Technical Report 1261

Understanding Demonstration-based Training: A Definition, Conceptual Framework, and Some Initial Guidelines

Eduardo Salas, Michael A. Rosen, and Davin Pavlas
University of Central Florida Department of Psychology,
and Institute for Simulation and Training

Randy Jensen, Dan Fu, and Sowmya Ramachandran
Stottler Henke Associates Inc.

Elizabeth Hinkelman
Galactic Village Games, Inc.

Donald R. Lampton
U.S. Army Research Institute

October 2009

United States Army Research Institute for the Behavioral and Social Sciences

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

A Directorate of the Department of the Army
Deputy Chief of Staff, G1

Authorized and approved for distribution:

BARBARA A. BLACK, Ph.D.
Research Program Manager
Training and Leader Development Division

MICHELLE SAMS, Ph.D.
Director

Technical review by

Christian Jerome, U.S. Army Research Institute
Heather A. Priest Walker, U.S. Army Research Institute

NOTICES

DISTRIBUTION: Primary distribution of this Technical Report has been made to ARI. Please address correspondence concerning distribution of reports to: U.S. Army Research Institute for the Behavioral and Social Sciences, Attn: DAPE-ARI-ZXM, 2511 Jefferson Davis Highway, Arlington, VA 22202-3926

FINAL DISPOSITION: This Technical Report may be destroyed with it is no longer needed. Please do not return it to the U.S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: The findings of this Technical Report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy) November 2009	2. REPORT TYPE Final	3. DATES COVERED (from. . . to) Nov 2006 to Aug 2008

4. TITLE AND SUBTITLE Understanding Demonstration-based Training: A Definition, Conceptual Framework, and Some Initial Guidelines	5a. CONTRACT OR GRANT NUMBER W91WAW-07-P-0020 5b. PROGRAM ELEMENT NUMBER 622785
6. AUTHOR(S) Eduardo Salas, Michael A. Rosen, Davin Pavlas, (University of Central Florida Department of Psychology, and Institute for Simulation and Training); Randy Jensen, Dan Fu, Sowmya Ramachandran, (Stottler Henke Associates Inc.); Elizabeth Hinkelman, (Galactic Village Games, Inc.); and Donald R. Lampton (U.S. Army Research Institute for the Behavioral and Social Sciences).	5c. PROJECT NUMBER A790 5d. TASK NUMBER 5e. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Stottler Henke Associates, Inc. 951 Mariner's Island Boulevard Suite 360 San Mateo, CA 94404-1558	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences ATTN: DAPE-ARI-IF 2511 Jefferson Davis Highway Arlington, Virginia 22202-3926	10. MONITOR ACRONYM ARI 11. MONITOR REPORT NUMBER Technical Report 1261

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

Contracting Officer's Representative and Subject Matter POC: Donald R. Lampton

14. ABSTRACT *(Maximum 200 words)*:

This research was conducted as part of a Phase I Army Small Business Innovative Research (SBIR) contract monitored by the United States Army Research Institute for the Behavioral and Social Sciences (ARI). The overall goal of the SBIR topic is to develop a comprehensive system for designing, producing, distributing, and using training demonstrations. This report provides an initial formalism for demonstration-based learning, to be incorporated into the design and development of that system. The report provides a conceptual definition of demonstrations, a framework of demonstration features, and a set of initial guidelines for designing effective demonstrations organized around the presented framework. This serves the dual purposes of organizing what is known about designing effective demonstrations and directing future research.

15. SUBJECT TERMS

training, demonstration, instruction strategy

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	27	Ellen Kinzer Technical Publication Specialist 703-602-8049

Technical Report 1261

Understanding Demonstration-based Training: A Definition, Conceptual Framework, and Some Initial Guidelines

Eduardo Salas, Michael A. Rosen, Davin Pavlas
University of Central Florida Department of Psychology,
and Institute for Simulation and Training

Randy Jensen, Dan Fu, Sowmya Ramachandran
Stottler Henke Associates, Inc.

Elizabeth Hinkelman
Galactic Village Games, Inc.

Donald R. Lampton
U.S. Army Research Institute

ARI – Orlando Research Element
Stephen L. Goldberg, Chief

U.S. Army Research Institute for the Behavioral and Social Sciences
2511 Jefferson Davis Highway, Arlington, VA 22202-3926

November 2009

Army Project Number	**Personnel, Performance**
622785A790	**and Training Technology**

ACKNOWLEDGEMENTS

Our thanks to Dr. Bruce Knerr of the U.S. Army Research Institute for his support and input on this research.

