more complex in that constructive simulations enable the modeling of various aspects of an environment or system. In the case of the JANNUS project, the researchers were able to construct and conduct simulated tests on materials that would be vulnerable to nuclear radiation. Recall that Perumalla and Sundaragopalan (2004) were able to introduce malware into a system of Internet networks without causing any harm, and Mól, Aghina, Jorge, and Couto (2008) were able to test dangerous levels of radiation without causing any harm. Computer model simulations are arguably the safest simulators, but they do lack the human element.

**Live simulations.**

Perhaps the most costly of the three types of simulations is the live simulation. The DoD (Leonard, 2001) defined live simulations as, “simulated operations of real systems using real people in realistic situations” (p. 119). The idea is to test an entire system of people, electronics, communications, and entire “operational scenarios where some conditions and environments are mimicked to provide a realistic operating situation” (p. 119). The best example of a live simulation is a fire drill at a school. Sirens sound, and everyone evacuates the building until the all-clear is given. On a much larger, costlier scale, the Louisiana Maneuvers of the 1940s were
among the U. S. Military’s first live simulations where half a million United States military soldiers battled each other in order to demonstrate their readiness for involvement in World War II (Perry, 2008). What was revealed through these live simulations was the embarrassing truth that, in fact, these soldiers and their commanders were not at all ready for combat. The Louisiana Maneuver of 1941 allowed the U. S. Military to regroup and rethink its involvement in the War. The U. S. Navy would leave for battle first, allowing U. S. Army ground troops to better strategize and prepare for combat.

It is of interest to note that role-play does not fit into the category of live simulation. Although role-play and live simulations do provide samples of human behavior (See Goldenberg et al., 2005), the emphasis of role-play lies on imitation, brief episodes, and often uses case study (See Aristotle, 1961; Feinstein et al., 2002; Gredler, 1996; Reilly & Spratt, 2007).

**Fidelity.**

Many empirical studies regarding simulations have labeled their simulations as “high-fidelity” (e.g. Carron et al., 2011; Dobranich & Blanchat, 2008; Havighurst, L. E. Fields, & C. L. Fields, 2010; Mahvash & Hayward, 2004; Perumalla & Sundaragopalan, 2004). The first question an engineer puts forth is, “How do you define fidelity?” This is a note-worthy question to this study; after all, instructional designers should include the expected level of fidelity they want their learners to experience in a given learning environment so that a learner’s performance of the expected outcome can be observed. Fidelity encompasses user experience and how real that user perceives his or her experience to be.

Fidelity is subjective. In its subjectivity, the concept, or even philosophy, of fidelity becomes increasingly complex (See Perumalla & Sundaragopalan, 2004). Gray (2002)
suggested that something with a high fidelity is “intended as a substitute for the real thing” (p. 206). Bowman and McMahan (2007) described high fidelity simulations as having the ability “to produce a realistic experience for the user that effectively places the user in the simulated environment” (p. 37). Carron, Trueb, and Yerson (2011) explored various research studies in order to define high fidelity as “an interactive and extremely realistic environment” (p. 149) in which training across multiple domains can take place. Carron et al. elaborated by explaining that high fidelity simulations can encompass individuals as well as teams of people under “virtual conditions as close to a real situation as possible” (p. 149). Comparable with Carron et al., others believe fidelity to represent and evaluate experiences authentically and that a simulation must meet a defined set of conditions that emphasizes the authenticity of that experience (Issenberg, McGaghie, Petrusa, Gordon, & Scalese, 2005; Reilly & Spratt, 2007). Authenticating one’s experience is equally as subjective. Does a live simulation present a more authentic learning experience than does a virtual simulation?

In their mixed methods empirical study, Havighurst, Fields, and Fields (2010) defined high fidelity as including “materials and equipment” that simulate the task that the learner is expected to perform. They also defined low fidelity; low fidelity simulations incorporate “materials and equipment that are less similar to what is used on the job” (p. 2). They provided an example of a low fidelity simulation as one in which a person is presented with a verbal description of a scenario and asked how he or she would respond appropriately (Havighurst et al., 2010). Havighurst et al. surveyed 159 participants and interviewed four participants to determine scores of preference of high fidelity simulations versus low fidelity simulations, but found no significant difference from the scores.

Similar to the participants in the Havighurst et al. (2010) study, police officers who
train on a use-of-force simulator called Multiple Interactive Learning Objectives (MILO) use hand-held, simulated weapons as materials and equipment during their high-fidelity simulation experience (IES Interactive Training, 2011). One can argue that both simulations represent a high level of fidelity. This is another example of why it is important for trainers and instructional designers to classify the type of simulator and its level of fidelity. As Page and Smith (1998) noted, “[One] thing you’ll discover…is that while quite often definitive sources for terminology exist, both usage and other published sources do not always match the definitive” (p. 53). The simulator in the Havighurst, Fields, and Fields (2010) study is a high-fidelity live simulator used in fire academies, whereas the MILO simulator would be classified as a high-fidelity virtual training simulator used to train law enforcement personnel.

The intent of Gray’s (2002) study on high-fidelity simulations was to create a means by which to classify simulations and levels of fidelity so that researchers in multiple fields could communicate in a similar language; however, he acknowledged that levels of fidelity are “inherently fuzzy and overlapping” (p. 223) thus creating ambiguity among the various levels of classification. For example, the high fidelity found in a flight simulator used to train commercial airline pilots may not be tantamount to the high fidelity needed in a flight simulator used to train fighter pilots. The simulations would be different; therefore, the learners’ experiences would be different. The purpose of Gray’s article on the role of high-fidelity simulations was to acknowledge the complexity in labeling levels of fidelity. Indeed, fidelity exists on a continuum (Milgram & Kishino, 1994), but that continuum depends on the design and development of the expected outcomes of learning.

In the IEEE’s standards (IEEE Std 1516.4-2007, 1990), fidelity is defined as a “description” of a model or simulation (IEEE Standards Board, 1990). The level of the
description, called high or low, represents the model or simulation’s capabilities in terms of resolution, precision, immersion, etc.. The degree of representation in real-world objects is also considered as high or low. In appraising the level of fidelity, the IEEE also took into consideration “features and conditions for learning” (IEEE Std 1278.1, 1995). This is comparable to the “materials and equipment” discussed in the Havighurst, Fields, and Fields study (2010).

Similar to IEEE standards, Milgram and Kishino (1994) put forth that fidelity can be based on how much one knows about the information being presented, how realistic that information is, and the extent to which one feels a certain “presence” within the demonstrated simulation. Furthermore, Milgram and Kishino suggested that the ultimate goal of fidelity is the user’s feeling of presence, an experience that would make the user feel as if he or she were “participating in ‘unmediated reality’” (p. 10). Milgram and Kishino coined the term “reproduction fidelity,” which alludes to “the quality with which the synthesising [sic] display is able to reproduce the actual or intended images of the objects being displayed” (1994, p. 11).

Bowman and McMahan (2007) described fidelity as a level of immersion. They proposed the question, “How much immersion is enough?” A higher level of immersion would mean a higher level of fidelity. High fidelity applications “rely on the realistic experience that immersive [virtual experiences] provide to the users” (p. 37). In their empirical study, Bowman and McMahan found that higher levels of immersion, or fidelity, can contribute to improved interaction with the user’s task performance. In the same study, Bowman and McMahan found that the total size of the visual field that surrounds the user had no significant effect on users’ task performance; this could be one screen, as in a projected image, many screens as in a 3D virtual environment, or even something as small as the screen on a computer monitor. Instead, it
was the higher levels of fidelity (immersion, per Bowman and McMahan) that led to better user performance and thus a more engaging user experience.

Fidelity is not limited to a computer screen or projector; it can come in many forms. For example, Reilly and Spratt’s (2007) qualitative empirical study examined pedagogical practices that used high-fidelity manikin simulators used by nursing students. The study incorporated observations and focus group interviews for the 21 participants. The manikins used were not the computer-based simulations with which Milgram and Kishino (1994) and Bowman and McMahan (2007) were familiar, but they did allow for the learners to experience a sort of “presence” in their learning; however, “presence” was not tested. The simulator manikins were called Laerdal VitalSim Nursing Anne and Laerdal VitalSim Nursing Kelly. Where Nursing Anne allowed for “in-hospital training targeting key skills for in-hospital care including women’s health, obstetrics, post-partum care, wound assessment and care, and general patient care” (Laerdal Medical, 2011), Nursing Kelly had “anatomical landmarks, trachea and esophagus,…[and] simulated lungs and stomach [that allowed for] the practice of many procedures, including…tracheal care and suctioning” (Laerdal Medical, 2011b) as well as the ability to listen to heart beats, breathing, and bowel sounds. Both simulations were considered high fidelity due to their levels of authenticity. These high-fidelity simulations allowed nursing students to practice targeted skills necessary for completing their job training. Reilly and Spratt found that the nursing students were engaged in their learning because they had experienced an interactive learning opportunity; therefore, Reilly and Spratt deemed the experience successful.

In the same study, however, Reilly and Spratt (2007) also discussed the use of role-play to act out case-based scenarios, as well; interestingly enough, they also described these
role-playing scenarios as high fidelity. Their study revealed that the more engaging of the two types of high-fidelity simulations was the one involving the simulator manikins. This supports Milgram and Kishino’s (1994) idea of “presence,” postulating that the higher the fidelity, the more “present” a learner feels in and with his or her learning experience.

**High fidelity and feedback.**

Many high-fidelity simulators and simulations provide various levels of feedback. Issenberg, McGaghie, Petrusa, Gordon, and Scalese (2005) examined how high-fidelity medical simulations lead to effective learning. In their empirical study, they defined effective learning as any “documented improvement” in the areas of clinical skills, health sciences, practical procedures, etc., where the learner was able to “capture key medical outcomes” (p. 15). Additionally, Issenberg, et al. reported that high-fidelity simulations “facilitate learning under the right conditions” (p. 10), where they described the “right conditions” as a setting in which the learner received feedback. Their 2005 qualitative study found that feedback was the most important feature of a high-fidelity simulator, echoing previous research on the importance of feedback in using high-fidelity simulations (Fanning & Gaba, 2007) and the importance of feedback in general (See Gallimore & Tharp, 1990; Shute, Bauer, & Zapata-Rivera, 2009); however, acknowledging the fluidity of simulations, levels of fidelity, and varying ranges of feedback, Issenberg et al. went a step further and specified three types of feedback from high-fidelity simulators. First, feedback can be built into the simulation though any of a number of assessments; for example, Nursing Anne could react or not react to the treatment administered to the simulator manikin. An additional form of feedback comes from the instructor, who can provide feedback during the learning experience. Here, however, the instructor must stop the simulator in order to give the learner feedback. Finally, feedback can be provided after the
session has been completed; this occurs by discussing the learner’s experience or reviewing a video recording of the session. Fanning and Gaba (2007) called this aspect of feedback “debriefing.” Their critical review of the role of debriefing in learning with simulations showed a change in behavior in learners when video playback was used versus only incorporating verbal debriefing as a means of feedback. Carron et al. (2011) also encouraged videotaping learners’ experiences with a simulator, as well, in order to debrief the learner on his or her learning experience.

Summary

As stated, Issenberg, et al. (2005) suggested that trainers incorporating high-fidelity simulators into their instruction should embrace the idea of mastery learning so as to “produce identical outcomes for all at high performance standards” (p. 24). The limitation, they admitted, is the time it may take for one learner to “master” a skill versus the time a training program allows for learner mastery. Issenberg et al. do point out that simulators – with high or low fidelity – should be used to improve learning rather than used to focus on a learner’s shortcomings. In their conclusion, Issenberg et al. called for more research on the use of high-fidelity simulators by noting,

There appears to be little awareness of the substantive and methodological breadth and depth of educational science…. We conclude that investigators need to be better informed if simulation-based…education is to advance as a discipline. (p. 25)

“More research” can be found in studies like that of Bryans and McIntosh (2000) and Lin and Lehman (1999). In a study on using simulators in nursing assessments, Bryans and McIntosh (2000) used post-simulation interviews to discuss the strengths and weaknesses in nursing students’ community assessment nursing practices. Bryans and McIntosh recorded 45-
minute structured interviews immediately after the participants experienced a role-play simulation. The focus of the interviews was on the simulated assessment in order to assess the knowledge and skills of the nursing students. Additionally, Lin and Lehman (1999) used a mixed methods study to explore the effects of prompting students who were using a computer-based simulator. Their qualitative strand used interview questions during simulation use to ask students specific questions about using the simulator. Each time, the researchers asked the students to “justify their actions” (Lin & Lehman, 1999, p. 853); in other words, they had to explain why they made the decisions they made. They found that in asking for justification the students were able to better reflect on their choices and actions in decision making. This is tantamount to the debriefing that Fanning and Gaba (2007) discussed.

Additionally, context plays an important role in the type of simulator to be used. When Gray (2002) discussed simulated-task environments, he argued that high-fidelity simulators are “intended as a substitute for the real thing” (p. 206), and they are used to train teams as small as 3-member flight crews or as large as 400-member soldier battalions. It is important to note, as Gagné (1954) suggested nearly sixty years ago, “perfect simulation is never completely achieved” (p. 96). Additionally, McGaghie (1999) reminded researchers that simulators are dynamic in their many uses. For example, simulations can be automated; they can use a variety of advanced technologies; they can be static or interactive; they can be game-like or serious. The fidelity, however, “is never completely isomorphic with the ‘real thing’” (p. 9). As the Louisiana Maneuvers demonstrated, high-fidelity simulations, great or small, are vital training devices that can target specific key skills and increase task performance. Simulators and simulations allow learners to be immersed in the learning to the point where they feel a certain presence. The literature presented here has shown that
Simulators and simulations lead to effective learning by providing experience in a safe environment, in addition to providing a variety of ways to encourage and support feedback.

**Self-efficacy Theory**

**Background and Overview**

Unlike the variety of literature covering simulators and simulations, the literature covering self-efficacy theory is grounded in but a few main researchers. With his groundbreaking theory of self-efficacy, Bandura described this phenomenon as the belief in one’s capabilities; he explained,

> [an individual’s]…expectations of personal efficacy determines whether coping behavior will be initiated, how much effort will be expected, and how long it will be sustained in the face of obstacles and aversive experiences. (1977, p. 191)

Self-efficacy theory vacillates between behaviorism and cognitivism. It is a cognitive theory with strong behaviorist influences. The goal of self-efficacy is a change in one’s behavior; however, that goal is also a “cognitive event” that is “induced and altered most readily by experience of mastery arising from effective performance” (Bandura, 1977, p. 191). Zimmerman (2000) described self-efficacy as a “performance-based measure of perceived capability” (p. 82).

Bandura’s self-efficacy theory is rooted in its theoretical predecessor of self-reinforcement, which is one’s capability of behavior maintenance (Bandura & Perloff, 1967). In an empirical study, Bandura and Perloff (1967) tested how human subjects, specifically children, used self-monitoring to reinforce personal performance standards. The study found that the children chose self-imposed schedules of reinforcement that created high effort and low self-reward; this resulted in high productivity and high personal performance standards. Because
of the children’s exemplary self-monitoring, Bandura and Perloff suggested that further research examine individuals’ self-monitoring systems and self-reinforcement, as well as the external influences that may affect performance outcomes.

Because Bandura and Perloff (1967) believed there to be both a change in an individual’s behavior and a reason for that change, Bandura then explored the concept of behavior maintenance in one’s self-efficacy. In self-efficacy theory, Bandura (1977) put forth that experiencing performance-based procedures was considered more effective to influencing psychological changes; therefore, one’s actual experience, rather than simply discussing something, was the key factor to a successful change in behavior. It was time to move away from studying animals in the lab to studying humans in natural settings, for as Bandura and Perloff (1967) noted,

“Unlike rats or chimpanzees, persons typically set themselves certain standards of behavior, and generate self-rewarding or self-punishing consequences depending upon how their behavior compares to their self-prescribed demands” (p. 111).

**Differentiating self-efficacy and self-esteem**

It is, perhaps, important to note here that there is a difference between self-efficacy and self-esteem. Self-efficacy is based on one’s competencies and actions; self-esteem is based on one’s emotions (Luszczynska, Gutiérez-Doña, & Schwarzer, 2005). The National Association of Self-Esteem (2010) defined self-esteem as "The experience of being capable of meeting life's challenges and being worthy of happiness.” Brown (1993) defined self-esteem as an individual’s evaluation of himself or herself in either a positive or negative way. In an empirical study on self-esteem and job performance, the researchers determined that self-esteem was indicative of one’s motivation and not one’s skills or procedural knowledge
(Ferris, Lian, Brown, Pang, & Keeping, 2010). Conversely, Bandura (1967, 1977, 1997, 2000) argued that self-esteem was not a good predictor of behavior because it is not based on “skill or procedural knowledge,” as Ferris et al suggested. Instead, Bandura put forth that self-efficacy is a good predictor of behavior because it is based on outcomes, whereas self-esteem was not a good predictor of behavior because it is “weaker,” being based on emotions and motivation, as Luszcynska et al. described, and not based on specific skills. Bandura (1997) explained,

The self-concept is a composite view of oneself that is presumed to be formed through direct experiences and evaluations adopted from significant others….Perceived self-efficacy is concerned with judgments of personal capability, whereas self-esteem is concerned with judgments of self-worth (pp. 10-11).

**From behaviorism to cognitivism and between**

Bandura’s theoretical paradigm shift from behaviorism to a more cognitive approach throughout the late 1960s and 1970s demonstrated more than just a transition in learning theories. Bandura was interested in one’s capabilities, and thus moved from examining individuals’ self-monitoring and self-reinforcement systems to focusing on individuals’ personal belief systems regarding task and performance-based outcomes. Bandura’s (1977) theoretical shift went from looking at an individual’s behavior to looking at an individual’s experience as the primary medium of change in behavior; he called these experiences “cognitive events…resulting from diverse modes of treatment” (p. 191), which, he explained, were grounded in learning theory.

As an example of this shift in theory, one can see years of studies that incorporated the cognitive events of observational learning (See Bandura, 1969, 1971, 1976; Bandura &
Perloff, 1967). Bandura believed that people could learn from observational responses rather than simply respond to stimuli, making learning a cognitive process (Bandura, 1977). Bandura suggested, “Behavior is related to its outcomes” (1977, p. 192); however, he suggested that the way people process feedback from behavior-related events is what often produces a given outcome (1977).

The culminating idea behind self-efficacy is that individuals are able to change their expected outcomes by changing their cognitive outlook. An individual’s outcome expectancy is his or her belief that “a given behavior will lead to certain outcomes” (Bandura, 1977, p. 193). Outcome expectancies refer to “positive or negative consequences of a specific action” (e.g. diving off of the high-dive; baking a pie) (Luszczynska, Scholz, & Schwarzer, 2005, p. 441). Additionally, efficacy expectation is “the conviction that one can successfully execute the behavior required to produce the outcomes” (p. 193). Outcome expectancy and efficacy expectation differ in that it is possible for a person to believe that certain actions (or inactions) will produce certain outcomes; however, if that person entertains doubts about whether or not he or she can perform those actions, then it is therefore likely that the doubt, or lack of belief, can influence his or her behavior, thereby influencing the overall outcome of the action (1977). These expectancies are cognitive ways of coping with expected behaviors. Figure 1 shows an example of Bandura’s hypothesis of this coping behavior, which he called “perceived self-efficacy.” Bandura hypothesized, “The strength of people’s convictions in their own effectiveness is likely to affect whether they will even try to cope with given situation” (1977, p. 193).
Figure 1. Self-efficacy model.

Self-efficacy, or the belief in one’s capabilities, affects what he or she can do in the expected outcome. Adapted from (Kakudate et al., 2010).

Experiencing behavioral change.

Bandura believed that one’s performance could be modified through various extrinsic and intrinsic influences (1969); however, as Bandura (1982) later noted, “A capability is only as good as its execution” (p. 122). People’s preconceptions and judgments can determine the amount of effort, or lack thereof, that they exert in a specific performance (Bandura, 1977, 1982; Bandura & Cervone, 1983).

Bandura (1977) has suggested that efficacy influences and expectations can come from four sources: personal performance accomplishments; vicarious experience; verbal persuasion; and emotional arousal. Figure 2 shows the four sources that strengthen one’s self-efficacy. This strengthening process is known as self-regulating behavior (Bandura, 1982) and again represents another transition from the behavioral approach to a more cognitive one.
Figure 2. Influences of self-efficacy.

Self-regulating behavior can strengthen one’s self-efficacy and have a positive effect on his or her efficacy expectations.

**Performance accomplishments.**

According to Bandura (1977), performance accomplishments are a source of self-efficacy because they stem from one’s prior knowledge, as well as from one’s prior personal “mastery experiences” (Bandura, 2000). An individual is more likely to experience higher self-efficacy if he or she has been successful in carrying out a certain performance skill in which he or she has had past successful experiences; however, if past experiences are deemed less fruitful, the individual’s perceived self-efficacy for future similar events will most likely be lower. For example, in an empirical study on the anxiety levels and self-efficacy of deep-water swimmers, Feltz (1982) found, “As one gained experience on the task, performance had a greater influence on self-efficacy than self-efficacy had on performance” (p. 764). The swimmers who performed well modified their behavior by putting forth more effort to perform better. Continued performance decreased the swimmers’ anxiety levels and increased their self-efficacy, resulting in better swim and dive performance.

If past experiences have led to current fears or anxieties, Wolpe suggested a desensitization approach, where individuals are gradually exposed to the aversive stimuli over
time (1974, as cited in Bandura, 1977). Bandura suggested that the treatment of phobia patients focus on performance accomplishments. The idea is that a patient could be desensitized to the fear he or she faced. Additionally, it was hypothesized that exposing these patients to the feared phenomenon would weaken their fear and eventually increase their ability to perform in the same given situation (Rabavilas, Boulougouris, & Stefanis, 1976).

In an empirical study on agoraphobics (Bandura, Adams, Hardy, & Howells, 1980), treatment included small group sessions to lessen anxiety and build self-efficacy. As subjects progressed and demonstrated a mastery of performance capability, they were slowly introduced to larger groups and bigger crowds where Bandura et al. (1980) measured subjects’ “perceived efficacy to venture into public territory” (p. 53). The subjects drew upon their successful past experiences with small groups, with walking down city streets by themselves, and riding in elevators with other people, among other positive past performances. Bandura et al. (1980) found that “strength of efficacy [was] substantially boosted by the enactive mastery treatment” (p. 58). Ultimately, it is one’s experience with successful mastery that will eventually lead to a strengthened sense of self-efficacy.

