Beyond Scenarios: Designing Holistic Experiences for Simulation-Based Training

Amber L. Alston, M.A., M.S.
MESH Solutions, LLC
a DSCI Company
aalston@mesh.dsci.com

Sae Schatz, Ph.D.
MESH Solutions, LLC
a DSCI Company
sschatz@mesh.dsci.com

ABSTRACT

The modern military operational environment is complex, filled with subtle physical, psychological, and sociocultural cues. Personnel must be able to rapidly perceive, understand, and then respond to a range of stimuli, from Improvised Explosive Devices and snipers to more nuanced indicators, such as the signs that point to an insurgent network. Our team is currently investigating training interventions that will enhance personnel's capacity to accurately perceive such cues. This training addresses sociocultural sensemaking, mental baseline creation, anomaly detection, and related communication skills.

To efficaciously support such training with simulation, the simulated stimuli must be accurately modeled. Beyond basic sensory realism (i.e., physical fidelity), trainees must be exposed to a coherent, connected stimulus flow. In other words, the simulated experience must produce a cohesive emergent pattern that transcends physical—and even task and psychological—fidelity; the simulation must produce an interpretable scheme that facilitates finely tuned perceptual training. To achieve this, we are translating approaches from "experiential design" to Modeling & Simulation (M&S). Experiential design is used to create strategically compelling and memorable experiences by systematically manipulating sensory, cognitive, affective, active, and relational factors. Although typically applied to physical, commercial settings (e.g., retail stores) some simulation researchers theorize that experiential design may also apply to virtual environments (e.g., Chertoff et al., 2010).

In this paper, we describe experiential design and demonstrate its applicability for simulated experiences. We present an operationalized breakdown of a "holistic experience" and then propose ten pragmatic guidelines, informed by experiential design best practices, for creating holistic experiences within simulation-based training environments. Experiential design is an emerging concept in simulation; the practitioner community is generally unfamiliar with this approach, yet it meaningfully transforms and extends academic discussions on fidelity and provides a novel framework that M&S practitioners can use to design and evaluate their human-in-the-loop systems. In other words, the *concept* of experiential design may help M&S practitioners make better use virtual training.

ABOUT THE AUTHORS

Amber L. Alston, M.A., M.S., is a human systems scientist with MESH Solutions LLC. Her work focuses on applying human centered design and engineering principles to the creation of highly useful and usable technologies. Prior to joining MESH, Amber worked in the hospitality technology industry, applying techniques such as experiential design to the creation of interactive customer applications.

Sae Schatz, Ph.D., is the Chief Scientist of MESH Solutions, LLC (a wholly owned subsidiary of DSCI). Her work focuses on education and training research, including instructional technologies, adaptive systems, and modeling and simulation. Sae was the lead author on two I/ITSEC best papers in 2012, including the overall best paper on "Making Good Instructors Great."

Beyond Scenarios: Designing Holistic Experiences for Simulation-Based Training

Amber L. Alston, M.A., M.S.
MESH Solutions, LLC
a DSCI Company
aalston@mesh.dsci.com

Sae Schatz, Ph.D.
MESH Solutions, LLC
a DSCI Company
sschatz@mesh.dsci.com

INTRODUCTION

Today's military personnel face a complex mission. Not only must they continue to meet high standards for traditional soldiering skills, but they must also execute a wide range of military operations other than war. These tasks may include peacekeeping, humanitarian aid, and relationship-building missions. Additionally, the type of mission in which personnel find themselves may change rapidly. For instance, a Marine squad in the middle of a friendly patrol during a stabilization effort may suddenly find itself in an ambush situation. To further add complexity, operations take place within a media spotlight, where each decision receives international scrutiny and may affect strategic relations.

Naturally, the type and complexity of training required to prepare personnel for such operations is equally challenging. Combinations of live, virtual, and constructive simulation-based training can help; however, developing efficacious simulations for these training objectives represents a significant challenge, particularly for tactical-level training. At the tactical level, military personnel interact one-on-one with friends, foes, and civilians in dynamic, varied, and often stressful environments. Appropriately simulating these conditions—especially in a virtual environment—is a substantial task.

This paper, however, does not discuss technological ways to achieve higher simulation fidelity. Instead, we explore theories related to the concepts of presence, flow, and holistic experience. Through this research, we seek to answer questions such as "if we had infinite technological capacity, but limited funds, how would we spend our resources to enhance a virtual simulator" (i.e., if I could do anything, what would I do?) and "how do I assess whether the simulator engenders the appropriate training conditions?" The paper begins by describing our personal application area, a Marine Corps perception-training simulator, in more detail. Next, we introduce "experiential design," an approach novel to Modeling & Simulation (M&S), but which marketers use to create strategically compelling and memorable experiences in retail environments. We then present an operationalized breakdown of a "holistic experience" and propose ten pragmatic guidelines, informed by experiential design best practices, for the creation of holistic experiences within simulation-based training environments.