UNDERSTANDING DEMONSTRATION-BASED TRAINING: A DEFINITION, CONCEPTUAL FRAMEWORK, AND SOME INITIAL GUIDELINES

EXECUTIVE SUMMARY

Research Requirement:

Organizations frequently use demonstrations to train their employees. Results of past research have shown wide variability in the effectiveness of demonstrations. While several basic and applied research threads have implications for designing effective demonstrations, these research threads generally have not been integrated. As a step towards integration, this paper provides a conceptual definition of demonstrations, a framework of demonstration features, and a set of initial guidelines for designing effective demonstrations organized around the presented framework. This serves the dual purposes of organizing what is known about designing effective demonstrations and directing future research.

This research was conducted as part of a Phase I Army Small Business Innovative Research (SBIR) contract monitored by the United States Army Research Institute for the Behavioral and Social Sciences (ARI). The overall goal of the SBIR topic is to develop a comprehensive system for designing, producing, distributing, and using training demonstrations. This report provides an initial formalism for demonstration-based learning, to be incorporated into the design and development of that system. (For this SBIR effort there is a focus on leveraging game engine technologies as part of the topic solution. However, the research presented in this report should be applicable to almost all media.)

Procedure:

In order to present a framework of demonstrations as well as a set of guidelines for designing effective demonstrations, a literature review was conducted. This consisted of systematic search of psychology and related academic databases as well as technical reports and conference proceedings for demonstration and observational learning research and publications. The references included in articles identified through this process were used to expand the literature search. Using a structured protocol, critical information was extracted from the literature generated from this search. From the research found, findings were organized to create a framework of demonstrations. This framework serves to organize the world of possibilities in terms of demonstration-based training, that is, the full range of instructional features that can be incorporated into a demonstration. Within this framework, the empirical and theoretical literature was used to develop a set of initial guidelines for maximizing the effectiveness of these various components of demonstrations.

Findings:

The research synthesis discussed above resulted in a framework based on two primary categorizations: procedural knowledge vs. strategic knowledge and passive vs. active demonstration styles. Procedural knowledge is 'how to' knowledge and involves training a fixed sequence of behaviors. Strategic knowledge involves selecting and executing the most appropriate procedure given a specific situation. Demonstrations are capable of training both of these types of knowledge; however, different demonstration features will be more or less effective for training different types of knowledge competencies. Additionally, the passive and active dimensions are further refined into six demonstration types: guided, unguided, preparatory, concurrent, retrospective, and prospective. Additionally, twelve guidelines are presented for maximizing the effectiveness of demonstrations.

Utilization and Dissemination of Findings:

The framework presented in this technical report can serve as a guide to thinking about demonstration-based training, for organizing the full range of instructional strategies available. This, along with the initial guidelines presented, can serve to inform the practice of developing effective demonstrations. However, this framework also serves as a means to guide future research. Therefore, the information presented here synthesizes the available literature for the practical purposes of designing more effective demonstrations as well as for guiding future research on demonstration-based training.

The sponsored effort with ARI has continued to Phase II, which will involve a two year development effort resulting in a prototype tool that employs guidelines from the study of demonstration-based learning in practice for the authoring of virtual training demonstrations. This capability is anticipated to fill a need in the training space between training manuals and simulation-based training. The results will be shared with the United States Army Training and Doctrine Command (TRADOC) and the Department of Homeland Security's Federal Law Enforcement Training Center.

UNDERSTANDING DEMONSTRATION-BASED TRAINING: A DEFINITION, CONCEPTUAL FRAMEWORK, AND SOME INITIAL GUIDELINES

CONTENTS

LIST OF FIGURES

UNDERSTANDING DEMONSTRATION-BASED TRAINING: A DEFINITION, CONCEPTUAL FRAMEWORK, AND SOME INITIAL GUIDELINES

"You can observe a lot just by watching."

- *Yogi Berra*

Learning is now part of our lives. Whether at home, work, or in the field, learning is what makes us excel. The more we learn, the better. The faster we learn, the better. The more we apply what we learn, the better. This is what makes organizations like the military, the aviation industry, and the medical communities thrive—having learners that are fast, efficient and self-correcting. So learning has become a mantra in many industries and agencies. Organizations have put in place formal and informal mechanisms for individuals and teams to learn, at a huge investment--$250 billion per year (ASTD, 2005). An investment that deserves tangible outcomes in personnel skill acquisition, increased productivity, lower rates of error, better decisions, and, of course, competitive edge.

But the outcomes are not there. Recent research indicates that only 10% of what is learned is applied to the job (Tannenbaum, 2001). Why is this the case? Is it the kind of learning strategies that organizations design and deliver? Is it the lack of practice and feedback? Or is it the kind of practice? What learning strategies have not reached their potential? Can non-practice strategies add value? This report is motivated by these questions.