**Vicarious experience.**

Vicarious experience occurs when one individual witnesses another individual perform a feared activity without experiencing any negative consequences (Bandura, 1977). For example, a person with a fear of heights may not want to jump off of a high dive into a pool, but if he or she witnesses a successful dive by someone else, the person’s perceived self-efficacy may have been strengthened through the vicarious experience. Another example could have come from the study on agoraphobics (Bandura et al., 1980); had Bandura et al. video recorded others in a restaurant or walking alone down the street, they could have shown the video to the subjects
who could have lived the experience vicariously. Another example is found in Hamill’s (2003) empirical study, where she explored self-efficacy and resilience in adolescents. Hamill questioned how adolescents developed competence in the face of adversity. Her study showed that adolescents looked to observing others as a means of learning. Additionally, the parents played a significant role, as many of the adolescents claimed that by listening to and following the rules of their parents they were less likely to succumb to external pressures they may have faced. Hamill put forth, “Unless people believe they can produce desired goals through their actions, they will have very little incentive to persevere in the face of difficulties” (2003, p. 116).

**Verbal persuasion.**

Through the power of suggestion, some people can be lead to believe they can do just about anything. Bandura (1977) calls this source of self-efficacy verbal persuasion. Most recently, he has referred to verbal persuasion as “social modeling” (Bandura, 2000). If a person is persuaded that he or she can do anything, then he or she is more likely to put forth more effort to try rather than hold on to personal doubts or focus on his or her deficiencies (2000). For example, a swimmer with a fear of the high-dive may be coached into jumping by hearing the swim coach’s encouraging words of “You can do it!” or “You won’t get hurt! Just jump!” Because this source of self-efficacy comes from others, Bandura also refers to it as “social persuasion” (2000). In an empirical study on Union members in the U. S. and the U. K., Mellor, Barclay, Bulger, and Kath (2006) examined the effect of verbal persuasion on self-efficacy in a union environment. They based their study on Bandura’s theory that a person perceives that he or she shares aspects of a situation or task with the role model introducing the situation or task, thus augmenting the influence of verbal persuasion (Bussey & Bandura,
The study from Mellor et al. implied that same-gendered relationships among union members influenced the effect of the member’s verbal persuasion in relation to self-efficacy (Mellor et al., 2006). They found that gender similarity and verbal persuasion by a steward interact to influence self-efficacy…such that the influence of verbal persuasion on self-efficacy will be strongest for same-gender cases and weakest for cross-gender cases (2006, p. 122).

Bussey and Bandura warned that although verbal persuasion is the easiest and most readily available, it is also the least reliable in strengthening one’s self-efficacy (Bandura, 1977; Bussey & Bandura, 1999), as there are no tangible reinforcements or examples, which could lead to a relapse of the fear or anxiety (Bandura, 1982).

Emotional arousal.

Perceived self-efficacy can also be influenced by a person’s “physical or emotional state” (Bandura, 2000); if someone feels anxious or vulnerable, he or she is less likely to have a high level of self-efficacy (Bandura, 1977). When people rely on negative emotions like fears and anxieties, they tend to judge their own capabilities more harshly than otherwise (Bandura, 2000; Kavanagh & Bower, 1985). Moreover, if a person feels pain or physical tension, he or she is more likely to use the pain as an indicator of low self-efficacy (Bandura, 1977, 2000). In a qualitative empirical study involving 16 university students, Kavanagh and Bower (1985) examined the influence of a person’s mood (e.g. happy, sad, anxious, etc.) on efficacy judgments regarding a variety of tasks. They posited that emotional arousal was a kind of filter that determined performance outcomes; they also suggested that emotional arousal was a “framework people use to interpret and evaluate selected [tasks]” (p. 508). The subjects who were self-critical and held negative opinions of themselves accurately predicted failure in their
own performance outcomes. For this reason, they believed that emotional arousal predicted a person’s achievement “even more closely than does past performance of the activity” (p. 508). This is in addition to the contextual and social environments (Bandura, 1982) that can trigger thoughts of ineptness, which can then lead to an increase in anxiety and a decrease in self-efficacy.

**Perceived self-efficacy.**

Twenty years after Bandura (1977) published his first definition of self-efficacy, he updated his explanation to read,

Self-efficacy theory acknowledges the diversity of human capabilities. Thus, it treats the efficacy belief system not as an omnibus trait but as a differentiated self of self-beliefs linked to distinct realms of functioning…. [It] is a generative capability in which cognitive, social, emotional, and behavioral subskills [sic] must be organized and effectively orchestrated to serve innumerable purposes. In short, perceived self-efficacy is concerned not with the number of skills you have, but with what you believe you can do with what you have under a variety of circumstances. (Bandura, 1997, pp. 36–37)

Bandura (1997) also added to his definition of perceived self-efficacy, that “beliefs in one’s capabilities to organize and execute the courses of action [are] required to produce given attainments” (p. 3). Perceived self-efficacy affects a person’s choices and the course of action used to carry out those choices (1997) – an agoraphobic choosing to walk down a city street alone or choosing to stay inside.

It has been shown that self-efficacy is a human function (Bandura, 2000) that can make one flourish as easily as it can make one fail. It is a powerful cognitive process that can “enable people to predict events and to exercise control over them” (Bandura, 2000, p. 212).
Schunk and Pajares (2002) put forth that self-efficacy is not only influential on one’s perception of individual task performance, but it is also “an important determinant of achievement” (p. 16). Schunk and Pajares explained,

Compared with [others] who doubt their learning capabilities, those who feel efficacious for learning or performing a task participate more readily, work harder, persist longer when they encounter difficulties, and achieve at a higher level (p. 16).

How one copes is often times how one is able to control his or her self-efficacy (Bandura, 1977, 1982, 1993, 1997, 2000; Bandura et al., 1980). Self-efficacy can reduce fears and anxieties, what Bandura has referred to as “fear arousal” (1977, 1982, 1997); in this case, perceived self-efficacy acts as a “cognitive mechanism” for coping with the fear arousal (1982). The cognitive mechanism of perceived self-efficacy is tantamount to the idea of “mind over matter,” or as Bandura called it, “belief over brawn” (1982, p. 142).

Influences that undermine high self-efficacy.

Individuals who possess low self-efficacy doubt their abilities to perform in given situations to achieve expected outcomes. Uneasy with their levels efficaciousness, these individuals often experience low motivation, diminished skills, weak commitment, and half-hearted efforts toward performance-based goals (Bandura, 1997). Unfortunately, diminished self-efficacy in one’s capabilities leads to “the formidableness of the task and the adverse consequences of failure” (1997, p. 39). The thoughts that plague those with low self-efficacy are the beginnings of what undermines individuals’ efforts and analytical thinking by “diverting attention from how best to execute activities to concerns over personal deficiencies and possible calamities” (1997, p. 39). Bandura also pointed out that individuals who experience low self-efficacy usually develop stress and depression easier than those individuals who have higher
levels of efficaciousness. Low self-efficacy affects both performance and aptitude.

Declining self-efficacy can come from disuse, undermining cultural practices, and even biological aging (Bandura, 1997). Bandura (1982) suggested a variety of influences that can undermine one’s personal sense of self-efficacy. Other influences identified by Bandura (1982) and Schunk and Pajares (2002) include situational factors; complex modern technologies; the presence of a more confident individual; unfamiliar or new tasks; self-debilitating thoughts; being assigned an inferior label; or being cast in a subordinate role relative to the roles of others, as indicated by Langer and Benevento (1978). In an empirical study that explored how people “erroneously [inferred] incompetence” from a variety of environmental factors, the researchers identified a number of causes that influenced individuals’ “performance debilitation” (Langer & Benevento, 1978). When individuals were assigned inferior labels in their workplace relative to other workers, such as “assistant” to a “boss,” they tended to display an “illusion of incompetence” (p. 893) in their work-related activities, as well as weakened task performance and lower expectations. According to Bandura (1982), circumstances like the one described in the Langer and Benevento (1978) study represent “demoralizing conditions” that lead to undermining one’s self-efficacy; hence, failed external, task-related outcomes become internally incorporated (Langer & Benevento, 1978), thereby leading to a lowered self-efficacy (Bandura, 1982; Schunk & Pajares, 2002). On a side note, Bandura also implied that individuals who experienced a decline in self-efficacy due to a subordinate role or an inferior label probably had limited competence to begin with (1982, p.142).

**Self-efficacy in occupational training.**

Self-efficacy does not confine itself within the walls of the laboratory or treatment center. It is with individuals on the high dive or the agoraphobics who courageously walk
through crowded city streets for the first time, or even with graduate students struggling to write a dissertation. Self-efficacy, being a human condition (Bandura, 1977; 1997; Schunk & Pajares, 2002), exists in individuals’ lives everywhere they go; this includes, but is not limited to, home, school, and work.

Bandura (1997) discussed self-efficacy in the realm of occupational training. Bandura also theorized that “efficacy beliefs predict the range of career options people consider viable for themselves” (1997, p. 423); in other words, self-efficacy beliefs influence career choice, too. People who have doubts about their capabilities in a given occupation often pass up opportunities to succeed when presented with them.

As has been stated previously, those with a high sense of self-efficacy tend to perform better than those with a low sense of self-efficacy; this idea transfers to the workplace. Van Maanen and Schein (1979) put forth that those who are new to a job often respond to their expected roles differently than those who are not newcomers. Bandura (1997) found that during the period of newcomer training, those who arrived to their new jobs with a high sense of self-efficacy learned more and outperformed their low self-efficacy counterparts. Bandura used an empirical study by Saks (1994, 1995, as cited in Bandura, 1997) to conclude that training contributed to the overall growth of workers’ occupational self-efficacy. From this idea, Bandura postulated that training programs in workplaces should prepare workers for the roles they would be expected to perform. He also suggested that in order to increase worker self-efficacy, the training program should include ways for workers to develop and/or improve their technical skills; discussion on what would be expected of the workers beyond the nature and scope of their professional duties; how to balance their workload with the time pressures as well as job stressors; and how to work with others (1997). Bandura postulated that including these
goals in a training program would contribute to the overall effectiveness of a successful training program that would also increase self-efficacy among individuals in the workplace.

Self-efficacy also plays a significant role with individuals new to working or who are seeking a career change. Either way, one’s perceived self-efficacy is related to how he or she views past experiences in the workplace. Jones (1986) suggested that the knowledge and skills that newcomers acquired through their past work experience also influences self-efficacy, which, in turn, will influence how they choose to deal with the ambiguities and uncertainties that exist in a new job. In an empirical study, Jones hypothesized that newcomers’ levels of self-efficacy would influence the effects of the occupational approaches on role orientation within the organization. He found newcomers with low self-efficacy were more likely to conform to preconceived notions dictated by others. In other words, an individual’s level of self-efficacy did indeed influence the effect of occupational approaches on role orientation; however, Jones noted that in certain situations, newcomers “have no other choice but to respond to organizational commands” (p. 275). In order to combat such organizational demands, Bandura (1997) suggested four methods in which workplace training can help the newcomers develop their self-efficacy: engage in formal training; teach the specific roles to appropriate individuals; specify how each individual’s role is expected to be performed; and encourage each newcomer to develop his or her own approach to the expected work role. This type of training not only encourages the development of work-related skills, it also allows the newcomers to experience a higher sense of perceived self-efficacy in their abilities to perform the expected outcomes within their new job.

Measuring perceived self-efficacy.

Recall that Zimmerman (2000) described self-efficacy as a “performance-based
measure of perceived capability” (p. 82). Bandura (1977) suggested measuring perceived self-efficacy based on how much an individual believes he or she is capable of performing a certain task. He later modified this suggestion by stating, “Measures of personal efficacy must be tailored to domains of functioning and represent gradations of task demands” (1997, p. 42). Bandura (1997) intended self-efficacy to be measured in terms of judgments of capability, which include realm of activity, differing levels of task demands within the activity domain, and differing situational circumstances. To be more specific, Bandura instructed,

Self-efficacy scales should measure people’s beliefs in their abilities to fulfill different levels of task demands within the psychological domain selected for study. Including a wide range of task demands identifies the upper limits of people’s beliefs as well as gradations of strength of perceived self-efficacy below that point. (p. 44).

Perceived self-efficacy judgments are usually measured using task-specific questionnaire items (Bandura, 1977; B. J. Zimmerman, 2000); however, other researchers have used a more generalized self-efficacy scale (Schwarzer & Jerusalem, 1995). It should be noted that Bandura and other researchers that support his theory do not support the use of generalized self-efficacy scales (See Pajares, 1996).

While domain-specific self-efficacy scales are often better predictors of an individual’s task outcomes and are often preferred to the more generalized scale, Pajares (1996) warned that task-specific scales require a variety of subskills from each domain; therefore, there may be much overlap in subskills for one task-specific skill. Additional to task-specific scales, self-efficacy measures should also be sensitive to the variety of contexts in which performance expectancies are based (Zimmerman, 2000; Schunk and Pajares, 2002).

In either questionnaire, it is important for the respondent to understand that he or she
is responding to questions about performance capabilities, not personal qualities (Zimmerman, 2000) or self-esteem (Ferris, Lian, Brown, Pang, & Keeping, 2010). Zimmerman also urged, “self-efficacy judgments specifically refer to future functioning and are assessed before [emphasis added] [individuals] perform the relevant activities” (p. 84). The idea of administering the self-efficacy assessment prior to performance is to help motivate the individual in performing the task-based outcome (Zimmerman, 2000).

**Efficacy beliefs in self-efficacy measurement.**

Efficacy beliefs vary based on their implied performance outcomes. They are “structured by experience and reflective thought rather than being simply a disjointed collection of highly specific self-beliefs” (Bandura, 1997, p. 51). There are three areas by which efficacy beliefs differ: level, generality, and strength (Bandura, 1997).

*Level.* Bandura explained that the very nature of a task by which personal self-efficacy can be judged varies by a number of challenges: level of ingenuity; exertion; accuracy; productivity; threat; and amount self-regulation required (pp. 42-43). In constructing the measurement scale for the level of efficacy belief, individuals are asked to describe things that make it difficult for them to perform the required activity. For example, in measuring high-dive efficacy, a diver is asked to judge the strength of his or her belief that he or she can jump off of the diving board. If the dive proves to be a difficult task, the diver would explain why; perhaps he or she has developed a fear of heights or a fear of falling.

*Generality.* Bandura (1997) also explained that because of the wide range of activities and domains, generality varies on a number of dimensions. Generality includes, the degree of similarity of activities, the modalities in which capabilities are expressed (behavioral, cognitive, affective), qualitative features of situations, and the
characteristics of the persons toward whom the behavior is directed (Bandura, 1997, p. 43).

**Strength**. Efficacy beliefs also vary by levels of strength – weak versus strong efficacy beliefs (Bandura, 1997). The stronger the sense of self-efficacy one has, the greater perseverance from the individual, as well as a stronger likelihood of successful performance outcome. Bandura instructs that in order to measure the strength in self-efficacy beliefs, the scaled items should be phrased “in terms of can do rather than will do. Can is a judgment of capability; will is a statement of intention” (p. 43); he further added, “The view that efficacy beliefs are intentions is conceptually incoherent and empirically disputed” (p. 43).

**Self-efficacy and qualitative studies.**

The majority of empirical research on self-efficacy has been conducted using quantitative methods, as researchers have used numerical scales to measure participants’ perceived self-efficacy. A numerical self-efficacy scale lends itself to the ease and convenience of statistical analysis. However, some researchers sought a deeper understanding behind the numbers and explored qualitative methods to ask participants questions and observe them in natural settings (See Kavanagh & Bower, 1985; Usher, 2009). For example, Lane, Devonport, and Horrell conducted a mixed methods study that investigated the differences that self-esteem and self-efficacy had on students’ abilities to conduct and carry out various research methods (2004). Another qualitative research study explored self-efficacy in older people with hypertension (Lee, Avis, & Arthur, 2007); it focused on the influence of a walking program on people’s self-efficacy to initiate and maintain a regimen for exercise. Kolopaking, Bardosono, and Fahmida (2010) used in depth interviews to examine the self-efficacy of urban Indonesian mothers’ abilities to provide nutritional food to their children. Recall that Kavanagh and Bower (1985) conducted a
qualitative empirical study involving 16 university students where they examined the influence of a person’s mood on efficacy judgments regarding task performance. They used observations and interviews with their subjects. Additionally, Usher (2009) conducted a qualitative study where she explored middle school students’ perceived self-efficacy. She interviewed eight different students for her study. She used semi-structured interviews to gather information from the students, and she used four preconceived categories, which she based on Bandura’s (1977) influences of self-efficacy: performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal.

Summary

As stated prior, perceived self-efficacy can have an influence on performance-based outcomes. Many studies on a variety of topics - from athletes to corporate executives - have shown that if the perceived self-efficacy is high, the person will most likely extend the effort and perform well, whereas a low self-efficacy may lead to low effort and poor performance outcomes (Krueger, Jr., & Dickson, 1994; Schunk & Pajares, 2002). Changes in one’s behavior can come from many sources based on past successes and failures. Recall that the emotions and anxiety levels in the swimmers in Feltz’s (1982) study were affecting their overall performance accomplishments. In Usher’s (2009) study on self-efficacy in adolescents regarding math, the researcher looked at external influences coming from parents and schools; in Usher’s study, social experiences affected performance accomplishments.

The literature presented in this review has shown that simulators and simulations can lead to effective learning (Gagné, 1954; Issenberg et al., 2005; Larew et al., 2006) by teaching knowledge and procedures (Carron et al., 2011; Hunter & Ravert, 2010; Murray, 1972) through practical instruction (Gallagher & Satava, 2002) and models of complex real-world situations
(Gredler, 1996). Additionally, this review of literature includes a discussion of self-efficacy and a presentation of a variety studies that focused on self-efficacy. As the literature has shown (Bandura, 1977, 1993; Feltz, 1982; Goldenberg et al., 2005; Kavanagh & Bower, 1985; Schunk & Pajares, 2002; Usher, 2009), perceived self-efficacy has an equally important presence in learning, as well. Having a high perceived self-efficacy about a certain task can lead to positive performance outcomes (Bandura, 1977, 1997; Bandura et al., 1980; Jones, 1986; Kavanagh & Bower, 1985; Krueger Jr. & Dickson, 1994; Mellor et al., 2006; Pajares, 1996; Schunk & Pajares, 2002; Rabavilas et al., 1976). Researchers have also indicated that using high-fidelity simulators leads to mastery learning, also known as “performance accomplishment,” which produces higher performance outcomes (Issenberg et al., 2005; Larew et al., 2006).

High-fidelity simulators and simulations also provide learners with feedback, which is considered to be “the most important feature of simulation-based...education” (Fanning & Gaba, 2007, p. 115). As noted earlier, feedback is a form of communication that augments the influence of verbal persuasion, which, in turn, influences a person’s perceived self-efficacy (Bussey & Bandura, 1999). Simulators and simulations provide realistic experiences that can mimic real-world situations (Gredler, 1996; Reilly & Spratt, 2007) allowing for in depth learning opportunities (Larew et al., 2006). This allows for vicarious experiences as learners have the opportunity to observe one another (Bandura, 1977) in the simulator or experience the tasks in the simulator together. Another beneficial feature of simulators and simulations is that they provide a safe environment in which to learn (Carron et al., 2011; Gallagher & Satava, 2002; Kneebone, 2005; Squire, 2006). Simulators and simulations provide “the need to be able to train in a highly specialized and safe environment” (Carron et al., 2011, p. 152). Gallagher and Satava (2002) believed that a safe environment allowed learners to develop the needed
skills for the task they would be expected to perform in the future. A safe environment also means fewer external anxieties to influence the learner’s emotional arousal.

Table 1 illustrates how using simulators and simulations supports Bandura’s self-efficacy theory. Simulators and simulations are also used for the purposes of training, assessing, and providing feedback across a myriad of disciplines.

Table 1: *Tabled presentation of how simulators support Bandura’s Theory of Self-Efficacy*

<table>
<thead>
<tr>
<th>Purpose of Simulators</th>
<th>Influences of Self-Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides “experience”</td>
<td>Previous Experience</td>
</tr>
<tr>
<td>Provides feedback</td>
<td>Verbal Persuasion</td>
</tr>
<tr>
<td>Allows for multiple trials and demonstrations</td>
<td>Vicarious Experience through observations</td>
</tr>
<tr>
<td>Safe environment in which to fail</td>
<td>Emotional Arousal (continued failure can lead to low self-efficacy)</td>
</tr>
</tbody>
</table>

A few studies have shown that trainers and instructors used simplistic forms of simulation (e.g. roll-play and case study review) to measure self-efficacy, but not necessarily to improve it (See Goldenberg et al., 2005; and Kameg et al., 2010). This form of simulation does not place the learner in the most naturalistic environment (Bandura, 1997). Using higher forms of fidelity, high immersion simulations would benefit learners in increasing their self-efficacy because the higher levels of immersion provide the learners the ability to experience training and learning in the confines of a safe environment.

**Sample studies**

Goldenberg et al. (2005) used surveys and interviews in an empirical mixed methods study; however, their study focused on role-play simulation and self-efficacy and not high-fidelity simulators and self-efficacy. Furthermore, the researchers did not administer their follow-up survey until two months after the students had participated in the role-play simulation.
This current study herein aimed to improve upon the Goldenberg et al. study by administering self-efficacy surveys combined with task-specific surveys immediately before and immediately after participants used the high-fidelity virtual training simulator.

In another study involving simulators and self-efficacy, Kameg et al. (2010) used a media comparison to determine if students liked learning with a simulator versus learning from direct lecture. Their study found that students preferred working with the simulator which the researchers believed lead to an increase in self-efficacy. This study aimed to improve upon the Kameg et al. study by focusing on how the simulator influenced the participants’ learning experiences.

Davis et al. (2000) examined self-efficacy and self-esteem in their empirical study. The Davis, et al. study did not allow for the participants to receive any previous training before using the simulator; instead, participants learned content while in the simulator. No significant difference was found in self-efficacy or self-esteem. This study aimed to improve upon the Davis et al. study by not including self-esteem in the study, as Bandura had specifically stated that the two are different and should not be combined in studies (Bandura, 1997); self-esteem, he said, was not found to be a predictor of behavior. Additionally, after examining the Davis, et al. research and methodology, this study focused on simulator use after training had occurred, rather than before training had occurred, as did Davis, et al.