OUR PRESENT EFFORT: PERCEPTION TRAINING

As part of an Office of Naval Research initiative, our team is currently developing a simulator intended to train Marine infantrymen to better operate in the volatile conditions described above (see Figure 1). This simulator, dubbed the Virtual Observation Platform (or Virtual OP), trains Marines to observe and interpret subtle physical, psychological, and sociocultural cues. These cues may include environmental factors, such as the clues that point to an Improvised Explosive Device, or nuanced behavioral cues, such as the social indicators that point to an insurgent network.

Figure 1. Photograph of the prototype Virtual Observation Platform simulator.

For instance, Marines may be asked to observe a virtual marketplace and identify possible dangers "left of bang." To complete this mission, they must quickly make sense of the area and its inhabitants' behaviors, create a "mental baseline" (or, more formally, schema) for what is normal, identify anomalies to the baseline, and then communicate their observations. (See Schatz, et al., 2012, for more information on these training objectives.)

In order to create the necessary conditions to support this training, the simulated stimuli must be accurately modeled. Beyond basic sensory realism (i.e., physical fidelity), trainees must be exposed to a coherent, connected stimulus flow. The virtual environment must include sufficient and appropriate cues, so that trainees can mentally establish baselines of normal behavior and potentially identify subtly anomalous indicators. In other words, the simulated experience must produce a cohesive emergent pattern that transcends physical—and even task and psychological—fidelity; the simulation must produce an interpretable scheme that facilitates finely tuned perceptual training. To achieve this, we are translating approaches from "experiential design."

EXPERIENTIAL DESIGN

Recently, practitioners of design, marketing, and entertainment have shown great interest in elevating routine customer "interactions" into more compelling and memorable customer "experiences." Proponents argue that well-designed experiences convey a more salient "sense" of a product or brand, enhance customer emotions towards it, build loyalty, and ultimately enhance revenue (e.g., Pullman & Gross, 2004; Pine II & Gilmore, 1998; Schmitt, 1999). The art and science of strategically designing these customer experiences is commonly known within the business and marketing fields as experiential design (or, interchangeably, experience design) and has proved valuable to companies that embrace it (see Table 1).

Table 1. Examples of business benefit through experiential design implementation.

Industry	Attributed Benefit to Company
Medical	A major hospital, faced with increasing competition and declining customer-satisfaction, utilized experiential design to address poor patient and family experience scores. By implementing more than 100 targeted experiential cues within the environment, the facility measured a 13% increase in perceived quality of care and a decrease of 33% in customer complaints with no other facility management changes (Berry et al., 2002).
Transportation	Avis Rent A Car facilities faced poor customer service and satisfaction scores at the beginning of the 1990s. In 1994, a pilot program for facility alterations based in experiential design techniques was launched at a major Avis airport-based facility. Within a year of implementing the new experiential design, the facility won the J.D. Power award for customer satisfaction. After a 6-year roll-out, Avis ranked #1 nationwide in customer satisfaction (Berry et al., 2002).
Entertainment	Applying experiential design techniques to a VIP guest area, a major circus found VIP guests to be more engaged with the brand. Particularly meaningful was the strong correlation between the relational dimension of experience and overall emotional impact perceived, with 23% of all participant guests ranking interactions with living character-actors within the setting to be the most meaningful experience overall (Pullman & Gross, 2004).

Although most applications of experiential design occur in physical, commercial environments (e.g., retail stores, restaurants, and hotels); some simulation researchers theorize that its best practices may also apply to virtual environments (e.g., Chertoff et al., 2010). In virtual settings, experiential design principles can create more compelling human-in-the-loop experiences, enhance trainees' emotional involvement with the simulation, and improve learning and retention outcomes. Before offering best practices for experiential design in virtual environments, however, we first provide an overview of experiential design principles.

Dimensions of Experience: A Marketing Perspective

Experiences are private events that occur in response to stimulation, whether real, virtual, or even self-generated (Schmitt, 1999). Experiences are inherently subjective; individuals filter them through their existing mental models and develop unique interpretations of each occurance (Carr et al., 2011). Experiential designers recognize that experiences are not completely controllable; yet, they strive to design contexts that enhance the likelihood of producing an intended outcome. They do this by selectively manipulating contextual variables. These variables may be classified in various ways, but a popular framework involves five categories: sense, feel, think, act, and relate (see Table 2). When all five categories of an experience are successfully integrated, they form a "holistic experience" (Schmitt, 1999).