Training has been defined as the systematic acquisition of the knowledge, skills and attitudes (KSA's) necessary for effective performance in work environments (Goldstein & Ford, 2002). In recent years, organizations have turned towards simulations (or synthetic learning environments) in order to prepare personnel for work in complex and dynamic environments. These simulations have been designed to provide training with information, demonstration, practice and feedback on needed knowledge, skills, and attitudes. And while progress has been made in these areas, demonstration-based learning has been relatively neglected by the science of learning (Salas & Cannon-Bowers, 2001; Tannenbaum & Yukl, 1992). Therefore, the purpose of this paper is fourfold: 1) to provide a conceptual definition of a demonstration, 2) outline the theoretical foundations of demonstration-based learning, 3) provide a typology of demonstrations based upon the conceptual definition and theoretical basis, and 4) provide an initial set of guidelines for increasing the effectiveness of demonstration-based training organized around the typology developed in this paper.

What are Demonstrations?

Demonstration-based learning is generally understood as the observation by the learner of another person (or team) performing the tasks, components of tasks (either in real time or through some form of recorded or computer generated medium), or characteristics of the task environment that have been targeted for training. In this section, we lay the groundwork for synthesizing the existing theoretical and empirical literature and applying it to the context of demonstrations in training. Because of the relative neglect of the demonstration component of training, we begin by developing a conceptual definition. This is a critical step as different terms related to demonstrations are often used with different intentions and meanings (Williams, Davids, & Williams, 1999). A clear articulation of what a demonstration is provides guidance in reviewing the literature as well as facilitating, directing, and coordinating future research efforts. As will be discussed below, demonstrations should be conceived of not only in terms of an example of task performance but also in terms of the accompanying requirements and information presented to learners to maximize the skill and knowledge acquisition process. In short, demonstrations can be more than an opportunity for a learner to watch task performance; they can be carefully engineered experiences where learners are prompted to actively process the informational content of the example and to systematically and reliably acquire targeted KSA's and transfer them to the work environment.

The term demonstration is frequently confounded with several others in the scientific and training literatures (e.g., observational learning, observational modeling, vicarious learning, social facilitation, social learning, behavior modeling, mimicry, matched-dependent behavior; Williams et al., 1999; Shlechter & Anthony, 1996). Essentially, the term demonstration when considered (we argue rightfully so) as a part of the environment (e.g., a stimulus, a component of training) is blended with the process of observing the demonstration by the learner. The latter should be characterized more correctly as observational learning, not demonstration.

The term demonstration is rooted in the Latin word *demonstrare*, meaning to show or explain (Wiktionary, 2006). This meaning is very close to the most relevant common definition, "a description or explanation, as of a process, illustrated by examples, specimens, or the like" (Dictionary.com, 2006). In line with these meanings and the issues discussed above, we offer the following definition of demonstration:

> *A demonstration is a strategically crafted, dynamic example of partial or whole task performance or of characteristics of the task environment intended to increase the learner's performance by illustrating (with modeling, simulation, or any visualization approach) the enactment of knowledge, skills, and attitudes (KSAs) targeted for skill acquisition.*

Demonstrations vary in terms of informational and physical characteristics (e.g., content, form of presentation) as well as the demands placed upon the learner in addition to observing the example (e.g., activities that occur prior to, during, and after the observation period). To be clear, we refer to the observational component of the demonstration as an example. When the term demonstration is used, we are referring to the entirety of the example and the additional activities and information provided that are intended to maximize the acquisition and transfer of targeted KSA's by viewing the example. Although a clear conceptual definition of demonstration is necessary for the development of a scientifically based approach to constructing effective demonstrations, it is by no means sufficient for guiding practice. In the following section we provide a review of the theoretical basis of learning through the observation of demonstrations.

Theoretical Basis for Demonstration-based Learning

Observation has long been noted as a critical means of human learning, especially in social contexts (Heyes, 2001). Emerging work in the area of the mirror-neuron system suggests a strong link between physically passive observation and learning due to similarities in neural activation during observation and production of certain activities (e.g., Rizzolatti & Craighero, 2004; Petrosini, Graziano, Madolesi, Neri, Molinari, & Leggio, 2003). This section reviews several topics related to human learning and observation that provide significant contributions to the understanding of demonstrations for the purposes of training. Observational learning is an umbrella label for a variety of basic research dealing primarily with motor learning. This literature provides a basic understanding of the cognitive processes involved in learning from observation. Behavior modeling training is a robust literature base dealing with the applications of observational learning to training in organizations. Multimedia learning theory consists of the recent advances in multimedia-based learning.