The literature has also shown that the higher a person’s self-efficacy, the higher his or her outcome expectancy (Bandura, 1977, 1997; Feltz, 1982; Kavanagh & Bower, 1985); likewise, the higher the fidelity of a simulator, the more realistic the learning experience, and the better opportunity for mastery learning (Bowman & McMahan, 2007; Bradley, 2006; Bryans & McIntosh, 2000; Carron et al., 2011; Gallagher & Satava, 2002; Havighurst et al.,
2010; Issenberg et al., 2005). To date, studies that investigated high-fidelity simulators did not also investigate learners’ self-efficacy.

Finally, this research aimed to improve upon the three previous studies in that it used task-specific items on the self-efficacy scale, whereas the aforementioned studies used only a generalized self-efficacy scale (Schwarzer & Jerusalem, 1995, Davis et al., 2000; Goldenberg et al., 2005; Kameg et al., 2010). Havighurst, Fields, and Fields (2010) came close to this kind of research, but their research was on the use of a high-fidelity live simulation; additionally, they did not specifically investigate self-efficacy; rather, the focus of their study was on users’ general perceptions of their experiences in the fire department. Recall that Issenberg, et al. (2005) argued that levels of fidelity be defined in research studies. Additionally, Issenberg et al. called for more research on the use of high-fidelity simulators due to the lack of awareness of the potential impact high-fidelity simulators could have on education at all levels and across all domains.

**Need for the study**

A simulator or simulation provides a safe environment in which to make mistakes or to fail. Typically, it is failure that leads to negative emotional arousal, lack of performance accomplishments, and decreased self-efficacy. As technology progresses, more and more high-fidelity simulators will find their ways into training programs across a variety of disciplines. Learners can utilize these tools for practice and training purposes in order to build the needed personal repertoire of positive performance accomplishments and positive emotional arousal; this, in turn, might lead to a heightened self-efficacy and higher performance outcomes.

The paucity of literature discussing the effects of high-fidelity virtual training simulators on learner self-efficacy in the workplace suggested the need to complete an
exploratory study that examined the influences of a high-fidelity virtual training simulator on learners’ self-efficacy in the workplace. In addition, such a study would add to the literature database in a way that would encourage further research and create an awareness of additional uses of high-fidelity virtual training simulators, as well as add to “the substantive and methodological breadth and depth” (Issenberg et al., 2005, p. 25) of interdisciplinary research.
Chapter III: Methodology

This chapter expands upon the purpose statement and research questions for this research study. It also includes a description of the data participants, data collection, and context of investigation. Finally, it describes the research design and procedure and the data analysis techniques.

Purpose Statement

The purpose of this study was to explore learners’ perceived self-efficacy regarding “task-specific performance outcomes” (Bandura, 1977, 1997, 2006) after having used a high-fidelity virtual training simulator. A convergent parallel mixed methods design was used for this study. Creswell and Plano-Clark (2011) defined convergent parallel mixed methods as a type of design in which qualitative and quantitative data are collected in parallel, analyzed separately, and then merged.

In the quantitative strand of this study, perceived self-efficacy questionnaires were used to investigate the influence of the high-fidelity virtual training simulator on learners’ perceived self-efficacy by finding the difference in learners’ self-efficacy scores before and after using the simulator. The qualitative strand of data consisted of observations and interview questions. Observations and answers to the interview questions provided insight into learners’ experiences and perspectives (Rossman & Rallis, 2003) on using high-fidelity virtual simulators for training purposes. The reason for collecting both quantitative and qualitative data was to combine the two forms of data in order to provide a more robust understanding of the influence of a high-fidelity virtual simulator on learners’ perceived self-efficacy than would be obtained by either type of data separately.
Research Questions

In order to explore users’ perceived self-efficacy prior to and after receiving training using high-fidelity virtual training simulation tools, this research study was guided by the following research questions:

Quantitative Research Question:
1. Is there a difference between learners’ perceived self-efficacy prior to and after using a high-fidelity virtual training simulator to perform specific tasks?

Qualitative Research Questions:
2. What are learners’ perceptions of their training experience with the high-fidelity virtual training simulator?
3. What aspects of the training experience with the high-fidelity virtual training simulator influenced learners’ perceived self-efficacy?

Research Participants

This study used purposive sampling techniques, where the participants were selected specifically because they were scheduled to use a high-fidelity virtual training simulator for their training purposes. According to Patton (2002), this method is often used for smaller sample sizes and is used to add credibility and reduce judgment.

Participants and location.

According to Lenth (2001), a sample size should be “adequate…and relative to the goals of the study” (p. 2). Likewise, Preacher and MacCallum (2002) maintained, “limitations on sample size are often unavoidable” (p. 153). The sample size for this research study was 18, which was both “adequate” and “unavoidable” for this study. The participants in this study were
law enforcement recruits from a law enforcement academy, where the average class size was approximately 20. Lenth (2001) reminded researchers that in practical situations, sample size is often determined by external factors such as budgets, time, and participant availability. If the sample size is small, the researcher should “focus on other aspects of study quality” (Lenth, 2001, p. 6). For this reason, the qualitative strand was added and included both interviews and observations in order to add to the breadth of data collected.

This study consisted of male and female law enforcement recruits enrolled in a law enforcement academy (called The Academy, a pseudonym) located in rural Virginia. At the time of the study, 18 recruits were enrolled. All recruits were at least 18 years old, as required by law for becoming a law enforcement official. This research study had 100% participation in all three data collection opportunities (surveys, observations, and interviews). Participants reported their own gender, race, and age. There were 2 females and 16 males among the participants. Of those, 2 were Black, 15 White, and 1 who preferred not to answer. Half of the participants identified themselves in the 22 – 25 year age group; 2 were in the 26 – 30 age group; 3 were in the 31 – 35 age group; 2 were in the 36 – 40 age group; 1 was in the 46 – 50 age group; and one participant preferred not to answer.

Data Collection

Quantitative Instrument

Surveys.

A myriad of research studies on self-efficacy have used Likert scales to assess self-efficacy (See Pajares, 1996; Zimmerman, 2000; Davis et al., 2000; Goldenberg et al., 2005; Bandura, 2006; Kameg et al., 2010). This study also used a Likert-type self-efficacy scale to
investigate learners’ perceived self-efficacy of their task-based performances both before and after using a high-fidelity virtual training simulator.

For each perceived self-efficacy portion of the survey, the participants were asked to consider their level of self-efficacy for a specific task at that point in time; some of these questions were general self-efficacy questions, as well. Participants were asked to rate their responses on a 6-point Likert scale ranging from 1 – 6 and representing the following:

(1) Strongly disagree
(2) Disagree
(3) Somewhat disagree
(4) Somewhat agree
(5) Agree
(6) Strongly agree

Bandura (1977, 1997, 2006) suggested using task-specific survey scales in lieu of “all-purpose surveys.” Specifically, Bandura put forth, “Scales of perceived self-efficacy must be tailored to the particular domain of functioning that is the object of interest” (2006, pp.307-306). Conversely, Schwarzer (2011; Schwarzer & Jerusalem, 1995) proposed using a general self-efficacy scale in conjunction with task-specific self-efficacy scales so as to test for both general and task-based self-efficacy. For these reasons, the surveys used in this study contained both task-specific perceived self-efficacy items and Schwarzer’s general self-efficacy items. (See Appendices F and H for labeled and coded survey instruments.)

The general self-efficacy survey asked participants to respond to items such as “It is easy for me to stick to my aims, and accomplish my goals” and “When I am confronted with a problem, I can usually find several solutions” (Schwarzer, 2011). (See Appendices E and G for
the pre-use and post-use survey instruments.) Schwarzer’s ten-item General Self-Efficacy (GSE) scale was combined with ten task-specific items from The Academy’s performance criteria in order to create the survey instrument for this study. The researcher met with an Academy instructor and reviewed specific tasks that the participants would be expected to perform in the simulator. The Academy instructor pulled three separate scenarios from the performance criteria curriculum and highlighted the specific tasks. The highlighted scenarios were armed robbery, domestic, and emotionally disturbed person. (The Academy Performance Criteria are located in Appendix D.)

The Academy instructor chose 15 tasks from the three scenarios. Some of the tasks overlapped; for example, “Maintains officer safety” was on each of the three scenarios. This transferred to the survey instrument as “When acting as the primary officer, I am able to maintain officer safety.” Another task that overlapped was “Appropriate use of deadly force.” This was on two of the three scenarios. On the survey, the item read, “I am able to determine whether or not the use of deadly force is justified in any given situation.” Bandura (1997) reminded instrument writers to think in terms of a learner’s ability – what the learner can do – and direct the survey item to what the learner can do or is able to do.

As stated, two surveys were used for this study. The surveys were referred to as the “pre-simulator-use survey” and the “post-simulator-use survey.” (These surveys are located in Appendices E and G.) The pre-simulator-use survey looked for participants’ perceived self-efficacy prior to using the high-fidelity virtual training simulator. The post-simulator-use survey looked for participants’ perceived self-efficacy after having used the simulator.

Each survey had 10 task-specific questions and 10 general self-efficacy questions. Rubin, Palmgreen, and Sypher (2009) suggested to mix the questions between the two surveys
and to reverse several of the questions, as well. The purpose of this was to ensure a close and careful reading of the surveys by the participants, especially in this case since the pre- and post-use surveys were taken so close together; therefore, the questions used in the surveys for this study were mixed, and some questions were reversed. For example, the pre-use survey had a task-specific question that read: “I am able to determine whether or not the use of deadly force is justified in any given situation.” The post-use survey reversed the question to read: “I am not able to determine whether or not the use of deadly force is justified in any given situation.” The second question was coded with an R for reversal.

The pre-simulator-use survey had three sections; the first section was the Participant Consent Form (located in Appendix L); the second section collected the self-efficacy data, and the third section of the survey collected general demographic data. The post-simulator-survey also consisted of three sections: the first section was Participant Consent Form again; the second section collected the self-efficacy data; the third section consisted of 10 open-ended questions regarding the participants’ experiences in the simulator. These questions covered the four influences of self-efficacy (performance accomplishments, verbal persuasion, vicarious experience, and emotional arousal) as well as two questions regarding the simulator. For example, to explore the participants’ perceptions of the simulator, they were asked, “On a scale of 1 – 10, how realistic was your experience in the simulator? 10 being extremely realistic. What made your experience realistic or not so realistic?” To explore emotional arousal within the participants, they were asked, “Was there ever a time when you felt anxious or worried about being able to perform any of the tasks you performed today? If yes, please tell us about that time and about how you felt.” The surveys marked with the codes are found in Appendices F and H for the pre-use and post-use respectively.
Qualitative Instruments

Interviews.

In addition to survey questionnaires, this study used interviews and observations to enrich and enhance data collected from the quantitative strand (Creswell & Plano Clark, 2011). Recall from Chapter 2 that Usher (2009) used a qualitative study to investigate the perceived self-efficacy of middle school math students in which she interviewed eight different students for her study; she believed that the interviews provided insight to the study that the survey did not reveal.

The purpose of the interviews was “to enter into the other person’s perspective” (Patton, 2002, p. 341). Because interviews can enhance quantitative data (Patton, 2002; Seidman, 2006), this study used what Patton referred to as the standardized open-ended interview. The purpose of using this format of interviewing was to “minimize variation in the questions posed to the interviewees” (Patton, p. 342). Recall from Chapter 2 that Bryans and McIntosh (2000) used post-simulation interviews to discuss the strengths and weaknesses in nursing students’ community assessment nursing practices. Bryans and McIntosh interviewed participants immediately after they experienced the role-play simulation. The participants in this current study were interviewed immediately after their experiences in the simulator, as well.

Research assistants conducted the interviews. The research assistants each read from a pre-written script. Each participant was asked the same set of interview questions, which were listed on the script. (See Appendix I for the script and interview questions the research assistants used.)
Transcribing.

Two devices were used to record the interviews. An iPhone 4 was used, as was a MacBook Pro laptop. Both devices were used in case there were technical difficulties or device failure. The iPhone 4 used an application called Voice Memos to record the interviews; the MacBook Pro used an application called GarageBand. All interviews were transferred from the iPhone 4 onto the laptop via iTunes and immediately erased from the iPhone 4 upon confirmation of transfer to the MacBook Pro. Additionally, all audio files were saved with as encrypted, password protected files.

Observations.

This study also used unobtrusive, nonparticipant observations. As stated in the review of literature, Bandura (1997) found that when participants’ perceived self-efficacy levels were higher they were accompanied by higher performance accomplishments. Because the participants in this study were interacting with a high-fidelity virtual training simulator as well as a human trainer, it benefited the study for the researcher to see firsthand the experiences and interactions of the participant. As Patton (2002) stated, “the inquirer is better able to understand and capture the context within which [participants] interact” (p. 262). Other reasons for observations included: observing events the participant may not have thought were viable to talk about in the interview; the ability to describe the setting where the activities took place; allowing the researcher to draw upon personal knowledge of the experience and activities for analysis; and, most importantly, triangulation of data.
**Context of Investigation**

The high-fidelity virtual training simulator (“simulator”) used in this study was a MILO Range simulator (IES Interactive Training, n. d.). IES Interactive Training described the MILO Range simulator as “designed to support the entire gamut of enforcement skills training requirements for Academy recruits to qualification &[sic] remedial training for seasoned officers” (p 2). The simulator offers over 200 different scenarios for instructional use. The participants in this study experienced 6 different scenarios. These were labeled in the observation notes as the following:

1. Domestic (Domestic Dispute)
2. Bank Alarm (Bank Robbery)
3. Homeless Lady (EDP Homeless Woman)
4. Hospital (EDP with Knife)
5. School Shooting (Active Shooter)
6. School Shooting (Second Response Team)

The descriptions in parentheses come from the simulator guide book. (See Appendix B for a description of each scenario.)

Participants walked into what was once a classroom in The Academy to experience the simulator. Painted light blue walls enveloped the learning space. The simulator was set up on one side of the room, and the desk of an Academy trainer and more law enforcement equipment were on the other. The MILO Ranger simulator consisted of a desk top computer, a projector, speakers, and a large, flat screen approximately 10 feet wide by 10 feet tall. (See Appendix C for photos of the simulator’s learning space and set up.)
With the lights out, and the room darkened, an Academy trainer sat at the computer while the participant stood in front of the screen, approximately 10 feet away from it. Only the light from the simulator lit up the room. The trainer would ask if the participant was ready, and upon a “yes,” the first scenario began. The simulator projected video images with real actors in them. For the most part, the images projected were eerily real and life-size. For example, in the Domestic scenario, the participant was presented with a man and woman arguing; the man was holding a crying baby. It would appear that the man was approximately 6 feet tall on the screen, a life-like representation of an average male. The sounds produced from the speakers were intensely loud, and blared a life-like representation of a couple arguing while the baby was crying very loudly. The purpose of this level of fidelity was to enhance learning and retention from the participants (IES Interactive Training, n.d.).

**Virtual materials.**

Two separate virtual materials were used in this study. One was a simulated handgun that resembled a Glock®. The other was a virtual canister of OC Spray (Oleoresin Capsicum, also known as Pepper Spray). Photos of the virtual materials are located in Appendix M.

**Research assistants.**

The qualitative strand involved both interviews and observations of all 18 participants; therefore, two research assistants were used to help with data collection. Both research assistants were IRB certified and fellow graduate students who had previous experience in conducting interviews. Due to scheduling challenges, two different research assistants were used, one for each of the two days the simulator was in use.
Research Procedures

This study included a pilot study prior to conducting the research. After the pilot study was conducted and analyzed, the researcher then conducted the main research study.

The Pilot Study

A pilot study was conducted to test the reliability and validity of the surveys used in the research. The surveys used included 10 task-related questions (Bandura, 1977, 1997, 2006) and 10 generalized self-efficacy questions (Schwarzer, 2011). The surveys also gathered general demographic information.

Pilot Study Participants.

A total of six participants were recruited to take the survey. Each participant had previous experience with the simulator used in the research. The participants consisted of 6 males, 4 of whom were law enforcement officials, and 2 of whom were trainers at The Academy. Law enforcement experience among the pilot study participants varied from 6 months to 20 years.

Pilot Study Procedure.

The survey was distributed to the participants via email, which included a link that took them directly to the web-based survey. Participants were asked to include any comments or suggestions about the survey questions and ease of use in taking the survey. One participant found a spelling error, which was promptly corrected.

JMP®, statistical analysis software, was used to test the reliability of the survey. The Cronbach’s Alpha of the reliability test was 0.905. See Figure 3 for a screen shot from the JMP® analysis.
Research Design and Procedure

A convergent parallel mixed methods design was used for this research study (Creswell, 2009; Creswell & Plano Clark, 2011). The purpose of using this design was to augment the existing quantitative research on self-efficacy, thereby providing a deeper understanding of the phenomenon. This mixed methods design involved collecting and analyzing quantitative and qualitative data in a single phase. Creswell and Plano Clark (2011) discussed four steps to the convergent parallel mixed methods design. First, the researcher collected both the quantitative data and part of the qualitative data by means of a survey instrument; in addition, the researcher used observations and interviews to collect the bulk of the qualitative data. Next, the researcher analyzed the two data sets separately using appropriate analytic procedures, which are defined later in this chapter. The third step involved the actual merging of the data sets, where the researcher compared the results separately so as to identify similarities, differences, themes, etc.. To compare the results separately, the researcher analyzed the data sets (surveys, interviews, and observations) separately and compared the themes within each data set. For example, she first compared all of the “task” themes that arose within the observations. Secondly, she compared all of the “task” themes that arose within the interviews. Finally, she compared all of the “task” themes that arose within the quantitative data set. In the final step, the researcher interpreted the ways in which the two sets of results “converged [and] diverged from each other, related to each
other, and/or combined to create a better understanding in response to the study’s overall purpose” (p. 78). The chart in Figure 4 illustrates the steps in the convergent process.

![Flowchart](image)

*Figure 4. Flowchart of the four steps in the convergent parallel mixed methods design. Adapted from (Creswell & Plano Clark, 2011).*

**Surveys.**

Initially the surveys were to be distributed via the Internet in computer labs located in The Academy. However, on Day 1 of the data collection, The Academy administration requested that paper surveys be used; therefore, the same web-based survey was turned into a Portable Document File (PDF) and printed for the participants. The participants took the pre-simulator-use survey in a classroom where they were receiving instruction at The Academy. Participants took the first survey at the end of training the day before using the simulator. Because the participants took a paper version of the survey, the researcher hand entered the responses to each survey in Microsoft Excel and then in the Qualtrics web-based survey. She did this to ensure there were no transpositions of numbers, etc.. The two entries were compared to look for differences. When no human errors were found after entering all 18 participants’ responses in
two separate computer software programs, she deemed the data as reliable as it would have been had the participants entered the responses into the web-based survey themselves.

On Day 2, 9 participants used the simulator, and 9 of participants were observed; however, only 8 completed all six scenarios; the ninth participant to use the simulator on Day 2 could not complete the simulation experience due to simulator failure. This participant, whose pseudonym was Larry, was excluded from the quantitative data. Larry’s simulation use was interrupted due to simulator failure on Day 2; therefore, Larry used the simulator on both training days. Because of this, his data was not deemed an appropriate and equal representative of the sample population. The new sample size became n=17.

Because the researcher could not observe and interview at the same time, two research assistants were used to aid in the interviews. The proposed procedure was as simple as Participant X entered the simulator and was observed; when he or she exited, Participant Y would enter the simulator. Meanwhile, Participant X would immediately take the post-simulator-use survey and then sit for the interview while Participant Y was in the simulator being observed. When Participant Y was finished with the simulator he or she would take the post-simulator-use survey while Participant Z entered the simulator. Etc. etc.. Due to human error, this did not happen on Day 2 of data collection. Upon exiting the simulator, the participants were supposed to have taken the post-simulation-survey; however, the research assistant forgot to administer the surveys to this group of participants; therefore, none of the participants who used the simulator on Day 2 took the post-simulator-use survey.

On Day 3, the ninth participant from Day 2 completed the simulator experience. Afterwards, the remaining 9 participants used the simulator, and were observed. Upon exiting the simulator, the researcher assistant directed the participants to take the post-simulator-use survey
immediately, which they did, including the participant from Day 2. Throughout the day, and to comply with The Academy’s schedule, the participants from Day 2 who used the simulator but did not take the post-simulator-use survey, took the web-based survey on Day 3. (Paper surveys were not used on this day because the participants had access to The Academy’s computer lab.)

It should also be noted that recruits entered the simulator one at a time, and no other recruits were in the simulation area. This meant that while one participant was in the simulator, others were engaged in classroom instruction throughout The Academy. Prior to simulator use, The Academy personnel instructed participants not to discuss the simulator experience with each other. This was a rule from The Academy, but it also helped ensure consistency in the research. Academy officials did not want participants discussing the scenarios with each other in order for the trainer to more accurately evaluate the participants regarding how they responded to the scenarios presented to them via the simulator.

**Interviews.**

Interviews lasted from 7 minutes to approximately 20 minutes; the length was dependent upon the participants’ responses. This was in order to capture first impressions and the most immediate and instinctive responses from the participants. The timeline of the data collection corresponded with The Academy’s simulator use, which was four days prior to the participants graduating from The Academy. Additionally, Day 3 of data collection was the last day the participants were actually inside The Academy; the remainder of their training included a live simulation followed by a ceremony for graduation. Because of these mitigating circumstances, the researcher was unable to conduct member checks or follow-up interviews.
Observations.

All 18 participants agreed to be observed. Nonparticipant observations took place for each participant in the simulator. Each participant signed an additional consent form allowing the researcher to be present during the simulation. (See Appendix N for a copy of the Additional Consent Form.) Initially, the researcher tried to use an observation checklist to guide her throughout the initial observations. However, because the simulator room was dark, she could not see to write notes on the observation checklist; therefore, the researcher used a laptop on which to take her observation notes and occasionally referred to the observation checklist. She used one blank observation checklist to guide her throughout the observations. (See Appendix J for a copy of the Observation Checklist.)

Each observation was titled by a participant number; at no time were any names ever used in the observation notes. The researcher sat in the back of the simulator room. On occasion, the researcher took photographs of the simulator’s images. She recorded the number of the photograph on the camera and the time at which she took it so she could later match the photographs to the correct participant. These notations were recorded in the observation notes, which proved to be most helpful. None of the photographs depicted images that may reveal or jeopardize any of the participants’ identities. One short video was taken to represent one of the scenarios. The purpose of the photographs was to help enrich the qualitative strand of the research, as well as provide an illustrative aid that detailed the different scenarios the participants experienced in the simulator.
Data Analysis Techniques

The Quantitative Strand

According to Howell (2007), paired t-tests are most widely used with small sample sizes (Howell, 2007). Because this study had an N of 17, a paired t-test was used to compare the participants’ perceived self-efficacy prior to using the simulator and their perceptions of perceived self-efficacy after having used the simulator. The purpose of using paired t-tests was to compare the population means of two groups when the samples were dependent. Descriptive statistics were also calculated for use in the merging of data sets.