Table 2. Summary of the five experiential categories, from a marketing perspective (based on Schmitt, 1999)

Component	Summary
Sense	Consumers' reactions to all of the sensory stimuli within a given experience
Feel	Consumers' inner feelings; emotional states and their intensity in response to an experience
Think	Consumers' mental engagement; experiences that encourage problem-solving or creative thinking
Act	Consumers' personal behaviors and interactions with an experience; creating a desire to act
Relate	Experiences that connect consumers to their broader social identity (e.g., subculture, country)

Dimensions of Experience: Translated to M&S

With a little creativity, the five dimensions of experiential design can be applied to simulation-based experiences (see Table 3; refer also to Chertoff et al., 2008; Chertoff, 2010). For instance, for the M&S discipline, "sense" may be more formally conceptualized as the *sensory dimension*, which describes participants' reactions to the sensory stimuli within, and around, a simulation. As the marketing literature explains, these are the "sights, smells, sounds, and textures generated by things" (Pullman & Gross, 2004, p. 554). In our case, the sensory domain significantly (but not wholly) involves the input/output of the simulated environment, such as the sights, sounds, smells, motion platform effects, and physical temperature whether on a live range or in the computer lab. Additionally, the sensory domain relates to the M&S concepts of physical fidelity, presence, and immersion; however, an engaging sensory experience need not, necessarily, involve accurate stimuli nor complete mental or physical engrossment.

For the M&S discipline, "feel" may be conceptualized as the *affective dimension*, which corresponds to emotional states, such as joy, pride, or stress. These emotions may result from a purposeful scenario event or from an amalgamation of events within the simulated experience. For instance, a simulation may induce surprise in response to realistic battlefield effect or it may produce positive feelings when a participant successfully completes a challenging scenario. In either case, the appropriateness of the emotions must be assessed, often against the intent of the simulated experience.

In traditional experiential design, "THINK marketing appeals to the intellect with the objective of creating cognitive, problem-solving experiences that engage customers creatively… [it] appeals to consumers' convergent and divergent thinking through surprise, intrigue, and provocation" (Schmitt, 2009, p. 117). Few adjustments are required to translate "think" into the *cognitive dimension* for M&S. Like its marketing-borne cousin, this domain describes participants' mental engagement, and for training simulations, it closely relates to their task engagement and *flow*. (Flow is a state of focused task concentration that results in total absorption and strong feelings of capability and control; Csikszent, 1991.)

"Act" may be conceptualized as the M&S discipline as the *active dimension*. It involves experiences that appeal to individuals on a personal level, encouraging them to actively engage, learn new behaviors, or establish new habits. In marketing, Nike's *Just Do It* campaign exemplifies the act dimension because it encourages consumers to visualize themselves as athletes, personally identify with the celebrity role-models, and engage in new or additional athletic activities (Schmitt, 2009). For training simulations, similar personal engagement and impetus is desired; only the object of the visualizations, personal connections, and new behaviors varies.

Finally, the "relate" marketing dimension becomes the M&S *relational dimension*. When applied to simulations, this dimension still involves social experiences. As the marketing literature explains, this dimension "creates value for the customer by providing a social identity and sense of belonging" (Schmitt, 2010, p. 106). This may involve experiences that reference individuals' social identity by appealing "to the need to be perceived positively by others" (Schmitt, 2009, p. 118), or it may involve experiences that are reinforced through social interactions. For instance, a competitive single-player simulation that ranks each participant based upon his score might encourage a relational experience; similarly, a collaborative simulation involving team training could engage the relational dimension.

Table 3. Summary of the five dimensions of experiential design applied to M&S

Component	Summary
Sensory	Participants' reactions to all of the sensory stimuli within, or surrounding, a simulation
Affective	Participants' emotional states, and whether they fit the purpose of the simulation
Cognitive	Participants' mental engagement with the simulated task (closely related to *flow*)
Active	Participants' personal identification, motivation to engage, and willingness to act
Relational	Simulations that invoke participants' broader social identity or include social co-experiences

The application of experiential design techniques requires that these domains be considered both individually and collectively. Although variables may be manipulated within individual domains, it is the sum of these experiential factors that ultimately results in the experience perceived by the participant.

WHY USE EXPERIENTIAL DESIGN FOR VIRTUAL ENVIRONMENTS? (OR WHO CARES?)