Observational Learning

The theoretical rationale for behavior modeling (and the use of demonstration for the purposes of training) comes from Bandura's (1986) social cognitive theory. Bandura describes four observational learning processes: 1) attention (whereby people must actively process what they are observing in order to learn), 2) retention (wherein what is observed must be stored symbolically in order to affect future behavior), 3) production (whereby the stored symbolic knowledge must be reconverted into overt actions), and 4) motivation (whereby the perceived consequences of performing the observed behavior must be favorable enough to strengthen the likelihood of future performance). This theory has received much empirical attention with the majority of research conducted under the general observational learning heading tending to involve lower level motor tasks. Hence, the generalizability of the empirical findings from these studies to types of complex tasks trained by organizations is suspect. Additionally, the findings of such studies tend to be equivocal because any one study usually addresses a small number of tasks. A recent meta-analysis conducted by Ashford, Davids, and Bennett (2006) revealed that part of the confusion comes from differences in analyzing movement dynamics versus movement outcomes measures and concludes that observational learning is most effective for acquiring relative motion patterns. While there have been challengers to Bandura's symbolic representational theory (c.f., ecological approaches; Scully & Newell, 1985), Bandura's observational learning theory remains the most widely researched and applied. Below, we briefly discuss each of the components of Bandura's theory.

Attention. Attention is the means by which an observer is able to extract information from the examples of performance, be they visual, auditory or perhaps tactile in nature. This highlights the importance of cue or information salience within demonstrations; that is, observers must be able to focus attention on the intended content (the targeted KSAs) in the demonstration. Within motor learning research, it has been found that the most salient aspects of demonstrations are the relative spatial and temporal patterns of movement (Ashford et al., 2006; Newell, Morris, & Scully, 1985). Observation aids the early stages of motor skill learning by providing this 'relative motion' information that constrains the learner's attempts at reproducing the unfamiliar movement patterns. Because of inherent limitations in human attention capacity, observers benefit from slower than real-time and repeated presentation of complex examples as well as presentation of complex tasks in sub-divided part-task sequences (Petrosini et al., 2003; Sheffield & Macoby, 1961). The level of expertise of the observer as well as his/her familiarity with the task greatly affects what an observer is able to recognize and attend to through observation as well (Jentsch, Bowers, & Salas, 2001).

Retention. Bandura's theory posits that observations are transformed into symbolic codes that are stored in memory. The strength of this memory trace is increased through processes of cognitive rehearsal (also called mental practice, symbolic rehearsal, and introspective or covert rehearsal). Cognitive rehearsal refers to the activation of the stored symbolic information in the absence of overt task performance. The symbolic mental representations are accessed at a later time and used to guide future performance. In motor learning research, the degree to which information is extracted through observation is stored as symbolic structures or as simple motor patterns is an issue of intense debate (e.g., Scully & Carnegie, 1998; Ferrari, 1996). However, for the acquisition of more cognitively-rooted tasks as compared with psychomotor tasks, the idea of symbolic storage of memory traces is the most useful explanatory mechanism. Just as mental practice has been shown to increase performance (Driskell, Copper, & Moran, 1994), mental practice is a key method for increasing the retention of mental representations acquired during observation of demonstration examples.

Production. Production involves the performance of the observed behavior. An individual recalls the symbolically stored information extracted by means of attentional processes from the time spent observing performance. This recalled information serves as a guide to producing behavior as well as a means to self-evaluate performance (Ferrari, 1996). Therefore, skill acquisition and production are intertwined as the model of performance acquired during observation is reconverted into behavior which is evaluated in reference to the model of performance acquired during observation. For example, Gray and colleagues (Gray, Neisser, Shapiro, & Kouns, 1991) found that ballet students who engaged in observational learning did better than those who didn't in terms of controlling movement (movement flow and rhythm) but not in terms of strict imitation of bodily movements (exact replication of movements exhibited in the example of performance).

Motivation. Motivational processes are a critical aspect of observational learning. Most fundamentally, a learner must be motivated to reproduce the KSA's within the example or learning will not occur. The observer's attention, retention and production processes are driven by levels of motivation. Higher levels of motivation will lead to more focused attention during observation, more mental rehearsal of the behavior after observation, as well as repeated performance of the behavior, all of which will strengthen the memory traces for the targeted KSAs and increase learning.

Bandura's social learning theory provides a strong theoretical basis for understanding the process of learning from demonstrations. As will be discussed in later sections of this paper, multiple moderators of the observational learning effectiveness have been discovered, most of which are explained in terms of their influence on one of the four processes described above. In the following section we discuss Behavioral Modeling Training (BMT), a widely applied and successful approach to training in organizations that is based on social learning theory.