Recall that due to human error, some participants took the post-simulation-use survey four days after using it, thus creating two subgroups. The subgroups were called the Laters and the Immediates. Additional t-tests were conducted to determine if there were significant differences between the Laters and the Immediates either before or after simulator use. When no significant differences were found between the Laters and the Immediates, the two groups were combined for analysis and additional t-tests were conducted to look for significant differences between the task-specific items and the GSE items. Because the surveys were also compared by task-specific items and GSE items, the researcher calculated the Cronbach’s alpha of each to make sure the instrument was internally consistent. Table 2 shows the Cronbach’s alphas for the pre- and post-simulator-use on task items and GSE items.
Table 2 *A display of each of the Cronbach's alpha used to test for internal consistency in the survey instruments.*

<table>
<thead>
<tr>
<th></th>
<th>PRE-SIMULATOR-USE</th>
<th>POST-SIMULATOR-USE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TASK ITEMS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cronbach's α</td>
<td>Entire set 0.6775</td>
<td>0.8568</td>
</tr>
<tr>
<td><strong>GSE ITEMS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cronbach's α</td>
<td>Entire set 0.6474</td>
<td>0.8652</td>
</tr>
</tbody>
</table>

After internal consistency was determined, the researcher conducted the additional t-tests between the task items and GSE items. When no significant differences were found, she also conducted a two-sample paired t-test that combined all the participants (except the excluded one). Results of these t-tests are discussed in Chapter 4. This study used JMP®, statistical analysis software, and Microsoft Excel to calculate the statistical analysis.

**The Qualitative Strand**

*Transcribing.*

Interviews were transcribed using Dragon Dictation software for the iPad. While wearing headphones attached to the laptop, the researcher listened to an interview on the laptop that played from the GarageBand software. While she listened to the interview, she spoke what she heard into Dragon Dictation on the iPad. Because she used the free version, she could only dictate 55 seconds of speech at a time; therefore, she would mark each section with the time shown on GarageBand’s timeline. For example, the transcripts show: “GB5:11,” which meant GarageBand 5 minutes, 11 seconds. This way the researcher knew where each section of the interview was captured on the software.
Once the researcher finished transcribing an interview, she would copy and paste it from Dragon Dictation on the iPad to the Notes Application on the iPad, which would later show up in the Notes section of her Google Mail. The transcript was then copied and pasted into a Microsoft Word document on the MacBook Pro laptop, formatted and readied for coding, and saved with a password. Each transcript was labeled with a participant number. At no time was a transcript left in the researcher’s Google Mail Notes. All transcripts were immediately deleted from the iPad and from the Google account after they were saved and backed up on both the laptop and an external hard drive, which was password encrypted, per IRB requirements.

Transcribed interviews and observations were coded for categories and themes. Rubin and Rubin (1999) defined coding as, “the process of grouping interviewees’ responses into categories that bring together the similar ideas, concepts, or themes [the researcher has] discovered, or steps or stages in a process” (p. 238). Rubin and Rubin added that a researcher can code for names, time sequences, signs of emotions, and even hesitations. Data to look for while coding included frequent words and phrases the participants used; repeated nouns and noun phrases; and words with pairs, mates, and opposites (Rubin & Rubin, 1999). All of these were taken into account while coding.

**Explanation of Categories.**

Six predetermined categories were used to code the observations and interviews. These categories included the four influences on perceived self-efficacy: previous experience, verbal persuasion, vicarious experience, and emotional arousal (Bandura, 1977). Also included was the category of task, per Bandura’s self-efficacy theory that one’s perceived self-efficacy is task-specific (1977). Finally, a simulator category was included to cover the various aspects of the simulator that participants used during this research. From these six categories, additional
categories emerged during the analysis; most were from the simulator category, and were considered as sub categories. The sub categories that emerged were virtual materials from the simulator, simulator breakdowns, and recommendations from the participants.

Interviews and observation field notes in this study were transcribed, and then coded using separate colors for six pre-determined categories:

1. previous experience – dark pink
2. verbal persuasion - orange
3. vicarious experience - green
4. emotional arousal - blue
5. task – light pink
6. simulator - yellow

This method of coding provided the researcher a visual that allowed her to literally see where the data converged. The pre-determined categories allowed for comparison in and among data sets; comparison allowed the researcher to discover themes that converged or contradicted each other (Creswell & Plano Clark, 2011; Rubin & Rubin, 1999). This study followed the stages suggested by Rubin and Rubin (1999) for coding:

- data were separated into pre-determined categories
- data were compared within the categories to look for variations and nuances in meanings
- cross-category comparisons were conducted to discover connections between themes.

Figure 5 shows a diagram of the stages. It is important to note that, while there were pre-determined categories, there was also room for the researcher to be open to some data not fitting into those categories. In this scenario, Rubin and Rubin suggested adding new categories to fit the data. This is where the sub categories emerged.
When analyzing qualitative data, Merriam (2002) and Rubin and Rubin (1999) suggested narrowing down the categories to the most prominent. In this research, four of the six categories did not produce a considerable amount of data; these categories were verbal persuasion, vicarious experience, previous experience, and task. Therefore, the data narrowed itself down.

**Merging Techniques**

This study merged quantitative and qualitative data in order to compare the results and present a more comprehensive explanation of the study’s findings. In order to do so, this study adapted merging strategies from both Creswell and Plano-Clark (2011) and Onwuegbuzie and Teddlie (2003). First, the quantitative and qualitative data were collected concurrently. After the data were collected, they were analyzed separately and placed into separate “databases,” based on the pre-determined categories from the quantitative and qualitative strands. Next, data displays in the form of tables were created; this allowed for illustration of each strand visually by means of tables. Again, data in this step remained separate, including the interview and observation data. Once displayed in table format, the data were compared using the pre-determined categories and any other categories that developed in order to find areas of convergence and divergence. Data consolidation began at the merging process. Here, both research strands of data were combined to create a new data set to be interpreted. (See Appendix K for the table that was created from this stage of analysis.) Finally, data interpretation integrated...
all data into a coherent whole that “[created] a better understanding in response to the study’s overall purpose” (Creswell & Plano Clark, 2011, p. 78). Figure 5 shows a flowchart of the strategies that occurred in order to merge data in this study.

![Flowchart of the steps involved in mixing the data](image)

*Figure 6. Flowchart of the steps involved in mixing the data*

Finally, when all the coding had been separated and the data merged and analyzed, the researcher wrote the results and recoded the results looking specifically for the answers to the two qualitative research questions. Here, she colored coded “learners’ perceptions” yellow and “aspects of the simulator” pink. This also allowed for the researcher to experience a higher level of confidence in the quality and reliability of the qualitative strand.

**Summary**

The purpose of this study was to explore learner’s self-efficacy after using a high-fidelity virtual simulator. This study used a convergent parallel mixed methods design in which data
were collected simultaneously, analyzed separately, and later merged. The purpose of merging the data was to find convergence of overarching themes.

Survey instruments were used to determine participants’ perceived self-efficacy prior to and after using the high-fidelity virtual simulator. A pilot study was conducted to determine reliability of the survey instrument; additional tests were also conducted to determine internal consistency, as well. Observations and interviews were used to enhance the study and help further explore the phenomenon. Research assistants helped with the simultaneous data collection.

To reiterate, Creswell and Plano Clark (2011) explained that merging happened after the quantitative and qualitative strands have been analyzed. In this study, the researcher brought together the two sets of results for a combined analysis. For example, the interview data results in the emotional arousal category were combined with the observation data results in the emotional arousal category. Appendix K shows an example of the combined results, where the interview codes are in red, and the observation codes are in blue. Where the results converge, is where they were combined. In this step, the results were further analyzed by relating the research strands (quantitative and qualitative) to each other in order to look for ways in which the results “converge, diverge from each other, relate to each other, and/or combine to create a better understanding in response to the study’s overall purpose” (p. 78).

Chapter 4 will review the research questions and explain the results of the data collections from both the quantitative and qualitative strands.
Chapter IV: Results

Introduction

This chapter discusses the results of the data. The results are from both quantitative and qualitative research strands. They discuss the convergence and divergence of the findings in the mixed methods. The results are presented and organized by the research questions that guided this study.

Quantitative Research Question

1. Is there a difference between learners’ perceived self-efficacy prior to and after using a high-fidelity virtual training simulator to perform specific tasks?

Qualitative Questions

2. What are learners’ perceptions of their training experience with the high-fidelity virtual training simulator?

3. What aspects of the training experience with the high-fidelity virtual training simulator influenced learners’ perceived self-efficacy?

The convergence of the data summarizes this study’s results. A convergence table of all three data sources is located in Appendix K. This table shows where the data converged after mixing occurred. Because no significant differences were found in the quantitative strand, the qualitative strand seemed to support the heart of the data and “explain the quantitative data” (Creswell & Plano Clark, 2011). Therefore, the three data sets (survey, observation, and interview) are included under the two qualitative research questions in Table K1.

The most prominent motif throughout all three forms of data was the emotional arousal that the participants experienced. Some of the emotional arousal came from participants’
frustration with the simulator not functioning properly, and some of the emotional arousal came from the high level of immersion the scenarios presented the participants.

The Quantitative Strand

*Is there a difference between learners’ perceived self-efficacy prior to and after using a high-fidelity virtual training simulator to perform specific tasks?*

The researcher took into account the fact that the research assistant from Day 2 did not administer the post-simulation-use surveys. Because this abnormality happened, the researcher checked for equivalency to see if the groups were different. The two groups were labeled Immediates (I) and Laters (L). Because some participants were tested later, analysis of pre-simulator-use and post-simulator-use was conducted. The two groups were found to be equivalent; therefore, no significant difference existed. Figure 7 shows screen captures of the comparisons of the two groups’ pre-simulator-use surveys and the post-simulator-use surveys. The screen capture on the left shows the comparison of the Immediates and Laters’ pre-simulator-use survey. The screen capture on the right shows the comparison of the Immediates and Laters’ post-simulator-use survey. No significant differences were found in the comparisons.
Figure 7. Statistical analysis showed no significant difference between the Immediates and Laters’ pre- and post-simulator-use surveys.

A paired t-test was used to examine the difference between the pre-simulator-use surveys and the post-simulator-use surveys. An acceptance level of 0.05 was used to set parameters for finding significant differences (Pedhazur & Schmelkin, 1991). The difference between the post-simulation-use survey and the pre-simulation-use survey resulted in a mean difference of 0.04. The p value for this paired t-test was 0.47; therefore, there was no significant difference in scores from pre-simulator-use to post-simulator-use. Figure 8 shows a screen shot from JMP® that depicts the statistical data above in more detail.

Figure 8. A more detailed representation of the paired t-test of the pre-simulator-use and post-simulator-use surveys.
**Task items versus GSE items.**

Each survey instrument consisted of 20 items. Ten items were task-specific based on The Academy’s performance criteria, and ten items were general self-efficacy items based on Schwarzer’s (2011) General Self-Efficacy survey. Bandura (1997) argued to use task-specific surveys; therefore, four t-tests were conducted to explore the comparisons between perceived self-efficacy task items and general self-efficacy items. Statistical analyses were conducted to test for significant difference in the four areas. Table 3 shows the results of the four t-tests. (Excel tables with complete statistical analysis for each t-test are located in Appendix T.)

<table>
<thead>
<tr>
<th>t-test</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between the Immediates and the Laters on the TASK pre-simulator-use survey</td>
<td>.74</td>
</tr>
<tr>
<td>Between the Immediates and the Laters on the TASK post-simulator-use survey</td>
<td>.64</td>
</tr>
<tr>
<td>Between the Immediates and the Laters on the GSE pre-simulator-use survey</td>
<td>.99</td>
</tr>
<tr>
<td>Between the Immediates and the Laters on the GSE post-simulator-use survey</td>
<td>.22</td>
</tr>
</tbody>
</table>

No significant differences were found in the t-tests. Therefore, the Immediates and Laters were combined, and a two-sample paired t-test was used to determine if there was significant difference between the pre- and post-simulator-use TASK scores and the pre- and post-simulator-use GSE scores. Table 4 shows the data used for this two-sample paired t-test.
Table 4 Statistical analysis revealed no significant differences between the TASK and GSE scores.

<table>
<thead>
<tr>
<th></th>
<th>Variabl e 1</th>
<th>Variabl e 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSE: t-Test: Paired Two Sample for Means</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5.11</td>
<td>4.98</td>
</tr>
<tr>
<td>Variance</td>
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<td>0.24</td>
</tr>
<tr>
<td>Observations</td>
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</tr>
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<td>Pearson Correlation</td>
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<td></td>
</tr>
<tr>
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</tr>
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<td></td>
</tr>
<tr>
<td>t Stat</td>
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<td></td>
</tr>
<tr>
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**Summary of Quantitative Results**

In summary, there was no significant difference between either the task-specific items or the general self-efficacy items on the survey instrument. The qualitative results will discuss the relationships and contradictions found in the quantitative results.

**The Qualitative Strand**

To validate the quantitative findings, the researcher triangulated her data using observations and interviews. Among the 18 participants, all agreed to be observed and
interviewed. The two qualitative research questions are discussed below. Two other themes emerged in addition to those addressed by the research questions; these were the role of the trainer and recommendations from the participants. They are also discussed below.

**Qualitative Question 1:**

*What are learners’ perceptions of their training experience with the high-fidelity virtual training simulator?*

In this study, “perceptions” refers to the learners’ thoughts and feelings about their experience in and with the simulator and about the simulator itself. Overall, the participants had what could be described as mixed perceptions of the simulator. The participants described the way they felt in the simulator as anxious, nervous, uncertain, frustrated, and scared. However, they also praised the simulator as a positive learning tool – when it worked.

Emotional arousal demonstrated by the participants ranged from the use of foul language, gasping breaths, shaking heads, and voicing frustration and concern. After examining the variety of emotional responses, the researcher found three themes that seemed to influence the participants’ emotional arousal:

1. lack of experience with the simulator
2. lack of experience as a law enforcement officer
3. the scenarios within the simulator

**Lack of experience with the simulator.**

“I didn’t really know what to expect.”

In the interviews, participants reported that their task performance was inhibited by their lack of knowledge of how to use the simulator and/or its virtual materials. This contrasts with the
Participants indicated frustration with the simulator because they did not understand how to interact with it. Matthew reported feeling anxious; he revealed, “You’re anxious in there ‘cause you’ve never done the simulator, and you’ve never been in those situations.” On his survey, Matthew also indicated having felt anxious, echoing his response in the interview, “I was anxious because I had never done the simulator before.” Andy also reported feeling anxious, as he told the interviewer, “I didn’t really know what to expect from the simulator.” Joe echoed Andy and added, “My blood pressure was up; my heart rate was up because you don’t know what to expect.” During Joe’s interaction with the simulator, he was observed telling the trainer that he was unable to see what was going on and “didn’t understand it.” Grace said it felt “weird” because she had never talked to a computer screen before. Myles brought up the fact that interacting with a computer screen was difficult for him, too; his response was, “It’s hard talking to a screen. It’s embarrassing on many levels. It’s hard when there’s not a real person there.” Dave brought up an interesting thought when he told his interviewer, “I don’t really connect with stuff like that. I mean, I don’t play video games or anything like that.” Paul summed up participants’ lack of experience with simulators when he told the interviewer,

It was just a different environment just looking at the screen and reacting to it. Whereas before when we trained, we were interacting with real-life people, with each other, and instructors. It made you more nervous.

Paul did not elaborate on why it made him more nervous; he did indicate, however, that prior to their experience in the simulator, all previous training had occurred with other participants and
instructors – human interaction. Paul later added that the simulator “adds more to [the instruction]...[because it adds] more noises and visualizations” than in the role playing in the Academy halls “by clearing rooms you already know are empty.” The simulator provided scenarios that the participants had not previously experienced. Interestingly, Paul was the only participant to mention the learning space of the simulator. He said that “being in that big open room took getting used to.” Conversely, William was one of the few who indicated, “I don’t think I really felt too much. I just kind of felt like I was standing there and not interacting with it as much as I should have been.” He mentioned that he did not know if he could “hide behind objects” or experience the true feeling of a gun firing.

**Lack of experience as a law enforcement officer.**

“It’s a completely different situation from military training.”

According to the pre-simulator-use survey, 12 of the participants, over 65%, did not have previous experience as a law enforcement officer. Of those 12 participants, 4 indicated that they had previous experience in the U. S. Military. As stated previously, the post-simulator-use survey asked the participants to indicate any feelings of anxiety and to explain them. James indicated that his “lack of self-confidence in [his] law enforcement capabilities” caused him to experience anxiety. Indeed, James indicated that he did not have previous experience as a law enforcement officer; however, during his interview, he disclosed that he had previous experience as a park ranger, a job that, as he described it, did not permit him to carry a weapon, but forced him to rely on “verbal judo.” James’ simulator experience was, perhaps, the most captivating. James had the lowest average of perceived self-efficacy on the pre-simulator-use survey with a mean score of 3.85. His post-simulator-use survey average dropped to a 3.65. James’ interview was one of the most compelling. There were times in which his voice dropped below a whisper.
almost as if he was confessing something private to the interviewer. He told the interviewer that it was his lack of experience in law enforcement that was affecting his task performance:

I was nervous going into it. You know if you fail the first three [scenarios] because you don’t know what you’re doing, you become more nervous as to whether or not you're making the right decisions. You can start to question yourself whether or not you're making the right choice. In here it's about passing. Out there it's really different. [James begins to whisper, almost to the point where he cannot be heard.] Training and experience comes into play quite a bit but… You know, like, one of the first… Actually the first one was a domestic call and the guy had a baby. It was like, I don't know what to do. [The trainer was] like, “Well you need to draw your weapon and shoot.” That's not my instinct. My instinct is to protect the child, and I just couldn't get it. I couldn't get it right. So you try to apprehend the subject however you can, but you can’t in [the simulator]. The baby may or may not live even if I wasn't there. It's just… It's another world. You know, I've not really been exposed to any of it before.

Additionally, James indicated on his post-simulator-use survey that he did not feel that he accomplished the tasks in the simulator because he “didn’t feel like [he] knew how to handle [them] effectively.” James also told his interviewer that he “wanted more verbal and physical interaction [with the simulator],” but he “was not sure what to do.” He repeated this to the interviewer several times. James did acknowledge to the interviewer that his experiences in the simulator were “negative,” but he wrote on his post-simulator-use survey that there was “no experience better than what was presented on the simulator” because the simulator presented “real life situations” that he had never used before.
While James’ story reflected the frustrations that new law enforcement recruits may face, it did not represent the perspectives of all the participants. Luke indicated that he did not feel “anxious, but there [was] a little bit of nerves going” because he would think to himself, “How am I going to react to this?” and then he would “just [use] that kind of thinking process to get through the simulator.” Duncan tried to relate to his military training, but realized, “It’s a completely different situation from military training.”

Perhaps one of the most telling remarks came from the observation of John’s simulator experience. At the end of his simulator use, he and the trainer had the following exchange:

Trainer: Got any questions?

John: No. Learn from experience. I feel kind of bad for the mistakes I’ve made. It’s pretty wild too. It’s the first time I trained for anything like that. It’s pretty jacked up.

John acknowledged that even though the experience was “jacked up” and that his perception of the simulator was “wild,” he had learned from the experience the simulator provided.

**The Scenarios within the Simulator.**

“*Stuff like this is a wake-up call.*”

Among the scenarios with which the participants were presented was one called “Active Shooter” (Second Response Team, see Appendix B for simulator scenarios). In this scenario, a virtual law enforcement dispatcher announced that there was an active shooter in the school (where the participant is virtually located), and there were several teams of officers from a variety of jurisdictions present in the school. The last scene presented a group of men coming from around a hallway corner; they were law enforcement officers from other jurisdictions. One of the officers was in plain clothes; however, he was wearing a blue vest with the word
“POLICE” in large, bold white letters on the back. Eight of the 18 participants shot and killed this officer in the simulator. Two additional participants shot at, but missed the officer, bringing the actual total to more than half who shot or shot at the other officer. Figure 9 shows two photos of the simulator’s presentation of the police officer being shot. The photo on the left depicts the first “hit,” in which the officer has been shot. The photo on the right, which the simulator shaded red, shows that the officer is down and that the hit was lethal. This scenario caused much of the emotional arousal that the participants claimed to have experienced. None of the participants were asked questions regarding specific tasks or scenarios in the interviews, but many did bring them up.

Figure 9. The simulator’s debrief allows participants to review their “hits.”

Duncan discussed his reaction to the Active Shooter scenario when the interviewer asked him what he learned about himself from his experience in the simulator. Duncan did not directly answer the interviewer’s question. Instead, he replied:

[*Duncan expresses deep sighs as the interviewer is asking this question.*] Umm…

[*Duncan paused*] I would say… you know, I’m about as ready as anybody, but the more training the better. Things like this you know, these little wake up calls here and there, whether you’re a brand new officer like I am or you’re a 20-year veteran officer, and
you’ve been doing it forever and a day. Stuff like this is a wakeup call cause it’s, you know. You can go your whole career and it’s the last day before you retire and you’re responding to a school shooting and you shoot another officer cause you don’t know there’s another team in the building, and that split-second decision to pull the trigger, and now you’re going to a funeral. I think doing it more on the simulator would boost my confidence in my abilities. I would say that doing it just that one time, for the first time, in a way it kinda made me take a second look, like in that one scenario where I shot that cop that was in the building, and then there’s the one where I think I might have clipped the kid, and that’s [Duncan stopped talking]. The machine said I didn’t kill the kid, but I looked at it, and I think that realistically it would have been a close thing. That’s enough right there to make me stop and take a look, like….so.. I think that repetitive training on something like that would help, but doing it once was like a wake-up call.

Figure 10 shows photos taken of Duncan’s scenario with the Domestic situation. The photo on the left shows the scene in which he may or may not have “killed” the baby; the photo on the right shows a close up of the round fired from Duncan’s virtual weapon. The red dot in the photos reveals the location of the “round fired” from Duncan’s virtual weapon.
Photos from Duncan’s simulated domestic dispute reveal that the rounds fired from his virtual weapon appear to have “hit” the baby’s head, as he feared. Duncan’s reaction to his task performance was also observed. The following is from the observation notes taken during Duncan’s observation:

Duncan: Awe, [expletive]! [Gosh] damn it! [Expletive]! (Duncan shot the officer and continued saying these two things over and over.)

Trainer: What’d you learn?