We view experiential design as an enhancement to scenario-based learning. Its theories and research provide a framework to structure discussions of scenario and simulation features, and its best practices may boost the learning outcomes associated with instructional scenarios. While the first hypothesized benefit requires little additional description, the second requires additional explanation, beginning with a brief overview of the convergence of experience, scenarios, and simulation.

Simulations, Scenarios, and Experiential Design

Simulation-based training differs from the similar concept of *scenario*-based training. Roughly put, simulation-based training replicates objects or environments in order to enable skills practice. In contrast, *scenario*-based training may—or may not—rely upon a tangible simulation. Instead, it primarily concerns the narrative and instructional content associated with the training.

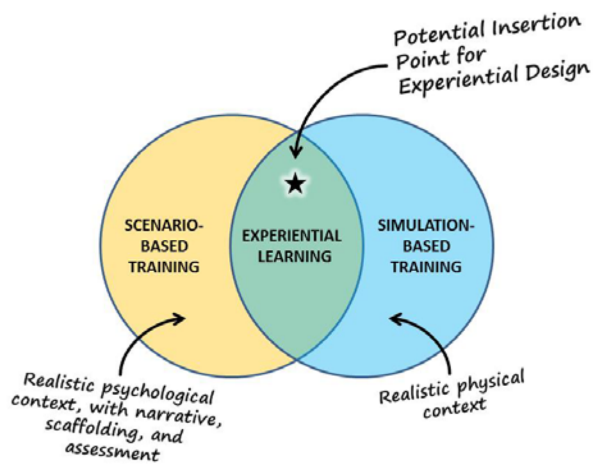

Figure 2. Heuristic depiction of the relationship between simulation- and scenario-based training; when used together, they can form an effective experiential learning context, which we hypothesize may be enhanced through experiential design.

Scenarios and Simulations. Today, many effective training environments use a combination of simulation- and scenario-based training principles. In such cases, the simulated environment establishes a realistic context for the training and provides the physical fidelity, while the embedded scenarios help establish the psychological and task fidelity. Scenarios also provide a structure for including instructional elements, such as scaffolding and assessment. Together, simulations and scenarios form a powerful experiential learning environment.

Experiential Learning. Experiential learning is the intentional process of learning through hands-on experience. Or, more formally, it is "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p. 41). Not all experiences facilitate learning. Effective experiential learning occurs in "an idealized learning cycle or spiral where the learner 'touches all the bases'—experiencing, reflecting, thinking, and acting—in a recursive process that is responsive to the learning situation and what is being learned" (Kolb & Kolb, 2009, p. 298; see figure 3).

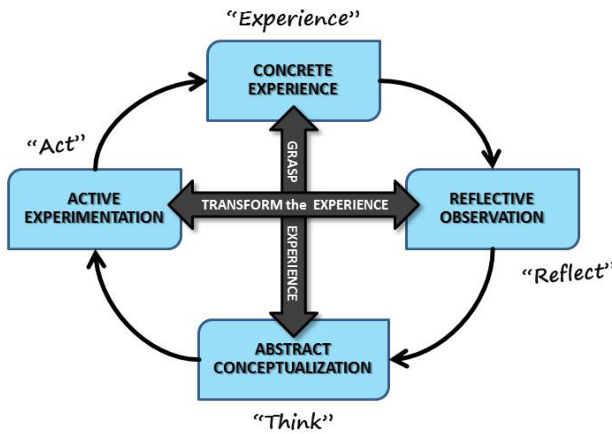

Figure 3. Experiential learning model from Kolb, 1984.

Enhancing Experiential Learning in Virtual Environments

Experiential learning theory applies to instructional experiences, writ large, not simply those experienced through simulation. Nonetheless, experiential learning concepts also apply to virtual experiences. In virtual environments, the simulation provides the context and intrinsic feedback (i.e., natural cause-and-effect reactions) for the experience. While (well-written) scenarios establish the events that appropriately challenge, teach, and test the trainees. In other words, scenarios encourage the "idealized learning cycle" that helps participants gain insight from the experience.

To best support experiential learning, in a perfect world, all virtual environments might offer impeccable sensory realism with robust, full-featured scenarios. However, in the real world, simulation-based training designers must make difficult tradeoffs in order to achieve the best Return on Investment (ROI). Thus, designers must determine the amount of costly sensory realism needed to produce the concrete experiences and support the active experimentation of Kolb's experiential learning model. Similarly, designers must determine which scenario features will best facilitate trainees' reflection on and abstraction of their experiences.

To complicate matters, instructional simulation designers typically make these tradeoff decisions early in a system's lifecycle, often before development begins. Thus, instead of direct observation or trial-and-error, many design decisions are based upon past research, generalized theories, and organizing frameworks. Our current effort, involving perceptual training in the Virtual OP, exemplifies this challenge.