Behavioral Modeling Training

With an extensive history of applied success and empirical support, behavioral modeling training (BMT) is one of the most extensively used and well-respected training methods available to modern organizations (Taylor, Russ-Eft, & Chan, 2005). BMT is based on Bandura's social learning theory described above (Hogan, Hakel, & Decker, 1986). Utilizing the model provided by social learning theory, BMT includes processes such as modeling, a retention process, behavioral rehearsal, feedback, and methods of training transfer to encourage the greatest transfer of training possible (Kraut, 1976; Doo, 2005). Specifically, during BMT a) trainees are given a list of well-defined skills and facts to be learned during training, b) during training models and visual aids are used to illustrate effective behaviors and skills, c) trainees are provided ample opportunities to practice newly learned skills, d) trainees are provided feedback and social reinforcement by trainers and other trainees, and e) trainers and the organization utilize many methods to promote transfer of training (Decker & Nathan, 1985). As noted by Taylor, Russ-Eft, and Chan (2005), other training methods may use some of these components in their approach, but in BMT the emphasis is on using all components. Using these methods, behavioral modeling training has proven to be an effective training tool in developing trainee skills and resulting in high transfer of training. Additionally, BMT has been tested and found effective in a number of scenarios including training technical and interpersonal skills. Below, we briefly review the empirical literature on two types of training to which BMT has been widely applied: the acquisition of technical skills, and interpersonal skills training.

Technical skills. Technology is intertwined with everyday life, with daily personal and professional use of computers, cell phones, PDAs, and software programs. Organizations often have a need to train employees on new technologies being used. Simon and Werner (1996) note that computer literacy is a concern for most organizations and that many employees express anxiety about technology upgrades in their organizations because of the fear they will not know how to operate the new technology. Behavior modeling training has been used in a number of organizations for computer training, training on new software, and training for new technologies being implemented in the organization.

When training employees on new computer software, the demonstration phase usually consists of trainers performing tasks step-by-step in the program with trainees observing either on the computer monitor or on a projected screen (Simon & Werner, 1996; Chou, 2001). After demonstration, trainees attempt the tasks on their own computers. Using this type of demonstration method, Chou (2001) found that BMT was “superior with respect to learning performance and computer-efficacy” (p. 67). Similarly, Simon and Werner (1996) found that BMT was the most effective training strategy over instruction and free exploration when training Naval members on a new data processing system. Specifically, trainees “learned more than other trainees, did best at demonstrating the skills taught in training in a hands-on test, and were most satisfied with the computer system” (Simon & Werner, 1996, p. 655). See the work of Yi and Davis (2003; 2001; Davis & Yi, 2004) for further examples of BMT applications to computer skills training.

Interpersonal skills. Burnaska (1976) claims that the first use of behavior modeling training for interpersonal skills was in 1970 at General Electric, where they trained employees how to “give constructive criticism, how to ask and give help, and how to establish mutual trust and respect” (p. 329). They found BMT to be an effective training tool in transferring these skills to the workplace and by decreasing the previously high turnover rate. With the success of the first round of training, they expanded BMT to other employees, training on how to handle interactions with coworkers and supervisors. General Electric had immense success with BMT, and Burnaska’s (1976) own study found that trainees who participated in BMT had significant increases in their interpersonal skills. BMT has also successfully been used to train supervisory skills such as how to coach employees (Decker, 1982), handle employee complaints and avoid conflict (Decker, 1982; Harrison, 1992), communicate effectively with subordinates (Moses & Richard, 1976), and practice group orientation (Harrison, 1992). Most BMT training for interpersonal skills consists of viewing a video recording or an instructor role-play of the behaviors to be learned during the demonstration phase. When training interpersonal skills, however, the goal is not for trainees to simply model the observed behaviors, but to have a set of rules that are generalizable to diverse circumstances (Baldwin, 1992). When using mixed models (i.e., models of correct and incorrect performance) during BMT, research has found that trainees are significantly more likely to generalize learned behaviors in different situations (Baldwin, 1992; Decker, 1984).

No matter the skill being trained, the success of behavior modeling training relies on the demonstration of behaviors to trainees. In learning technical skills, trainees are presented with demonstrations of positive behavior so that they will replicate the behaviors on the job. When training interpersonal skills, trainers demonstrate both positive and negative behaviors so that trainees learn acceptable behaviors and can generalize to the situation. In both situations, the effectiveness of the demonstration is related to declarative knowledge that trainees gain and transfer of training to the job. In the following section, we develop a definition and typology of demonstrations for the purposes of training based in large part from the observational learning and BMT literatures.