Duncan: shooo… That’s a bad feeling right there. (takes a deep sigh) That’s a bad feeling. Yea, that’s a lesson learned for sure. Bad feeling.

Duncan’s experience in the simulator was observed to be among the most emotionally aroused participants. His experience started with this domestic dispute. The remainder of Duncan’s scenarios seemed to have been influenced by this first experience, possibly due to a decrease in self-efficacy stemming from a negative experience with the simulated baby in the domestic dispute scenario.
“I felt weird raising my voice to a computer screen.”

Peyton and Myles both commented on the difficulty of interacting with the scenarios because of the “computer screen.” Peyton pointed out, “it was difficult communicating with the computer screen when the people were not responding.” Myles addressed his frustration with the screen when he wrote in his post-simulation-use survey, “I felt that it is difficult to talk to a screen…It was awkward to [ask] a person that is running by you to tell you where the violator was.” During Myles’ observation, the trainer told him,

You need to interact more. If this was a true call, you should have gone over there and physically removed one of them, but we can’t do that here, so you gotta walk up there [to the screen].

Bruce also mentioned the limitation of the scenarios due to the screen in his post-simulator-use survey: “I feel that the field of view could be increased by having screens that make you look around and see your surroundings.” William echoed the screen theme as well; he wrote the following in his post-simulator-use survey:

I thought it was a good experience overall. A few things I would like to see improved is being able to control my movements and not having to solely follow whatever the screen is doing.

Grace also indicated feeling uncomfortable interacting with the screen. She told the interviewer that she “felt weird raising [her] voice to a computer screen.”
Summary

Overwhelmingly, the motif throughout the data was a sense frustration followed by a sense of relief. Recall that Duncan indicated that he felt “comfortable” in the simulator, but his observation and interview revealed differently. In fact, he seemed quite agitated as he was observed; he used a variety of foul words in the simulator, avoided eye contact with the interviewer, rocked back and forth in his chair, and took deep breaths and many pauses as he described the Active Shooter scenario (a school shooting) with, “what appeared to be realistically dead kids laying everywhere and a guy with an assault rifle.” Although Duncan said that “war” prepared him for being a law enforcement officer, he later told the interviewer that he had “never seen] anything like [this] before.” Similar to what John encouraged about using the simulator in the future, Duncan was observed during his simulator experience saying, “That was a lesson learned for sure.”

Although the learners experienced a variety of emotional arousal ranging from anxiety to frustration, they perceived their training in the high-fidelity virtual training simulator as “imperative” and “valuable.”

Qualitative Question 2

What aspects of the training experience with the high fidelity virtual training simulator influenced learners’ perceived self-efficacy?

In this study, “aspects” refers to the parts and features of the simulator that participants used to fulfill their learning experiences in the simulator. Participants’ responses to the simulator can be clustered into the categories of providing experience, realism of the scenarios, virtual materials, and malfunctions within the simulator.
Providing Experience.

“Everything was new.”

Of the participants who identified themselves as having previous law enforcement experience, Myles was among those who said “yes.” He described his experience as “17 years in [a similar field].” In his interview he said he realized, “the situations are different.” Because of this, he said he felt “uncomfortable” because “everything was new.” Although his perception of the simulator was that it was “uncomfortable,” it was the newness of everything that had the most influence on him. He told his interviewer,

It’s uncomfortable you know. One scenario is with a man with a baby and he’s arguing with his wife, and he pulls a gun on you, and you gotta shoot him, and you know he’s got a baby in his hands. The interviewer asked him, “Did you learn anything then?” Myles replied, Scenarios. I mean…they’ve got…you’re in a school and there’s…you know…you’re expecting someone to come out shooting. You know there’s an active shooter in there. You see a barrel of a gun and that’s all you see, and you tell them to drop the gun. You know, and they go down the hallway and it’s the police; it’s your partners you know, and I fired two rounds, and it’s…it’s…it’s uncomfortable. (Myles’ voice is shaky.) Myles later told the interviewer, “I thought I’d know what to do.”

Myles started the above response describing one emotionally arousing scenario and ended describing a different emotionally arousing scenario. The first scenario depicted a domestic dispute, and the second scenario presented a situation of friendly fire in which Myles fatally shot another police officer in the simulator. These two scenarios had the most impact on emotional arousal.
“I didn’t know what I was doing.”

Vicarious experience occurs when a person observes another person perform a certain
task successfully (Bandura, 1977). This observation could occur live or while watching a video
recording of the same scenario. Initially, it appeared that there was very little vicarious
experience in the simulator. A few instances of potential vicarious experience included
demonstrations from the trainer. When the trainer noticed that the participant was not performing
a task correctly, occasionally, he paused the simulator, got up, and showed or demonstrated the
task for the participant. In the post-simulator-use survey, six participants reported having
observed someone in the simulator; each of these participants reported observing the trainer
demonstrate a task (e.g. “holstering a gun” or “using the OC spray”). It should be noted that
Bandura (1977) emphasized that vicarious experience happens when one learner observes
another learner performing the same task successfully; therefore, by Bandura’s definition, the
trainer’s demonstrations, while excellent teaching methods, were not true vicarious experiences
for the participants because he was the teacher.

However, there were other times in which a participant did not interact with the simulator
at all; instead, he or she would stand and watch the scenarios. For example, when observed,
Grace appeared to stand defiantly in front of the simulator without interacting with it. The trainer
became verbally frustrated with her; slightly raising his voice in an authoritative tone he asked,
“You just gonna stand there like that? You expect somebody is going to back you up all the
time?” In her interview, Grace remarked,

I didn't know what I was doing… like the domestic call here, that was, I mean, again,
kind of crazy because I mean I was sitting there talking to a computer screen and
obviously he (the male actor in the scenario) wasn't listening.
It was observed that Grace stopped trying to interact with the simulator within minutes of the start of the domestic scenario (the first scenario) about which she spoke. In fact, Grace watched four more scenarios before she finally interacted with one, the active shooter scenario. Consequently, Grace’s post-simulator-use survey revealed a .35 decrease in her perceived self-efficacy.

“You need a good debrief.”

The simulator in this study allowed users to review their task-based experiences through a “session debrief.” After each scenario, the trainer could “reinforce a missed learning objective” or “key training concept” (IES Interactive Training, n.d.) based on a participant’s experience and the feedback given in the session debriefs. During debrief, the participant was able to see and review his or her “hits” from rounds fired throughout this simulated experience. Figure 11 shows a photo of the simulator’s debrief screen depicting a lethal hit; it shows a red diamond shape that represents what would have been the point of entry from the participant’s weapon. The blue area shows the participant where he or she could have also made a successful hit. These debriefs were important because an equal amount of instruction was happening in them. Recall from Chapter 2 that Fanning and Gaba (2007) encouraged debriefing in simulators as a means of critically reviewing the learner’s experience. Unfortunately, some of the participants were denied this opportunity because the simulator locked up during the debrief, thus preventing the participant from reviewing his or her shots.
Mark was one of the participants who experienced simulation malfunction during his debrief. On his pre-simulator-use survey, Mark indicated that he had 23 years of previous law enforcement experience. During his simulator experience, Mark was observed correcting the simulator. A bank robbery scenario had a police car parked in front of the bank, which according to Mark (and the trainer) would not happen in real life. Mark still felt like he had something to learn from his experience and voiced frustration when the simulator locked up prior to his debrief. “Dog it,” he exclaimed to the trainer, who replied, “Yeah, that’s happening a lot today.” Mark told the interviewer,

You always want to take a good thing and make it better, so every time there’s a training opportunity, whether it’s real or whether it’s training, it’s still an opportunity to improve. Once you finish, that’s part of it. You finish, and you go through a debrief. You need a debrief. You need to know: What did we do wrong? How can we do it better? Where can we change? That’s that learning process you get even after you were to engage in a live shooting. That debrief you go through…that process enables you to improve on your skills and techniques. I didn’t get that today, and it’s an important part of your training.
When the virtual materials were operating properly with the simulator, their “rounds fired” were able to be seen on the simulator’s screen during debrief. The individual scenario’s debriefs provided valuable feedback for the participants. Participants were able to see exactly where their weapon fired and into what or whom. It was quite telling to hear Mark, a 23-year veteran, tell the interviewer how important a debrief is; at the same time, it was unfortunate that the simulator locked up or crashed during some of his debriefs.

Tim experienced a similar situation; he alluded to the debriefing scenarios as he told the interviewer,

[The simulator] helped me iron out the wrinkles to where I was kind of questioned. In there you can correct your mistakes, and it’s very helpful to see them played back. Some I saw, some I didn’t see (referring to the simulator locking up).

Emotional arousal and challenges that the simulator presented, such as malfunctions and complete breakdowns, influenced learners’ perceived self-efficacy.

**Realism of the Scenarios.**

“It all seemed so realistic.”

On their post-simulation-use survey, participants were asked to rate how realistic their experience was in the simulator. On a scale of 1 to 10, 10 being the most realistic, the mean was 6.88. When asked, “What made your experience realistic?” overwhelmingly, participants responded with “the scenarios.” Joe, who indicated having experience in the military but not in law enforcement, wrote,
My experience was realistic because the simulator presented very possible situations in today’s world, and the unexpected events that took place made the experience even more realistic because some of the people that officers have to deal with are unpredictable.

Paul also stated that the realism of the scenarios influenced him. He judged the simulator as a “10” on the scale in his post-simulator-use survey and wrote,

“The movements of the law enforcement officers, the movement of the camera/video, the noises, reactions/actions of actors in the screen…all seemed so realistic.

Duncan also rated the realism of the simulator with a “10,” but he did not elaborate. As stated earlier, Duncan mentioned that he felt “comfortable” in the simulator. According to his pre- and post-simulator-use surveys, his perceived self-efficacy went up .18; however, during his interview, the interviewer made a note that even though Duncan said he was “comfortable,” his voice was shaky, and he never made eye contact with her. Describing how it “felt” in the simulator, he told the interviewer,

I’m responding to a domestic on one call and…[short pause] how it felt…[deep breath] like…[Duncan paused for 7 seconds before he continued, clearing his throat he said] I was literally looking at a guy with a gun to a baby’s head. It was fine until the school shooting where what appeared to be realistically dead kids laying everywhere and a guy with an assault rifle. I felt like I was in a school. And there was kids. And there was a guy with an assault rifle. I never saw anything like that before.

Duncan listed himself as having previous experience with the military. In his pre-simulator-use survey, he wrote that he was in Iraq in 2009 in Combat Infantry and in Afghanistan in 2010. He did not indicate scenarios he may have experienced during his military tour of duty; however, in
his written response to the post-simulator-use survey question that asked participants to discuss any experiences they had that helped them in the simulator, Duncan’s response was “war.” During the interview, in his own words regarding his experience in the simulator, he told the interviewer, “I never saw anything like that before.”

**Virtual Materials.**

“Oh, I never realized this was part of the system.”

Virtual materials were defined in Chapter 2 as “materials and equipment” that simulate the task that the learner is expected to perform (Havighurst, Fields, & Fields, 2010). The participants in this study were presented with two pieces of virtual materials: a Firearm and an OC Canister (IES Interactive Training, n.d.). (See Appendix M to see the virtual materials used in this study.)

Recall that Havighurst, Fields, and Fields (2010) emphasized the use of virtual materials in high-fidelity environments. With virtual materials, the participants should have felt more immersed in their tasks (Milgram & Kishino, 1994). However, a large portion of participants in this study experienced an interruption in their simulator experience due to the virtual materials malfunctioning (e.g. the gun not firing, the OC Spray not spraying) or the entire simulator system failing. In fact, 15 of the 18 participants experienced some sort of breakdown in simulator operation. This added to the increased emotional arousal some felt.

The participant in Figure 18 of Appendix M wore his or her own holster, as did all of the participants. This presented a problem for many of the participants as they struggled with “holstering their weapon” for the trainer. It was observed that “not all guns fit all holsters,” per the trainer.
The use of virtual materials provided an unexpected aspect to the training experience. All too often, the OC Canister would malfunction; there were times when it would fail to spray and times when it made the sound of gunfire, which confused some of the participants. About the influence of the simulator’s virtual materials, William wrote, “I was limited by what I was given such as OC Spray and a gun. I was not able to go hands on, use a baton or interact with the people in the scenario.” Consequently, William’s perceived self-efficacy dropped .15, a small indicator that the “negative” aspects of the simulator influenced participants’ perceived self-efficacy, as well.

For many participants, the simulator use was their first experience drawing their weapon on another person. So much of what they were experiencing was new to them; therefore, it was of more importance that the virtual materials “work,” especially for this group. For example, Duncan was unaware that the virtual materials were part of the simulator. During his scenario with an emotionally disturbed person (EDP) in a wheel chair, he tried to shoot the person. His observed response was,

Duncan: Oh, I never realized this (the OC) was a part of the system. Oh, I just thought it was an empty can you guys have.

Trainer: No, if you had sprayed him he would have slumped over.

Duncan: Oh, I thought it was just a piece of [explicative] can.

Although the trainer mentioned that the man in the wheel chair would have “slumped over” had Duncan, or any of the participants, shot or sprayed him, it was never observed, throughout all 18 participants’ usage, that the man in the wheel chair “slumped over.” In fact, there was no
response from the simulator, and often times, it was this scenario in which the simulator would lock up and stop working.

Grace was also observed trying to use the OC Canister. In doing so, she turned the OC Canister on herself to examine it. The following dialogue occurred during Grace’s simulation observation:

Trainer: You gonna try that in the field?

Grace: No sir. What am I supposed to do with this?

The trainer paused the simulator and got up to instruct and interact with Grace.

Trainer: Okay, so you OCed him. Now what?

Grace: Umm…I don’t know. I don’t really know what I’m doing. [Grace giggled, and appeared be nervous. She continued to tell the trainer that she did not know “what to do here.” That the trainer got up and instructed Grace was most helpful. She did not understand how to use the virtual materials, nor did she understand how to interact with the simulator. It took the trainer pausing the simulator and providing direct instruction for her to understand how to use them.]

The above scenario happened with other participants, as well. Dave was also observed turning the OC Canister on himself to better understand how it worked with the simulator, as did Peyton and Myles. John was observed holding and looking at the two virtual materials when the first scenario started. Because his attention was not on the scenario, John failed to perform the task appropriately and, consequently, was “shot”; however, he may have been trying to get a better understanding of how the materials and equipment worked versus not understanding the task
presented to him. The unfamiliarity of the virtual materials was another influential aspect of the simulator on participants’ self-efficacy.

**Malfunctions.**

“I don’t like the equipment. It’s kind of faulty sometimes.”

The purpose of using virtual materials in this simulator was to provide a higher level of immersion (Bowman & McMahan, 2007) by giving the participants a sense of “presence” (Milgram & Kishino, 1994) with the materials and equipment; however, the participants often experienced equipment malfunctions that prevented them from walking away with a high-fidelity experience. Instead, the material and equipment malfunctions, along with malfunctions from the simulator itself, influenced participants’ emotional arousal and their task performance. For example, Joe explained to the interviewer,

I don’t like the equipment. It’s kind of faulty sometimes. Like the OC spray they had doesn’t work properly. The only thing I had a real problem with in there was the equipment failure. It caused me to fail some of the scenarios.

When a participant “failed” a task, the simulator screen showed a message indicating the failure. Figure 12 shows a photo of the simulator’s screen at this point.

*Figure 12. A photograph of the simulator’s message regarding participant failure.*
Matthew was observed struggling between using his gun or his OC spray in the first scenario presented to him, a domestic dispute. While being a novice may have played a role in his task performance, he indicated to the trainer that he “didn’t follow through because [he] didn’t understand the [materials’] options.” Consequently, he failed the task. On the other hand, as Tim engaged in a scenario with an emotionally disturbed person (EDP), a homeless lady, he seemingly performed his task successfully; however, the simulator responded with a failure screen, which prompted immediate confusion from Tim:

Tim: Oh, I failed?

Trainer: I don’t know if I agree with that. I think what you did was fine.

Tim: But I sprayed and nothing happened, then it said I failed. I don’t understand.

Trainer: The simulator is not responding to the OC tool today.

While the trainer seemed to make light of the fact that the OC spray tool was not working properly, Tim was clearly affected by this experience because he brought it up in his interview. He told the interviewer, “I don’t understand why I failed one of the scenarios.”

Bruce’s interaction with the same scenario above, the EDP homeless lady, was also interesting. It was observed that Bruce did not have his virtual materials ready because, like Matthew, he had taken the time to “check out the OC can because it wasn’t working.” Bruce did not have his virtual materials available because he was “trying to fix it” and thus “failed to act appropriately” via the simulator’s message. The trainer responded to Bruce’s task failure with, “It gives you an idea of how frustrating things are.” Again, another participant was trying to understand the materials’ malfunctions, and, consequently, failed the task. The trainer and Bruce
did discuss how to respond to weapon malfunction in the field, but only after the trainer once again apologized for the OC sprayer not working.

**Additional Themes**

Two additional themes arose from the data. Many participants discussed the trainer’s role in the simulator. Additionally, almost all of the participants had recommendations for the simulator’s use and/or improvement.

**The Simulator Trainer’s Role**

Part of the training experience in this simulator included the trainer. It was the trainer who turned frustrating moments of malfunctioning virtual materials into teachable moments when he would instruct participants on what to do with weapon failure in the field. Several of the participants mentioned this in their post-simulator-use surveys. When asked about what influenced their ability to perform certain tasks in the simulator, overwhelmingly, the participants indicated the trainer and The Academy. In fact, over 60%, indicated that the trainer and/or The Academy influenced their performance in the simulator.

Bandura (1977) defined verbal persuasion as positive or negative verbal influence through social modeling; when the influence is positive (e.g. “Good job!”) a person is more likely to put forth more effort to compensate for deficiencies (Bandura, 1977, 1997). In this research, participants were alone in the simulator with the trainer (no other participants). The simulator itself was not able to provide the type of verbal persuasion to which Bandura referred. Instead, any verbal persuasion that may have occurred came from the trainer. The trainer was often heard giving words of encouragement such as “good job” or “Your communication is
good.” The most thorough example of verbal persuasion delivered was observed during Bruce’s simulation experience:

Bruce: It’s frustrating. I can’t really tell what’s going on. Bruce gasps for air, breathing heavily.

Trainer sitting: Don’t sit there and beat yourself up. You’re beating yourself up.

Bruce makes huffing sounds, and moves back and forth shaking his head from side to side. He exclaims loudly: What I find so [explicative] frustrating for me personally is that it should…

Trainer sitting, interrupts Bruce: It’s supposed to stress you out or frustrate you. You did okay, kid. You did okay.

In this example, the trainer reminded Bruce that the scenario was supposed to have been frustrating and stressful because that is how it would have been in “real life.”

Recommendations from the Participants

One of the prominent themes that arose from the data was participant recommendations. Neither the survey instrument nor the interview questions or observation checklist explored the idea of including recommendations from the participants. Participants volunteered the information on their surveys and during their interviews.

Aside from the “glitches,” as Mark called them, the majority of the participants enjoyed using the simulator as a learning tool. One of the sub categories that emerged from the data was the topic of limitations of this simulator and the participants’ unsolicited recommendations for improvement. On the post-simulator-use survey, the participants were asked to describe their
experience with the simulator. Many described it as “great training” and a “positive experience.” However, they were also quick to point out its limitations and how they would improve it.

Luke recommended using a simulator that reacted to movement. “If there were some kind of thing like the Nintendo® Wii™ or the Kinect, [it] would allow you to use defense tactics and techniques,” he suggested. He also suggested “some kind of cover, concealment in the scenarios.” Luke was the first participant to pull a chair into the simulator area and use it for cover when his virtual handgun failed to work properly. He remarked, “It’s what I’d do in the field.” Bruce suggested having a machine that shoots back. This particular MILO Range simulator does, indeed, have this function; The Academy, however, chose not to use it. Bruce also suggested,

Maybe having a dummy in the room that you can strike or go hands-on with to show the evaluator, okay, this guy’s thinking correctly; he’s gonna go hands-on versus verbalizing it. It’s a lot more difficult to verbalize something to an instructor versus just doing it.

William also indicated that he found his experience in the simulator to be beneficial, but he added,

I think it would be more realistic if the gun actually worked and when it worked that it had recoil on it because I was bracing myself a lot for that and it never came, so I think it threw my shots off…[if the] gun was actually recoiling then you can feel more and be more in the moment with the situation.

Recall from Chapter 2 that Milgram and Kishino (1994) defined the feeling of “in the moment” as “presence,” which, they wrote, was an important aspect of a high-fidelity experience.
Overwhelmingly, the participants recommended that The Academy incorporate additional training on the simulator, or as Tim suggested, “as much as possible, as often as possible.”

**Summary of Results**

The convergence of the data summarizes this study’s results. A convergence table of all three data sources is located in Appendix K. This table shows where the data converged after mixing occurred. Because no significant differences were found in the quantitative strand, the qualitative strand seemed to support the heart of the data and “explain the quantitative data” (Creswell & Plano Clark, 2011). Therefore, the three data sets (survey, observation, and interview) are included under the two qualitative research questions in Table K1.

The most prominent motif throughout all three forms of data was the emotional arousal that the participants experienced. Some of the emotional arousal came from participants’ frustration with the simulator not functioning properly, and some of the emotional arousal came from the high level of immersion the scenarios presented the participants.

A review of the data showed a divergence of results in addition to the convergence of results. The participants indicated a high level of perceived self-efficacy on the pre-simulator-use survey, with a mean perceived self-efficacy of 5.05 out of 6. The qualitative data revealed otherwise. The qualitative data supported Bandura’s (1977) theory that perceived self-efficacy is task-specific; therefore, if a person used a flight simulator in the past, his or her experience most likely would not transfer to a use-of-force simulator in the present. Duncan spoke freely about the fact that he was not as prepared as he thought. He indicated that he believed both his experience with military simulators and with war prepared him for his experience in the
simulator; he later stated that he had never experienced anything like what he saw in the simulator and that it served him as a “wake-up call.”

Participants indicated that the most influential aspect of their simulator experience was the level of realism presented from the scenarios. Aside from the difficulties and challenges of “talking to a computer screen” or material and equipment malfunction, overwhelmingly, the participants referred to the scenarios as being most influential on their learning experience. The scenarios provided a high level of immersion, making all but one of the participants’ experiences “seem so realistic.” Recall that Joe indicated to the interviewer that he thought his military training would have prepared him; instead, he said that it was the simulator that he felt prepared him “because the simulator presented very possible situations in today’s world, and the unexpected events that took place made the experience even more realistic.” Likewise, Paul told his interviewer that the characteristics from the simulator had a great influence on him. He discussed “the noises,” and mentioned the blaring alarms, the screaming lady, the crying baby, and the sound of gunshots. “It all seemed so realistic,” Paul explained. Overwhelmingly, the participants in this study remarked either in an interview or through the survey, that they would have liked to have had more time with the simulator because they saw it as a valuable learning tool.