We must create an immersive experience, in which the multitude of stimuli creates a context that is cohesive enough that trainees can gain an intuitive sense of "normal" and distinguish subtle abnormal cues from this baseline. In other words, all facets of the experience must seamlessly integrate so that only the intended anomalies standout to participants. Additionally, we face the traditional challenges associated with all training environments: the experiences must be sufficiently engaging, so that trainees actively participate in the exercises, and the experiences must be sufficiently memorable, so that the trainees retain the knowledge they have gained. Thus, to enhance the quality of our Virtual OP simulator, we turned to experiential design.

GUIDELINES FOR HOLISTIC EXPERIENCES IN SIMULATION-BASED TRAINING

Through our work, we have developed an initial list of pragmatic guidelines, based in the commercial practice of experiential design, which can be leveraged by human-in-the-loop simulation practitioners to design, analyze and control the emergent experience of a simulation. As part of the guideline creation process, we conducted a thorough literature review, concentrating focus on highly regarded experiential design principles from outside simulation research as well as individual experiential elements previously explored by other simulation researchers. We believe the following ten guidelines empower simulation designers to move beyond simple scenarios towards the creation of highly immersive, holistic training experiences.

Before designing the experience, establish a user baseline

Prior to implementation of any of the following guidelines, practitioners must first document and develop a shared understanding of the intended user population and any known project-related goals and constraints. Only by first seeking to understand the trainee audience, and possible participant factors like motivation, knowledge, cultural awareness and previous experiences, can simulation practitioners hope to elicit memorable, engaging and highly relevant training experiences. The following process components are highly relevant to the planning of simulation-based training; they directly inform how the holistic experience guidelines are best applied (Dalsgaard, 2008):

- Ensure collective understanding of the physical and spatial surroundings
- Ensure collective understanding of any potential users
- Ensure collective understanding of the situation in which the experience will be encountered
- Ensure collective understanding of the values that the work should evoke
- Understand the likelihood for available interactive installations to convey desired intentions and values

Guideline 1: Produce multi-sensory experiences

Sensory stimuli are often utilized by experiential designers to bring a sense of life to an intended theme through the purposeful engagement of a participant's sight, sound, smell, taste and touch (i.e., the sensory domain). This interaction across multiple senses results in a more immersive and compelling experience (Pine II & Gilmore, 1998). Applications of experiential design in entertainment settings reinforce the notion that sense of touch is expandable beyond participant driven touch interactions. If properly tied to scenario execution, simulation designers can leverage commercial design techniques, such as representative temperature settings/fluctuation or gentle wind shifts, into the integrated virtual-physical environment. The variation of these meaningful, multi-sensory stimuli within a simulated scenario conveys subtle cues to the participant about the virtual environment.

The Center for Disease Control (CDC) recently constructed a virtual staff trainer that strongly emphasizes engagement of the sensory domain in order to simulate a more realistic field experience. Built to train the Deployment Safety and Resiliency Team (DSRT) for missions to less developed countries, the virtual trainer includes more than 100 situation appropriate visual, audio and scent cues, including visualizations of hazardous objects like mold and dangerous wiring, sound such as arguments and coughing, and scents such as garbage, sweat and vomit (Klomp & Spitalnick, 2011). These 100+ sensory stimuli are deployed by the CDC training simulation for both deployment familiarization and improved recognition of environmental cues when physically deployed.

Guideline 2: Layer stimuli to create realistic sensory complexity

In the pursuit of a highly immersive interaction, an experiential designer will often employ the layering of thematic sounds, smells and other stimuli into an environment, altering cues as participants move about or as a given scenario progresses. The most expected characteristic of a dynamic environment is that it will continue to evolve (Zielke, et al., 2009). Effective layered design implies the presence of that evolving, living environment.

The manifestation of environmental noises and the background chatter of human interactions can indicate a sense of place as well as contextual cues to the moods and activities of the people present. Zielke, et al. (2009) took a systematic approach to the layering of complex environmental sounds within a virtual environment. The team separated all potential environmental sounds into three audio dimensions: 1) global changes perceived by all virtual role-players and trainees alike—sounds such as weather and traffic; 2) regional changes perceived by virtual role-players and trainees only within a given sphere—sounds like an explosion within a building; 3) local changes perceived by trainees based on proximity indicators—sounds such as footsteps and nearby voices.

The complex representation of a living environment is necessary to support the realistic training of many perceptual-cognitive skills. The sound of a rapidly approaching truck or the sudden hush of nearby children upon your approach is indicative of a potential hazard within an environment. The feeling of directional heat or a subtly changing scent grants the type of sensemaking information available to trainees in the real-world. Only by realistically modeling the layers of stimuli within the real-world environment will the same cognitive complexity be sufficiently invoked.