Multimedia Learning

A number of theories of multimedia learning and the successful factors thereof have been proposed. It is generally understood that multimedia learning consists of both media and method, which can be combined in different ways to produce a desired learning outcome (Moreno, 2006). Multimedia learning principles have been applied specifically to observational learning. One study revealed that observational learning could not only be achieved by pre-recorded sessions showing student/teacher interactions, but that this learning would be more effective than learning solely from the provision of information such as reading materials (Cox, McKendree, Tobin, Lee, & Mayes, 1999). Multimedia can therefore be an instrument to re-use successful teaching sessions and provide “vicarious” learning to future learners. Similarly, Renkl’s examination of “worked-out examples” in multimedia shows that learners not only prefer this sort of teaching, but also may experience superior learning outcomes (Renkl, 2005). Such techniques mirror the approach of demonstrative learning, as they are effectively different means by which to access a demonstration. More generally, the multimedia principles collected in research state that students learn better from words and pictures than from words alone, and that spatial contiguity, temporal contiguity, coherence, and redundancy are all keys to the success of multimedia (Mayer, 2005). In the following sections, we briefly discuss three themes within the multimedia learning research literature.

Motivation. One oft-touted benefit of a multimedia learning tool is the enhanced motivation that it can engender in learners. Interestingly enough, this proposition appears to be empirically validated, and numerous models have sprung up to attempt to explain the motivational effects of a multimedia tool (Mayer, 2007; Wiesner & Astleitner, 2004). Ignoring the complexity of cognitive models to explain the effects of a multimedia learning tool, there are numerous validated design principles that predict the factors of a tool’s success. For example, four strongly indicated factors of motivational success are challenge, curiosity, control, and fantasy (Malone & Lepper, 1987). The implementation of some or all of these components is critical to the success of a multimedia learning tool. For the purposes of a demonstration-based tool, control and fantasy may not be reasonably achievable. Curiosity, however, is an intuitively key component to learning (Garris, Ahlers, & Driskell, 2002) and of even greater importance in a demonstrative setting. Beyond the basic motivational factors inherent to a multimedia learning tool, the access to multiple modalities may provide learners with further advantages.

Modality & individual differences. The modality of a multimedia demonstration has been examined in view of traditional attentional resource theories. Cognitive load is optimized when a visual demonstration is paired with audio explanation, as opposed to visual explanation through written text (Wouters, Paas, & van Merriënboer, 2004). Though there is some debate over the actual degree of necessity in balancing modalities (Mayer, 2007), empirical evidence suggests that it is more beneficial to follow these attentional resource guidelines (Wouters, Paas, & van Merriënboer, 2004). Modality also has bearing when considering the potential differences between learning styles: where some learners may succeed when ideas are presented textually, others require visual aids or auditory enhancement.

Distributed Learning technologies. While their use overcomes the logistical challenges provided by distance, distributed multimedia learning tools present an additional difficulty to observational learning: the hindrance of disembodied observation. Indirect observation in a virtual space may not provide viewers with enough understanding of the actions of others to engender observational learning (Dyck, Pinelle, Brown, & Gutwin, 2003). However, avatar-based presentations can provide a full view of action representation from which viewers can glean complete process knowledge. Additionally, remote desktop technology such as Virtual Network Computing (VNC) allows learners to view complete task processes on another users' system (Dyck, Pinelle, Brown, & Gutwin, 2003).

In sum, there are three main threads of basic and applied research with particular significance for demonstration-based learning: observational learning, behavior modeling training (BMT), and multimedia learning. The central theoretical rationale for understanding the use of demonstration for the purposes of training comes from Bandura's (1986) social cognitive theory. Bandura describes four observational learning processes: 1) attention (whereby people must actively process what they are observing in order to learn), 2) retention (wherein what is observed must be stored symbolically in order to affect future behavior), 3) production (whereby the stored symbolic knowledge must be reconverted into overt actions), and 4) motivation (whereby the perceived consequences of performing the observed behavior must be favorable enough to strengthen the likelihood of future performance). Additionally, behavior modeling training is a robust literature base dealing with the applications of observational learning to training in organizations. Multimedia learning provides theoretically grounded and empirically evaluated principles for designing the content of a demonstration (i.e., arranging text, audio, and graphics so that learning is maximized). Each of these lines of research makes significant, yet incomplete, contributions to an understanding of demonstration-based training. The typology of demonstrations presented in the following section provides a means for organizing the implications of these theoretical approaches as well as the existing empirical findings.