Overall, 15 of 18 participants were observed having experienced some form of simulator breakdown or malfunction. Additionally, exactly half of the participants indicated feeling frustrated with the simulator when it broke down. Some of the scenarios of simulator breakdown included the simulator “locking up” and the virtual materials not responding appropriately (e.g. the OC Canister making gunfire sounds). When the simulator experienced some sort of malfunction, this meant that the trainer either had to explain to the participant what was
happening, interrupting the flow of the experience and decreasing the level of immersion, or the trainer had to stop the experience completely, turn on the light in the room, and reboot the entire system. There were two occasions in which the trainer had to find another person in The Academy to recalibrate the system. The average down time per lock up was 3 – 6 minutes. The participant most affected by the simulator lock up was Larry, who started his simulator experience on Day 2; half way through the simulator, it locked up to the point where neither the simulator trainer nor other Academy trainers could successfully restart it; therefore, Larry had to complete his experience on Day 3, four days later. Because of this, Larry’s data were excluded from the analysis.

Participants’ perceived self-efficacy scores indicated a somewhat higher self-efficacy prior to using the high fidelity virtual simulator than after using it. However, the observations and interviews revealed that participants soon realized that these were “lessons learned.” No previous experience outside of law enforcement prepared them for “anything like this,” for there “was no experience better than what was presented on the simulator.”

In conclusion, the convergence of data revealed that emotional arousal from the simulator influenced task performance in the simulator, which led to a decrease in perceived self-efficacy. Chapter 5 will discuss the findings and implications of these results as well as suggest ideas for future research and future instruction with high-fidelity simulators.
Chapter V: Conclusions, Discussion, and Recommendations

This chapter reviews the study as a whole by summarizing the results, providing recommendations for practice, and discussing limitations. It also presents contributions of the study to multiple disciplines and discusses areas of future research.

Review of the Study

This study was first inspired by Bandura’s (1977) Self-Efficacy Theory. A second muse of inspiration came from the literature regarding the use of high-fidelity virtual training simulators. It was then discovered that a few studies (See Davis, et al., 2000; Goldenberg, et al., 2005; Kameg, et al., 2010) investigated self-efficacy when using simulators in training scenarios. However, these studies did not use task-specific self-efficacy surveys, nor did they address the role of the simulator or how participants responded to it. Therefore, this study sought to discover a more robust exploration of the influence of high-fidelity virtual training simulators on learners’ perceived self-efficacy in order to help better inform the literature and researchers of the instructional design and technology community.

The purpose of this mixed methods study was to explore how learners’ perceived self-efficacy regarding “task-specific performance outcomes” (Bandura, 1997, 2006) was influenced after using a high-fidelity virtual training simulator. Law enforcement recruits enrolled in a law enforcement training academy served as the participants for this study. During the study, participants responded to pre- and post-use surveys regarding their perceived self-efficacy and use of the simulator; they were observed using the simulator as a training tool, and they were also interviewed about their experiences in the simulator.

Triangulation of the data came from participant surveys, participant observations, participant interviews, coded data from both the observations and interviews, and
quantitative and qualitative analyses. Three research questions guided this study. The researcher looked for differences, if any, between learners’ perceived self-efficacy prior to and after using a high-fidelity virtual training simulator to perform specific tasks. She also explored learners’ perceptions of their training experience with the same simulator; in addition, she looked for aspects of the training experience with the simulator that influenced learners’ perceived self-efficacy.

While the data were collected concurrently and analyzed separately, both research strands supported each other. Six predetermined categories were used to code and analyze the data: These included previous experience, verbal persuasion, vicarious experience, emotional arousal, task, and simulator. Of the six, two categories were most prominent: emotional arousal and simulator. These two categories led to two prominent themes that emerged from the data:

1. Emotional arousal from the virtual environment
2. Emotional arousal from repeated malfunctions in the simulator

There were two very different aspects to the emotional arousal that so many of the participants discussed. The environment created by the high-fidelity virtual scenarios provided much of the emotional arousal experienced in this study; additionally, 60% of the participants experienced emotional arousal from the malfunctions in the simulator, as well.

**Emotional arousal from the virtual environment**

Gray (2002) put forth that the purpose of using simulators for training purposes was to imitate the real thing as closely as possible. How close something is to the real thing depends upon its level of fidelity (IEEE Std 1278.1-1995). Milgram and Kishino (1994) suggested that the goal of fidelity was to evoke the user’s feeling of “presence,” and to create an experience that
would make the user feel as if he or she were “participating in ‘unmediated reality’” (p. 10). Similarly, Bowman and McMahan’s (2007) empirical study put forth that the goal of a high-fidelity simulator was “to produce a realistic experience for the user that effectively places the user in the simulated environment” (p. 37). Bowman and McMahan’s study found that higher levels of immersion, or fidelity, contributed to improved interaction with the user’s task performance. Many participants in this current study expressed frustration with being put in the moment, which, as Bowman and McMahan suggested, was the simulator’s purpose. Participants expressed frustration with not wanting to shoot a baby – a virtual baby. Some participants admitted that the simulator provided a safe place to learn, but even so, they were reluctant to take chances when it involved a child or another police officer.

Because of the high-fidelity aspect of the simulator used in this study, those things that were not real (i.e. scenarios were projected onto a screen; no live people were involved) appeared to be so real that the high fidelity influenced participants’ task performance by increasing their emotional arousal. Some participants were physically shaken when presented with the scenarios. They exhibited anxiety through the use of foul language, breathing exasperations, and showing frustration by shaking their heads, walking around in circles, and swaying back and forth. The participants were reluctant to take chances involving lives of bystanders in the virtual scenarios (e.g. the baby in the domestic scenario and police officers in the active shooter and active response team scenarios). The trainer would remind them that the simulator was a place to learn and practice, and that this [the simulator] was the place to take risks.

Consistent with Bandura (1997), who put forth that “errors are common during the early phases of skill development” (p. 440), the trainer and the participants believed that simulated
training is a good place to continue learning. In fact, Bandura also stated, “Initially, trainees test their newly acquired skills in simulated situations where they need not fear making mistakes or appearing inadequate” (p. 443). These are all additional reasons for the beneficial uses of the simulator in training – when it works.

**Emotional arousal from repeated malfunctions in the simulator**

When malfunctions occurred in the simulator, the participants experienced a loss of fidelity (Gray, 2002). This study explored perceived self-efficacy “for a particular performance under a specific set of conditions” (Bandura, 1997, p. 49). It was expected that the participants would execute specific tasks within a give scenario. Instead, most participants experienced something altogether different. From not knowing how to use the simulator to experiencing a multitude of breakdowns and malfunctions, participants had more to say about their frustrations with the simulator not working correctly than any other topic. None of the participants were questioned about malfunctions in the simulator, nor were they questioned about recommendations, but they brought up these topics.

When media like a high-fidelity virtual simulator is being used for training purposes and does not work properly, the malfunctioning media becomes a negative influence on overall task performance. According to Bandura’s Theory of Self-Efficacy (1997), malfunctioning media, in this case the simulator, would most likely create “ambiguous circumstances” for the participants (p. 64). This was observed when the OC Canister Spray made the sound of gunfire. Two things would happen: first, the participant would turn the OC Spray on himself or herself; and second, the participant would stop using the OC Spray in the simulator, even when the task deemed it more appropriate than using the virtual handgun. Bandura stated, “Discrepancies between efficacy belief and performance will arise when either the tasks or the circumstances under
which they are performed are ambiguous” (p. 64). If the participants were not certain about how the simulator would respond to their execution of a task, they were less likely to engage in the task, thereby potentially lowering their perceived self-efficacy about the task in which they were engaged. Duncan was observed telling the trainer this when he said, “I thought I knew what to do.” He was referring to the simulator not responding to his actions.

One of the many purposes of using a simulator is to provide the learner with experience; previous experience is one of the influences that leads to an increase in a person’s perceived self-efficacy. In this case, if a participant correctly performed a task, such as firing a successful “hit” on a suspect, but the simulator crashed or did not respond appropriately, then the success is lost, and the participant is robbed of an experience that would have created a much needed “previous experience.”

Bandura’s (1997) Theory of Self-Efficacy also states that “when a procedure impairs functioning,” it can influence a person’s “coping efficacy” as they approach situations less assured of the task and/or the skills they already possess (p. 58). Additionally, when a series of malfunctions occur as they did in the simulator in this study, Bandura argued, “The seriousness of missteps can also influence the accuracy of self-efficacy judgments” (p. 68). Unfortunately for the participants in this study, they may have misjudged their own self-efficacy due to the missteps of a malfunctioning simulator.

**Summary of Study Results**

According to Bandura’s (1977, 2000) self-efficacy theory, if a person experiences a heightened state of emotional arousal by feeling anxious or vulnerable, he or she is more likely to judge his or her own capabilities more harshly than otherwise (Bandura, 2000; Kavanagh &
Recall Kavanagh and Bower’s (1985) study where they examined a person’s mood on self-efficacy. They found that emotional arousal was a kind of filter that determined performance outcomes. In the current study, the participants remarked that they were feeling anxious from the malfunctioning simulator; therefore, it would suggest, as Kavanagh and Bower discussed, that the malfunctions in the simulator, however small or large, provided the “framework” that prevented participants from completing their tasks. In essence, the simulator provided participants with “thoughts of ineptness” that ultimately led to an increase in emotional arousal and a decrease in self-efficacy.

As discussed in Chapter 2, persons who experience heightened emotional arousal often possess low self-efficacy thereby doubting their abilities to perform in given situations in order to achieve expected outcomes. Situational factors, similar to those experienced in this study, often undermined individuals’ self-efficacy (Schunk & Pajares, 2002), along with complex modern technologies, such as the high fidelity virtual simulator used in this study.

Overwhelmingly, participants voiced concern and frustration about not being able to complete a task due to simulator interference, either from the simulator locking up or from the virtual materials not working properly, or both. Additionally, many participants indicated on their post-simulator-use surveys and in their interviews and observations, that they had an inability to complete a task due to anxiety. For example, several participants wrote about and discussed the domestic scenario in which an angry man with a gun was holding a crying baby. The participant was supposed to “shoot to kill” the man with the gun, but many found this disturbing because they were worried about shooting the baby. The participants indicated that they were too worried or anxious to fire their virtual weapon; therefore, they “failed” the task.
Despite the fact that the simulator caused a variety of emotional arousal ranging from anxiety to frustration, as a whole, the participants’ perceptions were that the high-fidelity virtual training simulator was a valuable learning tool that provided them with experiences they had not yet encountered in classroom training. Some participants described the simulator as “imperative” for training; others used words like “valuable” and “needed.” For example, recall that James acknowledged to the interviewer that his experience in the simulator was “negative”; however, his post-simulator-use survey revealed that he believed, “there was no experience better than what was presented on the simulator” because the scenarios were so realistic. Similarly, John encouraged, “Learn from the experience…[even though] it’s pretty jacked up,” and experience is what the simulator provided the participants.

**Study Limitations**

This study encountered limitations that are common in mixed method studies; however, there were also limitations the study encountered due to unexpected matters. A convergent parallel mixed method study usually needs multiple researchers in order to properly carry out the required data collection procedures (Creswell & Plano Clark, 2011). This study used two research assistants to help with data collection. The research assistants were tasked with insuring that the participant exiting the simulator immediately took the web-based post-simulator-survey and then sat for an interview with the research assistant. The research assistant on Day 2 forgot to ask those participants to take the post-simulator-survey. However, this limitation provided an opportunity for the researcher to test between the two sub groups (the Immediates and the Laters).

Another limitation set forth by using research assistants was having two different
assistants. The research assistant on Day 2 was a white male in his forties who had previous law enforcement experience. The research assistant on Day 3 was a white female in her twenties with no previous law enforcement experience. Not that law enforcement experience was needed to carry out the tasks of the data collection, but it may have affected the interaction between the participant and the interviewer. However, both research assistants were graduate students with previous experience in collecting qualitative data and interviewing participants in a lab setting.

Another limitation was in the sample used in this study. This research study only recruited law enforcement recruits at a specific law enforcement academy because The Academy used a high-fidelity virtual training simulator. For this reason, the findings of this study cannot be generalized or applied to other populations. Additionally, the participants in this study were guaranteed confidentiality, as is required by IRB protocol; however, this did not mean that participants put forth their true feelings on the topics explored. Patton (2002) warned of “distorted responses” when interviewing a participant onsite.

**Contributions of the Study and Future Research**

Despite limitations, this study extends the current literature base by discussing the “seriousness of missteps” (Bandura, 1997) in malfunctioning simulators during training. A review of the literature did not reveal empirical studies exploring this phenomenon. The major contribution this study will make (to a variety of disciplines) is that malfunctioning media influences a person’s self-efficacy – regardless of the amount of experience. For example, the most experienced participant in this study, a law enforcement veteran with over 20 years of experience, questioned himself multiple times during his simulator experience. His concerns were paraphrased as: *Why is that police car parked in front of the bank during a suspected*
robbery? Why is the simulator telling me I failed a task? (when even the trainer said he did not believe the participant to have failed it); I did not get to debrief my experience because the simulator locked up during debrief. Now I’ll never know why it thinks I failed the task. Why is this OC Canister making the sound of gunfire? This veteran experienced loss of fidelity in his simulator experience, which caused him to question himself and eventually experience a lower perceived self-efficacy, according to his pre-use and post-use scales.

The presentation of literature in Chapter 2 did not discuss issues and challenges of using technology like a high-fidelity virtual simulators in training scenarios, aside from the fact that they are costly. However, overwhelmingly, this was the most prominent theme that emerged from the data. Participants’ emotional arousal was affected by the many simulator breakdowns. Some participants went into the simulator never having drawn a gun, so they were already stressed upon entering the simulator, and then the simulator would break down. Several participants mentioned not knowing what to expect, which may have also contributed to the emotional arousal.

**Future Research**

The challenges this study encountered regarding the malfunctioning simulator turned out to be an interesting phenomena itself. The phenomena is unfortunate because so many of the participants in this study grew frustrated with the lack of functionality in the simulator; on the other hand, observations and interviews in this study led to the revelation that there is more to a simulator than current empirical studies put forth. It is suggested that additional research be conducted on the “missteps” that lead to lowered self-efficacy due to the loss of fidelity through malfunctioning training tools. Additionally, the qualitative nature of this study lends itself to “understand the larger phenomenon through close examination” (Rossman & Rallis, 2003) of
specific cases of the participants; therefore, in depth case studies that examined each participant’s experience in the simulator are also recommendation for future research.

Participants in this study indicated that using the simulator was a positive experience. They indicated that the simulator provided them with much-needed experience for a variety of scenarios their academy training could not provide (e.g. domestic situations, school shootings, second response teams). Despite the “missteps” with the simulator in this study, the simulator did what it was supposed to do: it provided experience, which raised emotional arousal in the participants. It is suggested that additional research be conducted on the emotional arousal participants experience when using high-fidelity simulators. Additionally, the creation of sub groups in this study (the Immediates and the Laters) provided another possible research opportunity for future studies.

Finally, it is recommended that future research be conducted on the recommendations for practice that are laid out in this chapter, as well.

**Recommendations**

**Recommendations for Practice**

This study sought to increase our current understanding regarding learners’ perceived self-efficacy in training simulators. To do so, this study used task-specific, as well as general, self-efficacy scales to explore the influence of using a high-fidelity virtual training simulator in the workplace. Furthermore, a number of recommendations evolved from the qualitative data in this study. Below is a summary potential of recommendations that can be derived from the findings; many build upon one another, depending upon how much instructional time can be put forth in adapting them into the instructional design.
The basis for these recommendations comes from Gagné’s (1985) theory of instruction in which he proposed a “rationally based relationship between instructional events, their effects on learning processes, and the learning outcomes that are produced as a result of these processes” (p. 244). The researcher deems the recommendations for this study, IPP, or Inform, Present, and Practice.

1. Inform the learners of what to expect from the simulator.
2. Present the learners to the simulator and its environment.
3. Practice includes allowing the learners to experience the simulator’s virtual environment.

**Inform the learners of what to expect.**

This recommendation stems from Gagné’s suggestion that instructors gain the attention of the learners and inform the learners of the learning objectives. The results of this study suggest that instructors should tell learners exactly what to expect. For example, during classroom instruction, instructors could insert videotaped scenarios from the simulator into their instruction. This would be especially helpful for those learners who are novices at the tasks being introduced to them. Providing a videotape example of the scenarios used in the simulator would provide two things. First, it would help build learners’ schema (Ausubel, 1968) for novice recruits by showing them what a domestic dispute might look like, for example. Second, a video recording of a scenario from the simulator would also introduce the learners to the simulator, which, in effect, would establish a schema for the learners to get a feel for hearing and seeing what the environment will be like. Many participants in this study remarked about how the noises startled them (e.g. the screaming baby and the blaring alarms). Not only are the learners
introduced to the perils of a domestic dispute or landing a plane or encountering roadside bombs in a safe environment (e.g. the classroom), they would also be introduced to the “feel” of what the simulator would be like when they experience it. This would allow the learners to focus on the task and not on the simulator. Bandura (1997) referred to this as building vicarious experience. Recall that several participants in this study “just stood there” and watched the scenarios play out. During these play backs, the instructors could ask questions like, “What would you do here?” “What do you do if your landing gear fails?” “What is the escalation of use-of-force applied in this scenario?” “How do you radio for help should your platoon encounter enemy fire?” Etc. The trainers would adapt the questions to match the learning scenarios.

**Present the learners to the simulator and its environment.**

Gagné (1985) suggested that instructors “ask for recall of previously learned knowledge or skills” (p. 244), at which time the instructors would also present the learners with the task to be learned, in this case the simulator. Another suggestion would be to have the learners in front of the simulator and proceed through the above recommendation using the same scenario from the videotape. This places the learners in the learning space in order for them to acquaint themselves with the context in which the training would take place – the simulator itself, the trainer’s position in the simulator, and where the learner or learners would be in the simulator. One participant in this study remarked that it took him time to adjust to the “big open space.” Additionally, if there were no additional aids or tools available for use in the simulator, this would be the time to tell learners to “use the chair for cover,” or whatever other materials might be available. However, it is recommended that in order to keep in tune with the high-fidelity virtual simulator, the instructor should place items like shields or batons, or communication
radios, flight gear, first aid kits, etc. in the simulator room for the learners to use. Many of the participants in this study remarked that they wanted to demonstrate maneuvers they had learned during their previous training, but they did not have the equipment to do so.

**Practice includes allowing the learners to experience the simulator and its virtual environment.**

Finally, Gagné (1985) also suggested that instructors provide “learning guidance” and practice for the learners; in other words, allow the learners to use what is being taught to them. The purpose of using a high-fidelity virtual simulator is to immerse learners “in the moment” as much as possible. If the simulator and its environment are completely new to the learner, he or she would most likely spend his or her time in the simulator learning how to manipulate the system, as opposed to executing the expected performance tasks. Therefore, it is recommended that the learners take turns using the simulator in groups. Additionally, the lights should be on in order for the learners to observe each other. (Recall that the lights were off in this study.) If needed for time purposes, divide the learners into two groups – a morning group and an afternoon group – and have them take turns using the simulator with other learners observing. This would allow the learners to experience the four influences of self-efficacy. First, novices would be able to experience vicarious experience while observing veterans in the simulator. (If no veterans are available, have the trainers demonstrate the tasks.) Second, this experience creates opportunities for verbal persuasion in which the trainer praises the learner for tasks completed. Additionally, if the trainer encourages learners to be supportive of each other through the process, learners should feel more comfortable in acknowledging the performances of their peers. Third, learners are provided the opportunity to develop mastery experience by creating a previous experience that they would later take with them into the simulator when they experience...
the simulator on their own. Finally, the former experiences would lead to an increase in positive emotional arousal, which, in turn, would lead to a higher perceived self-efficacy in task performance.

**Summary**

In summary, trainers should show the learners footage from similar scenarios that exist in the simulator but that will not be used for assessment. Trainers should tell learners what to expect from the simulator by allowing them to hear the sounds that so many of the participants in this study described. Finally, the researcher highly suggests that instructors consider adopting instructional and learning activities from the third recommendation provided above. To reiterate the recommendations, instructors can remember IPP:

1. Inform the learners of what to expect from the simulator.
2. Present the learners to the simulator and its environment.
3. Practice includes allowing the learners to experience the simulator’s virtual environment.

Perhaps James conveyed this best when he told the interviewer, “If you fail the first three [scenarios] because you don’t know what you’re doing, you become more nervous…and you start to question yourself.”
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## Appendix A: Table of Studies

### Table 5 Studies that include self-efficacy and simulations

<table>
<thead>
<tr>
<th>Author</th>
<th>Research Purpose</th>
<th>Statistics</th>
<th>Self-Efficacy Scale</th>
<th>Findings</th>
</tr>
</thead>
</table>
| (Kameg et al., 2010)    | • Compared two teaching strategies: traditional lecture and high-fidelity human simulation  
  • Used a high-fidelity human simulator called SimMan, a computerized mannequin | • n=38  
  • non-randomized assignment, quasi-experimental  
  • used Pearson correlation to assess relationship between the scores in SE scale from Time 1 and Time 2  
  • used open-ended questions on why responses varied  
  • GSE  
  • Pilot tested with 5 responders | • t-test found significant change in self-efficacy  
  • Responses to open-ended questions noted using SimMan was “good.” |
| (Davis et al., 2000)    | • Examined predictors of self-efficacy in aviation training setting, specifically self-esteem, self-efficacy, and performance  
  • Used an aviation training simulator to provide basic instruction for flying | • n=297  
  • measured for self-esteem, self-efficacy, and performance  
  • used correlations to compute all measures  
  • used hierarchical regression analysis using GSE as the control | • GSE | • Found that prior experience influenced self-esteem, self-efficacy, and performance  
  • Suggested looking at feedback |
| (Goldenberg et al., 2005) | • Investigated the effect of classroom simulation on third-year nursing students’ self-efficacy in health teaching  
  • Used role-play as the simulation | • n=22 (a non-probability, convenience sample)  
  • exploratory, descriptive study  
  • looked for differences in mean self-efficacy scores before and after role-playing simulations  
  • also used parametric tests for looking at differences in self-efficacy scores, despite the convenience sample  
  • used a t-test  
  • used Pearson’s correlation to look at relationships between students’ health teaching scores and selected demographics  
  • used descriptive statistics (frequencies) to rate students’ ratings of simulation effectiveness (p. 312)  
  • Researcher-developed, two-part, 63-item questionnaire  
  • Pilot tested with 7 responders | • Found that students’ active participation in role-playing was “a useful strategy” for health teaching |
Appendix B Simulator Scenario Descriptions

**QUICK GUIDE:**

**Overview:**
You are dispatched to a domestic disturbance at a residence.

**Story Line:**
The trainee arrives at a domestic disturbance to find a male and female in the kitchen of the home arguing over an infant. The male is holding the infant and the female is demanding the infant. The male suspect can only pull a gun, assault with a rolling pin or take the baby hostage with the gun and flee the scene.