Guideline 3: Build for emotional understanding

Much of commercial experiential design is intended to appeal emotionally to the human actor within a given setting. Designers understand that these appeals should be situationally appropriate and made with an understanding of the likely emotional states (i.e., the affective domain) of the intended participants. Designers of virtual environments can leverage this principal through affective computing, or the dynamic targeting of human emotional states through the use of synthetic entities that appear to recognize, interpret and exhibit their own emotions within dynamic scenarios.

Although a specific discussion of these technologies is outside the scope of this paper, the focus of affective computing can be summarized as technology that interprets user emotion and is itself capable of "having" and expressing emotions. Interpretation of user emotion can be facilitated through advanced input sensors and artificial intelligence mapped to classifications of human emotional behaviors. The appearance of synthetic entities expressing emotion can be mapped computationally to scenario triggers. A system built to programmatically understand which scenarios should generate which emotions, and which emotions will impact cognitive functions such as memory, perception, attention, and interest, will convey a greater sense of realism to a human participant within a virtual environment through the appearance of synthetic entity behavior that is driven by human emotion.

Guideline 4: Create conditions that facilitate flow

In order to full engage a participant mentally (i.e., the cognitive domain), experiential designers seek to create a sense of flow by balancing environmental components and scenario related interactions to best utilize the intended user's cognitive capabilities. If interactions and tasks within an environment are too easy, a sense of boredom will occur; if interactions and tasks are sufficiently challenging, a higher sense of involvement may occur (Czikszentmihalyi & Czikszentmihalyi, 1992). Simulation designers can leverage this technique through scenario creation that balances long-term and short-term memory tasks, and is a clear, attainable objective for the intended audience capabilities. The simulation system itself should provide evidence that participant actions cause a direct impact on scenario outcomes, and the virtual environment and synthetic entities should produce clear and immediate reactions to participant behaviors to facilitate learning through the concrete demonstration of success or failure.

The active reduction of unnecessary distractions is also critical to ensure continued cognitive engagement within a virtual environment. This can be a particular challenge in scenarios requiring movement. Movement within a virtual environment has traditionally been limited by hardware and space constraints, keeping movement interactions confined to user interfaces such as joysticks, speech commands, tracking camera integrations or special treadmills. Sarkela, et al. (2009) found that allowing for more effortless movement within a virtual environment produced a higher sense of experiential presence within that environment. The perceived sense of fluency is contextual to the training situation and must also be balanced with feasibility. If naturalistic movement is not possible, the most intuitive and scenario relevant option should be identified, remembering that sense of movement and effort within a virtual space can also be impacted by physical devices such as Head-Mounted-Displays (Lee, Liu, & Caudell, 2009).

Guideline 5: Target the user's self-concept

In a commercial setting, experiential designers recognize that a strong appeal to a person's sense-of-self creates an experience that is more likely to compel them towards the intended call-to-action. Informed by an understanding of their target audience, designers influence motivation and action through the purposeful inclusion of items and stories that are interesting and important to that customer. These relatable and meaningful experiences evoke emotion in ways that can cause a cognitive shift—modifying perception, motivation, and action as a result (Forlizzi & Ford, 2000).

Denis & Jouvelot (2005) state that learning and self-motivation are closely related, with personally meaningful experiences that stimulate a desire to act resulting in the use of cognitive strategies that improve participant long-term memory, while unpleasant scenario events, such as instrumentation confusion, anxiety invoking scenarios or overly difficult task-work, decrease motivation and willingness to learn globally across the instructional environment. Designers of simulation-based scenarios can improve instruction retention and motivation to act post-simulation through the purposeful inclusion of experience opportunities such as recognition, responsibility, achievement, advancement, and growth, which strongly appeal to the active domain.

Guideline 6: Build for user adaptation

Experiential designers understand that participants experience environments differently, and that the most memorable experience will invoke a personal connection to the setting or task. This engagement of the active domain is highly influenced by the diverse skills and background that an individual brings into any interaction. Therefore, designers strive to create elements that respond to or can be customized by the participant

By integrating adaptive mechanisms into the simulation platform, simulation-based training can be tailored to the needs of the trainee, whether through scenario levels based on skill/experience or in response to successful/failed task performance. Actions have outcome consequence in a real-world environment, and an adaptive simulation that modifies scenario flow and the actions of behaviorally accurate virtual role-players in response to trainee performance will provide a more personalized and relevant training When building their current stress resilience training simulator, the CDC required that the system design allow for instructor and performance configurable levels of user experience and expertise; these level settings then determined the occurrence frequency of the simulated stressors as well as the difficulty of the overall training scenario narrative (Klomp & Spitalnick, 2011).