A Typology of Demonstrations

Figure 1 illustrates the proposed typology of demonstrations. This framework is not intended to serve as a classification scheme for any one demonstration; that is, the categories presented represent classes of features that can be included within a demonstration. Any one demonstration may (and likely will) have features from more than one category. This framework is intended to organize the world of possibilities, provide a common language for discussing demonstrations, organize the literature for practical aims, and to provide guidance for future research (e.g., identifying which possibilities have and have not been subjected to systematic research).

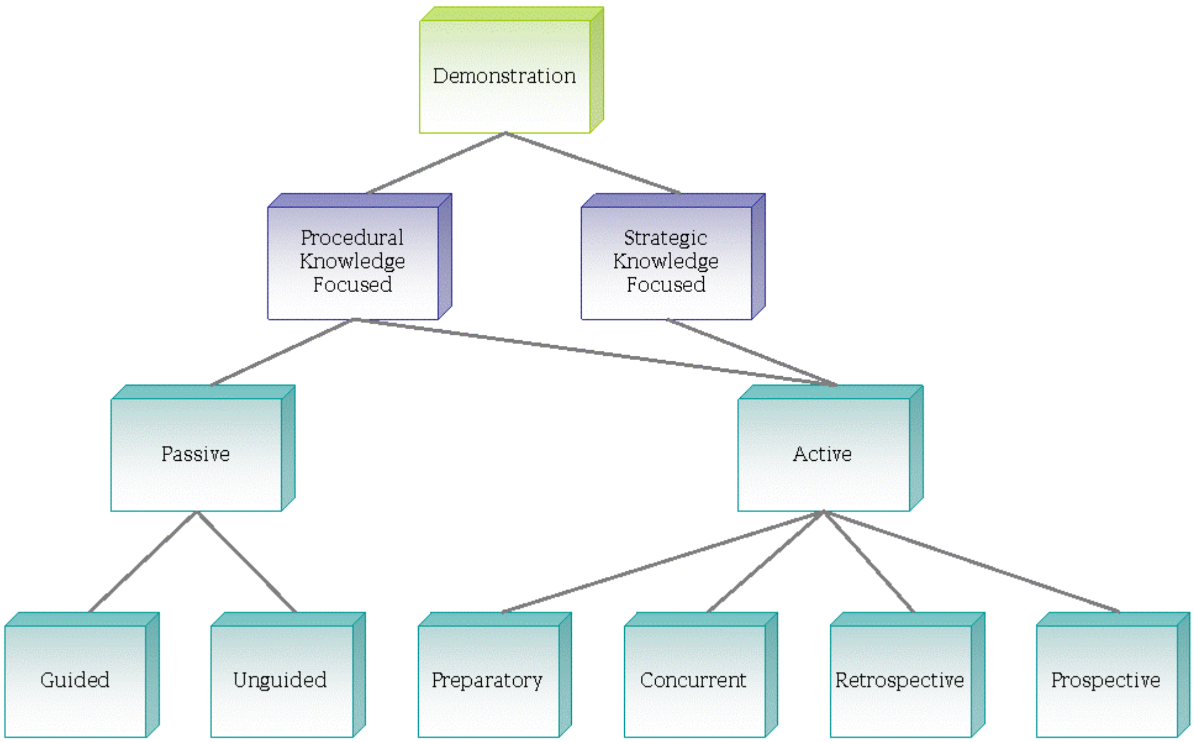

Figure 1. Typology of demonstrations for simulation-based training.

The typology proposed here incorporates two central factors. The first factor is the *type of knowledge* which the demonstration is intended to impart in the learner (i.e., procedural or strategic). This distinction is more a matter of intention on the part of the training designer, and not the demonstration itself. However, it is useful to include this in a typology of demonstrations because, as we will describe later, various characteristics of a demonstration will make it more or less suitable for developing either strategic or procedural knowledge in the learner. The second factor included in the typology is the *type of activity or information* given to the learner in addition to the task of simple observation. These activities are components of the overall demonstration that take place either before, during, or after the observation of task performance. They are intended to maximize learning during observation; this occurs when the information or activity increases the effectiveness of one or more of the four observational learning processes proposed by Bandura (1986)—attention, retention, production, and motivation. In a general sense, it is useful to think of these activities as promoting learning by inducing deeper levels of transfer appropriate processing in the observer (Craik & Lockhart, 1972; Bransford et al., 1977). We now discuss each of these two factors in more detail as well as the lower level components of the conceptual framework.