**Possible Training Objectives:**
1. Proper procedure on dealing with domestic disturbances.
2. Threat recognition and proper verbal command.
3. Proper utilization of lethal and non-lethal force options.

**Option Notes:**
This scenario supports the following system options:
- OC canister, Low Light Conditions, (Flashlights and Return Fire if installed).

**QUICK GUIDE:**

**Overview:**
You are stopping by a local bank to use the ATM while on duty.

**Story Line:**
As the trainee begins walking towards the bank, a bank alarm goes off and they hear automatic rifle fire. Two suspects then exit the bank with weapons. The male suspect, who is wearing body armor, begins shooting at the trainee. If the subject is shot, the second subject can begin shooting at the trainee.

**Possible Training Objectives:**
1. Policy and procedure dealing robbery in progress
2. Proper threat assessment
3. Situational awareness

**Option Notes:**
This scenario supports the following system options:
- Flashlight and Return Fire System
Simulator Scenario Descriptions continued
Simulator Scenario Descriptions continued

**Quick Guide:**

**SYSTEM BRANCH:**

- **P1**
  - **MANUAL BRANCH:** LETHAL THREAT - SHOOTS OFFICERS
  - **SYSTEM BRANCH:** SUSPECT SHOOTS AT THE TRAINEE
  - **SUSPECT DIES IF SHOT BY TRAINEE**

- **P2**
  - **MANUAL BRANCH:** LETHAL THREAT - SHOOTS AT STUDENTS
  - **SYSTEM BRANCH:** SUSPECT DIES IF SHOT BY TRAINEE

**Overview:**

You are dispatched to an active shooting in progress at your local middle school. You are informed that there are possibly two active shooters.

**Story Line:**

Upon arriving at the school the trainee rendezvous with other officers to form a rapid response team. The trainee takes the left cover position. During a search of the school the trainee arrives at the cafeteria and observes a suspect, armed with a long arm, came from behind a position of cover. The suspect can then either shoot at the trainee, shoot at other students or he can set down the long arm, fire a gun, then draw a pistol and begin shooting at the trainee. If the trainee successfully engages the suspect, the suspect dies. The team then moves on to locate other suspects. As the trainee rounds a corner a second shooter holding a female student hostage is observed. The trainee can then either shoot the suspect or the suspect will execute the hostage and begin shooting at the trainee.

**Possible Training Objectives:**

1. Policy and Procedure on dealing with an active shooter.
2. Proper threat assessment.
3. Trainee’s understanding of Rapid Response Teams.
4. Trainee’s understanding of active shooter dynamics.

**Option Notes:**

This scenario supports the following system options:
- Low Light Conditions, (Flashlights and Return Fire if installed).

**Quick Guide:**

**SYSTEM BRANCH:** POINT OFFICER OF SECOND RESPONSE TEAM DIES IF SHOT BY TRAINEE

**Overview:**

You respond to a call of an active shooter at a local high school. You form a rapid response team with other officers to search the building.

**Story Line:**

Upon entry into the school the trainee observes another officer and forms a rapid response team. You are assigned the Right Cover Position. The trainee begins to search the school for the active shooter. After searching several rooms you see and hear a gun shot coming from a intersecting hallway. Then a second response team enters the hall and continues on their way.

**Possible Training Objectives:**

1. Policy and Procedure on dealing with an active shooter.
2. Proper threat assessment.
3. Trainee’s understanding of Rapid Response Teams.
4. Trainee’s understanding of active shooter dynamics.

**Option Notes:**

This scenario supports the following system options:
- Low Light Conditions, (Flashlights and Return Fire if installed).
Appendix C: The Simulator’s Learning Space and Setup

Figure 13. The simulator’s screen

Figure 14. The simulator’s table. This is where the trainer sits during simulation. Here, he or she can activate the simulator through the desktop computer.

Figure 15. The simulator set up. The simulator itself is comprised of a few manageable parts, such as the computer itself, a projector, a laser, and a loud speaker.

Figure 16. A participant using the simulator.
Appendix D: Academy Performance Criteria

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.18 Demonstrate appropriate actions for a residential alarm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.20 Identify procedures to search for a person in a building or environment as</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>applicable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.6 Identify the factors affecting the use of necessary and reasonable force</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.9 Officer will determine whether or not the use of deadly force / firearm is</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>necessary / justified</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SEARCH TEAM**

1. Issues verbal challenge before entry (4.20.3) (6.6.3)  
2. Demonstrates proper use of cover (4.18.2) (4.20.4)  
3. Uses the 7 meter side step and quick peek techniques (4.20.3)  
4. Demonstrates proper room entry techniques (4.20.3)  
5. Clears, covers or secures all danger areas (4.20.3)  
6. Demonstrates proper weapon control and safety (4.20.4) (6.9.2)  
7. Provides appropriate cover / back-up for other officers (4.18.1) (4.20.4) (6.6.3)  
8. Demonstrates proper use of flashlight (4.20.3)  
9. Demonstrates the appropriate use of deadly force (6.6.1) (6.6.2) (6.6.3) (6.9.1) (6.9.2)  
10. Proceed through building until all suspects are found or building is confirmed to be empty (4.20.5)  
11. Arrests any suspect found in the building  
    1. Demonstrates proper handcuffing of the suspect (6.6.3)  
    2. Checks waist band and pockets before moving suspect  
12. Safely removes suspect from building  
13. Maintains officer safety (4.20.4)  
14. Contacts responsible party (4.18.4)  

Comments:

Evaluator Test 1:                                                                 Date:  
Evaluator Test 2:                                                                 Date:  
Evaluator Test 3:                                                                 Date:  

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### Performance Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3 Stop or delay persons attempting to commit suicide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.6 Identify the factors that affect the use of reasonable and necessary force</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.9 Officer will determine whether or not the use of deadly force/firearm is necessary/justified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Notify supervisor, request back-up and rescue</td>
<td>(3.3.1)</td>
<td>(6.6.3)</td>
<td></td>
</tr>
<tr>
<td>2. Maintains a safe position behind cover</td>
<td>(3.3.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Proper communication with the subject</td>
<td>(3.3.2)</td>
<td>(6.6.3)</td>
<td></td>
</tr>
<tr>
<td>4. Controls subjects movement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Maintains officer safety</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. <strong>Appropriate use of deadly force</strong></td>
<td>(6.6.1)</td>
<td>(6.6.2)</td>
<td>(6.6.3)</td>
</tr>
<tr>
<td>7. Identifies proper documentation of incident</td>
<td>(3.3.3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

Evaluator Test 1: ____________________________ Date: ____________________________

Evaluator Test 2: ____________________________ Date: ____________________________

Evaluator Test 3: ____________________________ Date: ____________________________
### Academy Performance Criteria continued

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.41.3 Demonstration of the techniques to be used to effect a high risk stop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Each recruit will be tested as a primary officer and a back-up officer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRIMARY OFFICER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Notify dispatch of high risk vehicle stop. Advise dispatch of vehicle description, tag number and number of occupants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Choose a safe location for the stop and advise dispatch of the location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Properly position primary vehicle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Primary officer identifies himself and his intentions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Primary officer commands occupants to interlock fingers on top of their heads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Primary officer commands driver to turn off ignition and drop keys out the window</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Primary officer removes each occupant, one at a time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. <strong>Primary officer orders exiting suspect to turn 360 degrees to check for weapons</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. <strong>Primary officer moves suspect into the takedown position for the back-up officer</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Primary officer challenges the vehicle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. <strong>As primary officer, properly and safely, clear the passenger compartment and trunk</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. <strong>Maintains officer safety</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

---

Evaluator Test 1: 

Date: 

Evaluator Test 2: 

Date: 

Evaluator Test 3: 

Date:
Appendix E: Pre-Simulator-Use Survey

Law Enforcement Recruit Survey Instrument – October 12, 2011: Pre-Simulator-Use
A number of general statements and statements about police-related maneuvers is presented below. The purpose is to gather information that will help us to better understand how police recruits experience training in a simulator. There are no correct or incorrect answers. We are interested in only your honest opinions. Your responses will remain confidential. INSTRUCTIONS: Please indicate your personal opinion about each statement by clicking the appropriate response for each statement.

Strongly agree | Disagree | Somewhat Disagree | Somewhat Agree | Agree | Strongly Agree

### Appraisal Scale – Pre-Simulator Use

<table>
<thead>
<tr>
<th>Statement</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is easy for me to stick to my aims and accomplish my goals.</td>
<td></td>
</tr>
<tr>
<td>2. I am able to determine whether or not the use of deadly force is justified in any given situation.</td>
<td></td>
</tr>
<tr>
<td>3. I am not confident in my ability to perform a high-risk stop.</td>
<td></td>
</tr>
<tr>
<td>4. I am confident that I can identify factors affecting the use of necessary and reasonable force.</td>
<td></td>
</tr>
<tr>
<td>5. I am not very confident that I could deal efficiently with unexpected events.</td>
<td></td>
</tr>
<tr>
<td>6. I can solve most problems if I invest the necessary effort.</td>
<td></td>
</tr>
<tr>
<td>7. As a primary officer investigating a suspicious vehicle, I am not confident in my ability to properly and safely clear the passenger compartment and trunk.</td>
<td></td>
</tr>
<tr>
<td>8. I get nervous when facing difficulties because I do not rely on my coping abilities.</td>
<td></td>
</tr>
<tr>
<td>9. When confronting an armed suspect, I am not confident that I am able to use proper communication skills to insure my safety and the safety of others.</td>
<td></td>
</tr>
<tr>
<td>10. I can demonstrate proper room entry techniques with ease.</td>
<td></td>
</tr>
<tr>
<td>11. I can sometimes manage to solve difficult problems.</td>
<td></td>
</tr>
<tr>
<td>12. When acting as the primary officer, I am able to maintain officer safety.</td>
<td></td>
</tr>
<tr>
<td>13. If someone opposes me, I usually allow them to get what they want.</td>
<td></td>
</tr>
<tr>
<td>14. Upon entry into a house or building with a domestic disturbance, I am confident in my ability to clear, cover, and secure all dangerous areas.</td>
<td></td>
</tr>
<tr>
<td>15. Because I am not very resourceful, I am not very good at knowing how to handle unforeseen situations.</td>
<td></td>
</tr>
<tr>
<td>16. When I am confronted with a problem, I can usually find several solutions.</td>
<td></td>
</tr>
<tr>
<td>17. I have concern about my ability to maintain a safe position behind cover while acting as the back-up officer for a crime in progress.</td>
<td></td>
</tr>
</tbody>
</table>
18. I can usually handle whatever comes my way.

19. Upon responding to a crime in progress, such as an armed bank robbery or school shooting, I am confident in my ability to control the suspects’ movements while maintaining personal safety and other officers’ safety, as well.

20. If I am in trouble, I can usually think of a solution.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Male</th>
<th>Female</th>
<th>Prefer not to answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is your gender?</td>
<td>Male</td>
<td>Female</td>
<td>Prefer not to answer</td>
</tr>
<tr>
<td>2. What is your age in years?</td>
<td>18-21</td>
<td>22-25</td>
<td>26-30</td>
</tr>
<tr>
<td>3. What is your race/ethnicity?</td>
<td>Asian</td>
<td>Black</td>
<td>Hispanic</td>
</tr>
<tr>
<td>4. Have you trained on a simulator before?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4a. If yes, please provide details.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Do you have previous law enforcement or military experience?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>5a. If yes, what did you do?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5b. For how long?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The chance to observe and talk with you could greatly enhance our understanding of how police recruits respond to the simulator. Would you be willing to participate? If so, please indicate by typing your name below.
## Appendix F: Pre-Simulator-Use Survey with Codes

### Law Enforcement Recruit Survey Instrument – October 12, 2011: Pre-Simulator-Use

<table>
<thead>
<tr>
<th>Appraisal Scale – Pre-Simulator Use</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is easy for me to stick to my aims and accomplish my goals.</td>
<td>GSE</td>
</tr>
<tr>
<td>2. I am able to determine whether or not the use of deadly force is justified in any given situation.</td>
<td>TASK</td>
</tr>
<tr>
<td>3. I am not confident in my ability to perform a high-risk stop.</td>
<td>TASK-R</td>
</tr>
<tr>
<td>4. I am confident that I can identify factors affecting the use of necessary and reasonable force.</td>
<td>TASK</td>
</tr>
<tr>
<td>5. I am not very confident that I could deal efficiently with unexpected events.</td>
<td>GSE-R</td>
</tr>
<tr>
<td>6. I can solve most problems if I invest the necessary effort.</td>
<td>GSE</td>
</tr>
<tr>
<td>7. As a primary officer investigating a suspicious vehicle, I am not confident in my ability to properly and safely clear the passenger compartment and trunk.</td>
<td>TASK-R</td>
</tr>
<tr>
<td>8. I get nervous when facing difficulties because I do not reply on my coping abilities.</td>
<td>GSE-R</td>
</tr>
<tr>
<td>9. When confronting an armed suspect, I am not confident that I am able to use proper communication skills to insure my safety and the safety of others.</td>
<td>TASK-R</td>
</tr>
<tr>
<td>10. I can demonstrate proper room entry techniques with ease.</td>
<td>TASK</td>
</tr>
<tr>
<td>11. I can sometimes manage to solve difficult problems.</td>
<td>GSE</td>
</tr>
<tr>
<td>12. When acting as the primary officer, I am able to maintain officer safety.</td>
<td>TASK</td>
</tr>
<tr>
<td>13. If someone opposes me, I usually allow them to get what they want.</td>
<td>GSE-R</td>
</tr>
<tr>
<td>14. Upon entry into a house or building with a domestic disturbance, I am confident in my ability to clear, cover, and secure all dangerous areas.</td>
<td>TASK</td>
</tr>
<tr>
<td>15. Because I am not very resourceful, I am not very good at knowing how to handle unforeseen situations.</td>
<td>GSE-R</td>
</tr>
<tr>
<td>16. When I am confronted with a problem, I can usually find several solutions.</td>
<td>GSE</td>
</tr>
<tr>
<td>17. I have concern about my ability to maintain a safe position behind cover while acting as the back-up officer for a crime in progress.</td>
<td>TASK-R</td>
</tr>
</tbody>
</table>
18. I can usually handle whatever comes my way.  

19. Upon responding to a crime in progress, such as an armed bank robbery or school shooting, I am confident in my ability to control the suspects’ movements while maintaining personal safety and other officers’ safety, as well. 

20. If I am in trouble, I can usually think of a solution.

GSE = general self-efficacy  
TASK = Task-based perceived self-efficacy  
R = code reversal

<table>
<thead>
<tr>
<th>Demographics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is your gender?</td>
<td>Demographic</td>
</tr>
<tr>
<td>2. What is your age in years?</td>
<td>Demographic</td>
</tr>
<tr>
<td>3. What is your race/ethnicity?</td>
<td>Demographic</td>
</tr>
<tr>
<td>4. Have you trained on a simulator before?</td>
<td>PE – previous experience with simulator</td>
</tr>
<tr>
<td>4a. If yes, please provide details.</td>
<td></td>
</tr>
<tr>
<td>5. Do you have previous law enforcement or military experience?</td>
<td>PE – previous experience with law enforcement or military</td>
</tr>
<tr>
<td>5a. If yes, what did you do?</td>
<td></td>
</tr>
<tr>
<td>5b. For how long?</td>
<td></td>
</tr>
</tbody>
</table>
Appendix G: Post-Simulator-Use Survey


A number of general statements and statements about police-related maneuvers is presented below. The purpose is to gather information that will help us to better understand how police recruits experience training in a simulator. There are no correct or incorrect answers. We are interested in only your honest opinions. Your responses will remain confidential. INSTRUCTIONS: Please indicate your personal opinion about each statement by clicking the appropriate response for each statement.

Strongly agree | Disagree | Somewhat Disagree | Somewhat Agree | Agree | Strongly Agree

<table>
<thead>
<tr>
<th>Appraisal Scale – Pre-Simulator Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is not easy for me to stick to my aims and accomplish my goals.</td>
</tr>
<tr>
<td>2. I am not able to determine whether or not the use of deadly force is justified in any given situation.</td>
</tr>
<tr>
<td>3. I am confident in my ability to perform a high-risk stop.</td>
</tr>
<tr>
<td>4. I am not confident that I can identify factors affecting the use of necessary and reasonable force.</td>
</tr>
<tr>
<td>5. I am confident that I could deal efficiently with unexpected events.</td>
</tr>
<tr>
<td>6. I am not confident that I can solve most problems if I invest the necessary effort.</td>
</tr>
<tr>
<td>7. As a primary officer investigating a suspicious vehicle, I am able to properly and safely clear the passenger compartment and trunk.</td>
</tr>
<tr>
<td>8. I can remain calm when facing difficulties because I am able to rely on my coping abilities.</td>
</tr>
<tr>
<td>9. When confronting an armed suspect, I am confident in my ability to use proper communication skills.</td>
</tr>
<tr>
<td>10. I have difficulty conducting proper room entry techniques with ease.</td>
</tr>
<tr>
<td>11. I can always manage to solve difficult problems.</td>
</tr>
<tr>
<td>12. When acting as the primary officer, I am not yet confident in my ability to maintain officer safety.</td>
</tr>
<tr>
<td>13. If someone opposes me, I can find the means to get what I want.</td>
</tr>
<tr>
<td>14. When entering a house or building with a domestic disturbance, I am not yet confident in my ability to clear, cover, and secure all dangerous areas.</td>
</tr>
<tr>
<td>15. I am very good at knowing how to handle unforeseen situations.</td>
</tr>
<tr>
<td>16. When I am confronted with a problem, I can usually back down.</td>
</tr>
<tr>
<td>17. I am confident in my ability to maintain a safe position behind cover while acting as the back-up officer for a crime in progress.</td>
</tr>
</tbody>
</table>
18. I am not confident to handle whatever may come my way.

19. Upon responding to a crime in progress, such as an armed bank robbery or school shooting, I am not yet confident in my ability to control the suspects’ movements while maintaining personal safety and other officers’ safety, as well.

20. If I am in trouble, I can usually rely on other people to get me out of it.

<table>
<thead>
<tr>
<th>Short Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>21. Did you accomplish the tasks MILO presented?</td>
</tr>
<tr>
<td>Please tell us more about your accomplishments with the simulator.</td>
</tr>
<tr>
<td>22. During your simulation training, what influenced your ability to perform certain tasks?</td>
</tr>
<tr>
<td>Please tell us more about any experiences you may have had in the past that helped you today.</td>
</tr>
<tr>
<td>23. Have you ever observed anyone else perform any of the tasks you performed today (either in the simulator our out of it)?</td>
</tr>
<tr>
<td>If yes, who, what, where, when, which one(s)?</td>
</tr>
<tr>
<td>24. Did you experience a time either in the simulator, Academy training, or otherwise when someone encouraged you to perform any of the tasks you performed today?</td>
</tr>
<tr>
<td>If yes, please tell us about how someone encouraged you in the past.</td>
</tr>
<tr>
<td>25. Was there ever a time when you felt anxious or worried about being able to perform any of the tasks you performed today?</td>
</tr>
<tr>
<td>If yes, please tell us about that time and about how you felt.</td>
</tr>
<tr>
<td>26. On a scale of 1 – 10, to what extent, if any, do you feel that the simulator had an influence on your training? 10 being most influential and 1 being not influential at all.</td>
</tr>
<tr>
<td>27. What are some features of the simulator that you believe can make a recruit’s experience either a positive or a negative one?</td>
</tr>
<tr>
<td>28. On a scale of 1 – 10, how realistic was your experience in the simulator? 10 being extremely realistic.</td>
</tr>
<tr>
<td>What made your experience realistic or not so realistic?</td>
</tr>
<tr>
<td>29. With one word or phrase, how would you describe the simulator as a training device?</td>
</tr>
<tr>
<td>30. Would you like to add any comments regarding your experience?</td>
</tr>
</tbody>
</table>
## Appendix H: Post-Simulator-Use Survey with Codes

**Law Enforcement Recruit Survey Instrument – October 13 & 17, 2011: Post-Simulator-Use**

<table>
<thead>
<tr>
<th>Appraisal Scale – Pre-Simulator Use</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is not easy for me to stick to my aims and accomplish my goals.</td>
<td>GSE-R</td>
</tr>
<tr>
<td>2. I am not able to determine whether or not the use of deadly force is justified in any given situation.</td>
<td>TASK-R</td>
</tr>
<tr>
<td>3. I am confident in my ability to perform a high-risk stop.</td>
<td>TASK</td>
</tr>
<tr>
<td>4. I am not confident that I can identify factors affecting the use of necessary and reasonable force.</td>
<td>TASK-R</td>
</tr>
<tr>
<td>5. I am confident that I could deal efficiently with unexpected events.</td>
<td>GSE</td>
</tr>
<tr>
<td>6. I am not confident that I can solve most problems if I invest the necessary effort.</td>
<td>GSE-R</td>
</tr>
<tr>
<td>7. As a primary officer investigating a suspicious vehicle, I am able to properly and safely clear the passenger compartment and trunk.</td>
<td>TASK</td>
</tr>
<tr>
<td>8. I can remain calm when facing difficulties because I am able to rely on my coping abilities.</td>
<td>GSE</td>
</tr>
<tr>
<td>9. When confronting an armed suspect, I am confident in my ability to use proper communication skills.</td>
<td>TASK</td>
</tr>
<tr>
<td>10. I have difficulty conducting proper room entry techniques with ease.</td>
<td>TASK-R</td>
</tr>
<tr>
<td>11. I can always manage to solve difficult problems.</td>
<td>GSE</td>
</tr>
<tr>
<td>12. When acting as the primary officer, I am not yet confident in my ability to maintain officer safety.</td>
<td>TASK-R</td>
</tr>
<tr>
<td>13. If someone opposes me, I can find the means to get what I want.</td>
<td>GSE</td>
</tr>
<tr>
<td>14. When entering a house or building with a domestic disturbance, I am not yet confident in my ability to clear, cover, and secure all dangerous areas.</td>
<td>TASK-R</td>
</tr>
<tr>
<td>15. I am very good at knowing how to handle unforeseen situations.</td>
<td>GSE</td>
</tr>
<tr>
<td>16. When I am confronted with a problem, I can usually back down.</td>
<td>GSE-R</td>
</tr>
<tr>
<td>17. I am confident in my ability to maintain a safe position behind cover while acting as the back-up officer for a crime in progress.</td>
<td>TASK</td>
</tr>
<tr>
<td>Question</td>
<td>Code</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>18. I am not confident to handle whatever may come my way.</td>
<td>GSE-R</td>
</tr>
<tr>
<td>19. Upon responding to a crime in progress, such as an armed bank robbery or school shooting, I am not yet confident in my ability to control the</td>
<td>TASK-R</td>
</tr>
<tr>
<td>suspects’ movements while maintaining personal safety and other officers’ safety, as well</td>
<td></td>
</tr>
<tr>
<td>20. If I am in trouble, I can usually rely on other people to get me out of it.</td>
<td>GSE-R</td>
</tr>
</tbody>
</table>

GSE = general self-efficacy  
TASK = Task-based perceived self-efficacy  
R = code reversal

**Short Answer**

21. Did you accomplish the tasks MILO presented?  
   Yes/No  
   PA

22. During your simulation training, what influenced your ability to perform certain tasks?  
   Yes/No  
   PA

23. Have you ever observed anyone else perform any of the tasks you performed today (either in the simulator or out of it)?  
   Yes/No  
   VE

24. Did you experience a time either in the simulator, Academy training, or otherwise when someone encouraged you to perform any of the tasks you performed today?  
   Yes/No  
   VP

25. Was there ever a time when you felt anxious or worried about being able to perform any of the tasks you performed today?  
   Yes/No  
   EA

26. On a scale of 1 – 10, to what extent, if any, do you feel that the simulator had an influence on your training? 10 being most influential and 1 being not influential at all.  
   1 – 10  
   S

27. What are some features of the simulator that you believe can make a recruit’s experience either a positive or a negative one?  
   S

28. On a scale of 1 – 10, how realistic was your experience in the simulator? 10 being extremely realistic.  
   1 – 10  
   S

29. With one word or phrase, how would you describe the simulator as a training device?  
   S

30. Would you like to add any comments regarding your experience?  
   Yes/No

PE = Previous Experience  
VP = Verbal Persuasion  
VE = Vicarious Experience  
EA = Emotional Arousal  
T = Task  
S = Simulator
Appendix I: Interview Script and Questions

Hello, my name is (Interviewer’s Name). I am assisting Heather Holbrook, who is conducting this research. I will be asking you 5 questions about your experience with the simulator today. Your answers are confidential. You will not be identified on this recording, except by the number Heather assigned you. You do not have to answer any question, and you can stop the interview at any time. Your interview will be recorded and transcribed and used in a research dissertation. No identifying factors will be made, and no one at the academy or your agency will see the transcripts or hear the recording of the interview. I will say your participant number on the tape, but not your name. Do you have any questions? Ready to begin?