Guideline 7: Inject cultural nuance

The creation of a seamless holistic experience in any application requires the consideration of culturally relevant cues that evoke key themes within an intended experience. Simulation designers have an excellent opportunity to emphasize dynamic behavioral and emotional nuances that evoke a larger cultural or environmental meaning and provide the participant with relational context that informs their role in the larger social identity of the environment.

Cultural nuance within an environment can range from symbolic graffiti seen in the background to the cultural specific body positioning of a simulated actor indicating deceptive intentions. The injection of cultural nuance capability within a simulation is extremely valuable when training higher-level perceptual-cognitive skills such as problem solving, sense-making, and situational forecasting in a virtual training environment. Some simulation platform developers have utilized motion capture technology to allow for the injection of scenario supporting avatars with culturally appropriate movements and facial expressions (Zielke, et al., 2009), proving beneficial in traditional military training as well other cultural training opportunities such as diplomacy and international business.

Guideline 8: Promote social experiences

Experiential designers recognize that the relational dimension of an experience, often untapped in traditional interaction design, is a powerful tool to create memorable and shared brand experiences (Battarbee, 2003). As such, designers look for opportunities to facilitate and promote interaction opportunities, or co-experiences, between participants and between individuals and their larger social circle.

The concept of designing for co-experience is particularly relevant to simulation-based team training design. Designers of these scenarios must consider the nuances of social communication, collaboration, and relationship maintenance within the virtual environment, and work to combine these elements into a more seamless user experience for all involved parties (Battarbee, 2003). Experiences need not only be co-experiences to target the relational dimension. Designers can use other mechanisms to usefully evoke participants' sense of social belonging, e.g. through competition, social facilitation, or simply creating the desire to act in appropriate ways in order to be perceived as "part of the group."

Guideline 9: Create highly relevant thematic environments

Perhaps the most commonly applied experiential design guideline used in commercial applications is the notion of creating an obvious, reinforcing theme within the intended customer environment. Designers set the experiential stage with purposeful staging and the implementation of relevant thematic cues, often mixing in artifacts to add physical realism to the environment (Pine II & Gilmore, 1998), such as a physical map of a simulated battlefield.

Although represented experiences may vary by intended purpose, each possess unique elements that when combined, represent a participant's schema of a given setting. Within a virtual environment, the look of buildings, the frequency of rain, or the type of surrounding vehicles all reinforce the authenticness of a virtual representation. By immersing participants into a realistic substitute environment, a more compelling and concrete experience is established. When well executed, a relevant theme will produce a memorable learning environment. A poorly executed theme will fail to provide a meaningful setting in which participants can conceptually organize impressions and encountered events, leading to poor overall memory of the experience (Pine II & Gilmore, 1998).

Simulation designers should first look to their virtual environment for improved thematic opportunities, targeting the unique environmental elements that would be expected to occur in the real-life setting. Additionally, physical/virtual space integrations should be considered during the design process; the implementation of well-placed, relevant set-design pieces in the real-world can enhance immersion through the blurring of virtual and physical views.

Guideline 10: Design the experience across time

Finally, effective experiential designers recognize that a holistic participant experience involves not just the actual occurrence of an event, but the pre-event anticipations and post-event reflections of that participant as well. In order to create a truly meaningful holistic experience that contributes to the greatest possible training transfer, simulation-based designers must consider the five dimensions of experience across the domain of time—before, during, and after the actual scenario event

SUMMARY AND CONCLUSION

In this paper, we have described experiential design and translated its applicability to the design of simulated experiences. We outlined how the application of experiential design components can enhance simulation-based training through the careful consideration of the dimensions of participant experience. We then provided practical guidelines, informed by experiential design best practices, which contain the necessary components to elevate simulation-based scenario design towards the creation of holistic training experiences.

Table 4. Summary of the 10 Guidelines

Holistic Experience Guideline	Domain
Produce multi-sensory experiences	Sensory
Layer stimuli to create realistic sensory complexity	Sensory
Build for emotional understanding	Affective
Create conditions that facilitate flow	Cognitive
Target the user's self-concept	Active
Build for user adaptation	Active
Inject cultural nuance	Relational
Promote social experiences	Relational
Create highly relevant thematic environments	*Holistic*
Design the experience across time	*Holistic*

As we look to produce a more interpretable design framework that facilitates finely tuned perceptual training within a virtual environment, we will further refine these guidelines and validate their experiential impacts across the experience domains through additional experimental research. A matrix of validated experiential design guidelines across perceptual skill training objectives would be highly useful to designers looking to emphasize development of a particular perceptual skill through simulation-based training. Additionally, such a matrix would inform necessary system component planning, proving very valuable in project scoping as well as budgetary constraint decisions.

ACKNOWLEDGEMENTS

This work was supported, in part, by the Office of Naval Research project N00014-11-C-0193, Perceptual Training Systems and Tools (PercepTS). The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressed or implied, of the Department of Defense or Office of Naval Research. The U.S. Government is authorized to reproduce and distribute reprints for Government purposes notwithstanding any copyright notation hereon.

REFERENCES

Battarbee, K. (2003). Defining Co-Experience. *DPPI '03 Proceedings of the 2003 international conference on Designing pleasurable products and interfaces*, (pp. 109-113).

Berry, L. L., Carbone, L. P., & Haeckel, S. H. (2002). *Managing the total customer experience*. MIT Sloan Management Review.

Carr, V., Sangiorgi, D., Buscher, M., Junginer, S., & Cooper, R. (2011). Integrating Evidence-Based Design and Experience-Based Approaches in Healthcare Service Design. *Health Environments R&D, 4*(4), 12-33.

Czikszentmihalyi, M., & Czikszentmihalyi, I. S. (1992). *Optimal experience: psychological studies of flow in consciousness*. New York: Cambridge University Press.

Chertoff, D. B., Goldiez, B., & LaViola, J. J. (2010). Virtual Experience Test: A virtual environment evaluation questionnaire. *Virtual Reality Conference (VR)* (pp. 103-110). IEEE.

Chertoff, D., Schatz, S., McDaniel, R., & Bowers, C. (2008). Improving Presence Theory Through Experiential Design. *Presence, 17*(4), 405-413.

Csikszent, M. (1991). *Flow*. Harper Perennial.

Dalsgaard, P. (2008). Experiential Design: Findings from Designing Engaging Interactive Environments. In S. Pinder (Ed.), *Advances in Human Computer Interaction.* InTech.

Denis, G. & Jouvelot, P. (2005). Motivation-driven educational game design: applying best practices to music education. In *Proceedings of the 2005 ACM SIGCHI International Conference on Advances in Computer Entertainment Technology*. 462-465.

Forlizzi, J., & Ford, S. (2000). The building blocks of experience: an early framework for interaction designers. *DIS '00 Proceedings of the 3rd conference on Designing Interactive Systems*,, (pp. 419-423).

Klomp, R. W., & Spitalnick, J. S. (2011, January). Virtual Classroom Immersion Training. *Training & Development*, pp. 38-43.

Kolb, D. (1984). *Experiential learning: experience as the source of learning and development.* Englewood Cliffs, NJ: Prentice Hall.

Kolb, A.Y. & Kolb, D.A. (2009) *The Learning Way: Meta-cognitive Aspects of Experiential Learning*. Simulation & Gaming. 40(3), 297-327.

Lee, C. H., Liu, A., & Caudell, T. P. (2009). A study of locomotion paradigms for immersive medical simulation environments. *The Visual Computer, 25*, 1009-1018.

Pine II, B., & Gilmore, J. (1998, July-August). Welcome to the Experience Economy. *Havard Business Review*, pp. 97-105.

Pullman, M. E., & Gross, M. A. (2004). Ability of experience design elements to elicit emotions and loyalty behaviors. *Decision Sciences*, 35(3), 551-578.

Sarkela, H., Takatalo, J., May, P., Laasko, M., & Nyman, G. (2009). The movement patterns and the experiential components of virtual environments. *International Journal of Human-Computer Studies, 67*, 787-799.

Schatz, S., Wray, R., Folsom-Kovarik, J. T., & Nicholson, D. (2012). Adaptive perceptual training in a virtual environment. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 56(1), 2472-2476. doi: 10.1177/1071181312561503.

Schmitt, B. (1999). *Experiential marketing*. New York: The Free Press.

Schmitt, B. H. (2009). A framework for managing customer experiences. In Schmitt, B. H., & Rogers, D. L. (Eds.). *Handbook on brand and experience management* (pp. 113-131). Edward Elgar Publishing.

Schmitt, B. H. (2010). *Customer experience management: a revolutionary approach to connecting with your customers*. Wiley.

Zielke, M. A., Evans, M. J., Dufour, F., Christopher, T. V., et al. (2009, March-April). Serious Games for Immersive Cultural Training: Creating a Living World. *IEEE Computer Graphics and Applications*, pp. 49-60.