Qualitative Interview Questions – for immediately after simulation use

1. Tell me about yourself as a police recruit.

2. Describe your experience in the simulator.
   a. How realistic was the experience for you?
   b. How did you feel when you were in the simulator?
   c. What sorts of things were you thinking/feeling?
   d. What characteristics of the simulator positively / negatively affected your experience?

3. The trainer asked you if you learned anything. If you answered “yes,” what did you learn?
   a. What did you learn about yourself from your experience in the simulator?
   b. What did you learn about how ready you are to perform the sorts of tasks you performed in the simulator?

4. You took a survey that asked you questions about how confident you were in performing certain tasks. Describe how the simulator may or may not have influenced your level of confidence in performing certain tasks.
   a. Did it influence it? Yes / No If so, how?

5. Would you like to add anything? Discuss anything else?
Appendix J: Observation Checklist

Scenario 1 - ____________________ Scenario 5 - ____________________

Scenario 2 - ____________________ Scenario 6 - ____________________

Scenario 3 - ____________________ Other - ________________________

Scenario 4 - ____________________

**Code with the following:**

A. Previous experience  
   a. (shows mastery)

B. Verbal persuasion  
   a. (trainer instructs)

C. Vicarious experience  
   a. (observes trainer)

D. Emotional arousal  
   a. (observed physical/ emotional state of participant)

E. Specific tasks  
   a. (knowledge of)

F. Simulator  
   a. (use of materials/tools)

G. Other
### Appendix K: Mixed Methods Convergence Table of all 3 Data Sets

Table 6 *Convergence Table of all 3 Data Sets*

Red = Interview; Blue = Observation; Black = Survey

<table>
<thead>
<tr>
<th></th>
<th>Qual Question #2</th>
<th>Qual Question #3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emotional Arousal</strong></td>
<td>The recruits described the way they felt in the simulator as anxious, nervous, uncertain, frustrated, and scared. 9 and 2 reported feeling comfortable and fine, respectively. After examining the cause for the variety of emotional responses, I found 7 themes. The cause of emotional arousal stemmed from: 1.) lack of experience as a LEO 2.) lack of experience with the simulator 3.) performance anxiety 4.) not knowing what to expect 5.) realistic scenarios 6.) simulation malfunction 7.) previous experience as a LEO or with a simulator R: It’s frustrating. I can’t really tell what’s going on. (Recruit is gasping.) Trainer said: don’t sit there and beat yourself up. You’re beating yourself up. R: is making huffing sounds; “What I find frustrating for me personally is that it’s hard to see what’s around me. Maybe I should have gone hands on or moved for cover.” Trainer: It’s supposed to stress yourself out or frustrate you. You did ok.</td>
<td>Emotional arousal came from frustration with the simulator – not knowing what to do or how to interact with it. It also came from simulator malfunction – things just not working properly or the simulator crashing altogether. Additionally, emotional arousal came from task performance, which was also influenced by the simulator. Emotional arousal ranged from the use of foul language, gasping, shaking heads, and voicing frustration and concern.</td>
</tr>
<tr>
<td><strong>Task</strong></td>
<td>I included this category thinking like an Instructional Designer, rather than a learner. I thought these tasks, or scenarios, would assess the recruits’ performances. While the scenarios allowed for some level of evaluation, what they did was provided experience with the tasks that the recruits are most likely to encounter in their link of work. Even #11 mentioned, “I think [the scenarios are] a good indicator of what</td>
<td>Task performance was inhibited by lack of knowledge of how to use the simulator and/or the virtual materials. (Reference the survey where 72% of the recruits said they had previous experience with a simulator. This shows that not all simulators are created equal. 15 of the 18 recruits (almost 85%) stated that they felt they accomplished</td>
</tr>
</tbody>
</table>
kind of person you are and how you can think through stuff.”

Over half (12 out of 18) of the recruits had an increase in perceived self-efficacy after having experienced the simulator, regardless of the time lapse. Basically, the tasks, whether observed or interacted with, influenced perceived self-efficacy because they provided experience on some level for the recruits. No recruit reported not having learned anything from the tasks. Those recruits who reported that they failed tasks or did not know what they were doing, were observed in the simulator as “just standing there.”

Simulator

The recruits were asked to describe the simulator using one word or phrase. 50% of the recruits described the simulator as great, good, excellent, or outstanding. 3 said helpful, useful; 1 said imperative, and 2 others wrote “improvement,” adding, “The one word answer that was given has multiple meanings. I believe that the MILO helped me see that I need improvement in some areas. But it is also the answer because I feel that the MILO itself could use improvement” (Luke, #3)

3 new sub categories emerged:
1. Challenges
2. Characteristics
3. The learning experience

Recruits brought up challenges they experienced with the simulator. Most complained about talking to a screen. Others were more concerned that they were unable to physically interact and go “hands on” with simulator; they wanted to be able to use defense tactics/techniques, take cover, and “get a better feel for the geography.” (CITE #) A few still voiced frustration with the faulty equipment (e.g. OC Spray not working, the simulator crashing during a debrief, the simulator locking up, the simulator not responding when the recruit uses force).

Four characteristics emerged from the interview data; these included:
1. the option of using different levels of force
<table>
<thead>
<tr>
<th>Overall PSE</th>
<th>Perceived influence on task performance in simulator:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some recruits believed the experience did not influence their self-efficacy at all, while one recruit indicated that he wasn’t “cut out to be a cop,” and that his experience in the simulator “made [him] question whether or not [he] had enough training to complete the tasks.” The majority of the recruits, however, indicated that they felt a positive influence from their learning experiences in the simulator. Many echoed #4 who said, “It influenced my confidence in that I was able to interact with some of the subjects in a way that I’ve never done before. It also helped with someone of my responses, and actually firing my weapon at people, which obviously I’ve never done before. Being able to make those decisions…it’s realistic…I do feel confident, more confident, having done so with the training.”</td>
<td>Most of the recruits reported that the training they received in the academy influenced their ability to perform tasks in the simulator. Riley mentioned that “the subjects’ actions and [his] experience” influenced his abilities to perform the tasks, whereas William noted that the limitations put forth by the simulator, such as “not able to go hands on, use a baton, or interact with the people in the scenario” influenced his abilities.</td>
</tr>
</tbody>
</table>
The purpose of this research is to gather information that will help us to better understand how police recruits experience training in a simulator. Heather A. Holbrook, a doctoral candidate at Virginia Tech in the School of Education, is conducting the study. There are no foreseeable risks in participation. Participation in this survey is entirely voluntary. Voluntary participation also means:

* You need not answer any questions you consider inappropriate
* You may stop filling out the survey at any point.
* If you decline to participate, you may exit out of the survey at any time.

The first survey has 26 questions; it will take approximately 10 minutes to complete. The second survey, which will be taken after you use the MILO simulator, has 30 questions and will take approximately 15-20 minutes to complete.

Expected benefits of this research are to inform future law enforcement trainers on the usefulness of high-fidelity simulators in training exercises.

This survey and all participation is completely anonymous and confidential. If you have any questions about this survey and your rights, please contact Heather A. Holbrook, doctoral candidate at Virginia Tech at 540-354-4878 or hahphd@vt.edu.

I have read and understand and consent to participate in this research survey.

Signature ___________________ Date ________

The chance to observe and talk with you could greatly enhance our understanding of how police recruits respond to the simulator. Would you be willing to participate? If so, please indicate by typing your name below.

I am willing to participate in observations and interviews with the doctoral candidate.

Print Name ____________________________
Appendix M: Virtual Materials Used in this Study

*Figure 17.* The two separate virtual materials that participants used in this study. On the left is a handgun that simulates a Glock; on the right is the virtual OC Spray Canister.

*Figure 18.* A participant wears the virtual handgun in his personal holster.

*Figure 19.* A participant uses both virtual materials in the simulator during one of the scenarios.
Appendix N: Additional Consent Form for Interview, Observation, and Media

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent for Participants
in Research Projects Involving Human Subjects

Title of Project: The Exploration of High-Fidelity Virtual Training Simulation on Learner Self-Efficacy in the Work Place

Investigator(s): Heather A. Holbrook, doctoral student

I. Purpose of this Research/Project

The purpose of this research is to gather information that will help us to better understand how police recruits experience training in a simulator. Heather A. Holbrook, a doctoral candidate at Virginia Tech in the School of Education, is conducting the study. There are no foreseeable risks in participation. Participation in this survey is entirely voluntary.

This survey and all participation will be completely anonymous and confidential. If you have any questions about this survey and your rights, please contact Heather A. Holbrook, doctoral candidate at Virginia Tech at 540-354-4878 or hahphd@vt.edu.

III. Risks to Confidentiality

This study involves the audio or video recording of your interview with the researcher. Neither your name nor any other identifying information will be associated with the audio or audio recording or the transcript. Only the researcher will be able to listen to or view the recordings. This paragraph is to inform you that the access to transcripts of the interviews and videos will only be allowed to the primary investigator and doctoral investigator.

- The staff at your police academy or police department will not see your individual responses or know your identity.
- A pseudonym will be used to describe the training academy and any police departments referred to in the interviews.
- Pseudonyms will be used to identify you in all interviews and written materials. You may decline to answer any questions that you don't feel comfortable with.
- All consent forms and data resulting from this study will be kept in a locked safe in the doctoral investigator’s home, and all the data will be digitized and stored on a secure computer.
- All data will be coded with labels and numbers.
- No personal identifying marks will be present on any data forms.
- Data will be analyzed without personal identification.

II. Benefits and Compensation
Expected benefits of this research are to inform future law enforcement trainers on the usefulness of high-fidelity simulators in training exercises. There is no compensation for participation in this study.

IV. Freedom to Withdraw

Participants are free to cease involvement at any time without prejudice, penalty, or any other negative consequence. You need not answer any questions you consider inappropriate. You may ask the researcher to leave the observation at any point. You may stop the interview at any point.

V. Subject's Responsibilities

I voluntarily agree to participate in this study. I have the following responsibilities:

I agree to allow the researcher to observe me in a non-obtrusive manner and to record me using a video recording device. Initial __________
I agree to answer questions honestly. Initial __________
I agree to allow the researcher to record the interview on a digital recording device. Initial __________
I agree to allow the researcher to use non-identifying direct quotes. Initial __________

VI. Subject's Permission

By signing this form, I am allowing the researcher to audio or video tape me as part of this research. I also understand that this consent for recording is effective until the following date: September 15, 2012. On or before that date, the tapes will be destroyed.

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

Participant’s signature ____________________________ Date ____________________________
Heather Holbrook ________________________________ hahphd@vt.edu
Investigator

[NOTE: Subjects must be given a complete copy (or duplicate original) of the signed Informed Consent.]

Virginia Tech Institutional Review Board: Project No. 11-801
Approved September 29, 2011 to September 27, 2012
MEMORANDUM

DATE: September 29, 2011

TO: Katherine S. Cennamo, Heather Holbrook

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires May 31, 2014)

PROTOCOL TITLE: The Influence of High-Fidelity Virtual Training Simulation on Learner Self-Efficacy in the Workplace

IRB NUMBER: 11-801

Effective September 28, 2011, the Virginia Tech IRB Chair, Dr. David M. Moore, approved the new protocol for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at http://www.irb.vt.edu/pages/responsibilities.htm (please review before the commencement of your research).

PROTOCOL INFORMATION:
Approved as: Expedited, under 45 CFR 46.110 category(ies) 6, 7
Protocol Approval Date: 9/28/2011
Protocol Expiration Date: 9/27/2012
Continuing Review Due Date: 9/13/2012
*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:
Per federally regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grants proposals / work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.
Appendix P: Consent to Conduct Research at an Institution

Voluntary Consent Form to Conduct Research at [The Academy]

A copy of the signed consent form can be obtained with permission from the IRB. The signed consent form contains identifying factors of the participants, trainers, and/or institution involved in this study.

I grant Heather A. Holbrook, Doctoral Candidate at Virginia Polytechnic and State University, permission to distribute surveys to current law enforcement recruits in our academy, and to carry out observations and interviews during the use of the MILO simulator as part of her dissertation research. I understand that participation is voluntary, and that we can withdraw at any time without penalty, and that data will not be linked to any specific recruit, trainer, or to this academy.

I have received an unsigned copy of this consent form to keep in my possession.

NAME ___________________________________________________________

EMAIL _______________________ PHONE ____________________________

SIGNATURE _________________________ DATE ______________________

POSITION ______________________________________________________

_____ Please check here if you would like a complimentary copy of the study results.

Contact Information for researchers:

First Contact:
Heather A. Holbrook, Doctoral Candidate
411 Hunt Club Rd, Apt 35D
Blacksburg, VA
540-354-48878
hahphd@vt.edu

Concerns:
Katherine S. Cennamo, Primary Investigator, Doctoral Advisor
Professor, Instructional Design & Technology,
Learning Sciences and Technologies Department,
School of Education, Virginia Tech,
Blacksburg, VA 24060
cennamo@vt.edu
Appendix Q: Permission to Use General Self-Efficacy Survey Questions

Permission granted

to use the General Self-Efficacy Scale for non-commercial research and development purposes. The scale may be shortened and/or modified to meet the particular requirements of the research context.

http://userpage.fu-berlin.de/~health/selfscal.htm

You may print an unlimited number of copies on paper for distribution to research participants. Or the scale may be used in online survey research if the user group is limited to certified users who enter the website with a password.

There is no permission to publish the scale in the Internet, or to print it in publications (except 1 sample item).

The source needs to be cited, the URL mentioned above as well as the book publication:


Professor Dr. Ralf Schwarzer
www.ralfschwarzer.de
Appendix R: Fair Use Analysis

VT Fair Use Analysis Results

Draft 09/01/2009
(Questions? Concerns? Contact Gail McMillan, Director of the Digital Library and Archives at Virginia Tech's University Libraries: gailmc@vt.edu)

(Please ensure that Javascript is enabled on your browser before using this tool.)

Virginia Tech ETD Fair Use Analysis Results

This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.

Name: Heather Anne Holbrook


Report generated on: 08-08-2011 at: 17:48:32

Based on the information you provided:

**Factor 1**

Your consideration of the purpose and character of your use of the copyrighted work weighs: *in favor of fair use*

**Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

**Factor 3**

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

**Factor 4**

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

Based on the information you provided, your use of the copyrighted work weighs: *in favor of fair use*

[Details about analysis of fair use](http://etd.vt.edu/fairuse/analyzer/results.php?11/5/49:34 PM)
Appendix S: Permission to Reproduce IES Scenarios

Preproduction of Scenarios
2 messages

Heather A. Holbrook <halph@vt.edu>
To: John@ies-usa.com

Wed, Feb 1, 2012 at 4:12 PM

February 1, 2012

Dear John,

Thank you for taking the time to speak with me today. As I mentioned on the phone, I am a doctoral candidate at Virginia Tech working on my dissertation, which explored how high-fidelity virtual training simulators influence participants' self-efficacy. The Academy that used the NUCO simulator chose six scenarios for the participants to experience. With your permission, I would like to reproduce these six scenarios from the IES Scenarios Guide book that came with the simulator. As we discussed, if you could simply reply to this email, that would be great.

Thank you so much, and I really appreciate your time.

Sincerely,

Heather A. Holbrook
Virginia Polytechnic Institute and State University
Doctoral Candidate, Instructional Design and Technology

John Jones <john.jones@ies-usa.com>
To: Heather A. Holbrook <halph@vt.edu>

Wed, Feb 1, 2012 at 4:19 PM

IES has no problem with this request. You have our approval to use the 6 scenarios in your dissertation. If you need any other assistance, don't hesitate to ask.

Sincerely,

Jones, John W.
Dir. Of Operations
IES Interactive Training
1.800.844.1062

From: halph@vt.edu [mailto:halph@vt.edu] On Behalf Of Heather A. Holbrook
Sent: Wednesday, February 01, 2012 4:19 PM
To: John Jones
Subject: Preproduction of Scenarios

---
This email was anti-virus checked by Antare Security Gateway. http://www.antare.com

---

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## Appendix T: Results from Four T-tests Testing for Significant Differences

### Table 7 T-test between the Immediates and the Laters on the TASK pre-simulator-use survey

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable 1</th>
<th>Variable 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>5.1000</td>
<td>5.0111</td>
</tr>
<tr>
<td>Variance</td>
<td>0.2714</td>
<td>0.3536</td>
</tr>
<tr>
<td>Observations</td>
<td>8.0000</td>
<td>9.0000</td>
</tr>
<tr>
<td>Hypothesized Mean Difference</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>df</td>
<td>15.0000</td>
<td></td>
</tr>
<tr>
<td>t Stat</td>
<td>0.3285</td>
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</tr>
<tr>
<td>P(T&lt;=t) one-tail</td>
<td>0.3735</td>
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</tr>
<tr>
<td>t Critical one-tail</td>
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<td></td>
</tr>
<tr>
<td>P(T&lt;=t) two-tail</td>
<td>0.7471</td>
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</tr>
<tr>
<td>t Critical two-tail</td>
<td>2.1314</td>
<td></td>
</tr>
</tbody>
</table>

### Table 8 T-test between the Immediates and the Laters on the TASK post-simulator-use survey

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable 1</th>
<th>Variable 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
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<tr>
<td>Variance</td>
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<td>0.520278</td>
</tr>
<tr>
<td>Observations</td>
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<td>9</td>
</tr>
<tr>
<td>Hypothesized Mean Difference</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>df</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>t Stat</td>
<td>0.472833</td>
<td></td>
</tr>
<tr>
<td>P(T&lt;=t) one-tail</td>
<td>0.32181</td>
<td></td>
</tr>
<tr>
<td>t Critical one-tail</td>
<td>1.76131</td>
<td></td>
</tr>
<tr>
<td>P(T&lt;=t) two-tail</td>
<td>0.643619</td>
<td></td>
</tr>
<tr>
<td>t Critical two-tail</td>
<td>2.144787</td>
<td></td>
</tr>
</tbody>
</table>
Table 9 *T*-test between the Immediates and the Laters on the GSE pre-simulator-use survey

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable 1</th>
<th>Variable 2</th>
</tr>
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<tbody>
<tr>
<td>Mean</td>
<td>5.0875</td>
<td>5.0889</td>
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<td>Variance</td>
<td>0.2898</td>
<td>0.2636</td>
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<td>Observations</td>
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<tr>
<td>Hypothesized Mean Difference</td>
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<td></td>
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<tr>
<td>df</td>
<td>15.0000</td>
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<tr>
<td>t Stat</td>
<td>-0.0054</td>
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<tr>
<td>P(T&lt;=t) one-tail</td>
<td>0.4979</td>
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<tr>
<td>t Critical one-tail</td>
<td>1.7531</td>
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<tr>
<td>P(T&lt;=t) two-tail</td>
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<tr>
<td>t Critical two-tail</td>
<td>2.1314</td>
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Table 10 *T*-test between the Immediates and the Laters on the GSE post-simulator-use-survey

<table>
<thead>
<tr>
<th>Variable</th>
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<th>Variable 2</th>
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<tr>
<td>Mean</td>
<td>4.825</td>
<td>4.544444</td>
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<td>Variance</td>
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<td>0.177778</td>
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<td>Observations</td>
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<td>9</td>
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<td>Hypothesized Mean Difference</td>
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<td>df</td>
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<tr>
<td>t Stat</td>
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<tr>
<td>P(T&lt;=t) two-tail</td>
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<td>t Critical two-tail</td>
<td>2.144787</td>
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