Type of Knowledge Focus

It is useful to distinguish between three types of knowledge for the present purposes: declarative, procedural, and strategic. Declarative knowledge is essentially the 'what' knowledge (Baddeley, 1997); that is, it consists of discrete factual information and includes such things as knowledge about an overall system, equipment, task goals, and relations between these things. Declarative knowledge is most readily acquired during the information component of training and therefore is not considered a primary focus of demonstrations. Procedural knowledge is 'how-to' knowledge; it involves knowledge about the sequences of actions involved in task performance (Willingham et al., 1989). Performing a 'document merge' in a word processor is an example of a task dependent upon procedural knowledge; it is a rehearsed and static sequence of behaviors performed to reach a task goal. Evidence from category learning studies suggests that the acquisition of declarative and procedural knowledge are mediated by different cognitive systems (Ashby et al., 2003; Maddox et al., 2004); however, learning in one system can influence learning in the other (Willingham et al., 1989). Strategic knowledge has been explained as 'how-to-know-when-to-do-what' knowledge (Kontogiannis & Shepherd, 1999) and is generally associated with problem solving. Strategic knowledge involves learning aspects of the task that are not specific to one context; that is, it involves learning strategies about how components of the task can be rearranged to fit more than one situation as well as understanding when and why this alteration of procedure needs to occur (Doane et al., 1996). Benaroch (2001) describes strategic knowledge in the context of system control in terms of two features: subgoaling knowledge (i.e., knowledge used to dynamically identify a set of goals for a specific nonroutine event or problem), and goal-sequencing knowledge (i.e., knowledge about how and when to pursue each of the goals at a given time). Continuing the example from above, strategic knowledge is required for an office worker to decide when merging documents is the correct procedure to implement versus some other tactic such as manually cutting and pasting portions of one document into another. Demonstrations are most readily associated with the development of procedural knowledge. In fact, demonstrations are illustrations of how to perform a specific task; however, with the addition of activities designed to guide learners through reasoning about the example of performance, strategic knowledge can be acquired through demonstrations more readily as well.

Procedural knowledge focused demonstrations are those demonstrations designed for the acquisition of simple procedures (i.e., a standard sequence of actions required for task performance). The more structured and consistent the task being trained is, the more likely the demonstration is to be procedurally oriented. For example, a procedural knowledge focused demonstration would be appropriate for training to use the safety features of machinery when the procedure for use is always performed in the same manner (Rubinsky & Smith, 1973). Additionally, applications of BMT to training technical skills (such as computer skills) provide examples of procedural knowledge focused demonstrations. Learning basic computer skills largely entails learning multiple sets of behavioral sequences. However, as skill-levels increase, the focus of instruction may shift to knowledge about when to use which task strategy or how to adapt strategies to changing conditions.

Strategic knowledge focused demonstrations are those demonstrations designed for the acquisition of more complex knowledge and skills that are applicable over a wider variety of contexts than those presented in the example. Because any one example illustrates only one sequence of actions, two approaches can be taken to creating demonstrations that focus on strategic knowledge. First, multiple examples can be provided that depict how task procedures should change in different contexts (Baldwin, 1992). Second, activities and information can be included in the demonstration that fosters deeper processing of the content. For example, our definition of a demonstration includes the 'characteristics of the task environment' as a reasonable focus for the content of a demonstration. Viewing examples of road side conditions can improve a driver's ability to make decisions (Ferrari, 1996). This is a skill much different than the procedural knowledge required to drive a vehicle (e.g., the steps involved in changing lanes on a highway). In fact, there is no procedural content in such a demonstration; an example of road side conditions does not include any information about how an individual operates an automobile. Viewing characteristics of the task environment can help a learner develop skills concerning when to apply which procedures and how to adapt procedures given different circumstances (e.g., under different road conditions, what do you do or how would you change what you normally do?). This, of course, is effective only after the learner has acquired the basic procedural skills of driving. Another example of strategic knowledge focused demonstrations comes from the discussion of BMT applications to interpersonal skills training. The goal of such training is not the inculcation of a static procedure, but the ability to adaptively and dynamically interact successfully with others.

Type of Activity or Information Incorporated into the Demonstration

The typology of demonstrations has two high level categories concerning the types of activities and information provided in the demonstration. First, *passive demonstrations* do not require any activity on the part of the learner outside of the act of observing. These are by far the most frequently encountered demonstrations in day to day life and training programs. Passive demonstrations rely entirely on the content of the example and sometimes guiding information to focus the attention of the learner, but do not incorporate any directions that require action (behavioral or cognitive) on the part of the learner. *Active demonstrations* impose demands on the learners outside of passively observing an example of task performance. Active demonstrations go beyond just providing more information to the learner (as in a passive guided demonstration described below). Active demonstrations require the learner to engage in activities designed to increase the retention of knowledge and transfer of skill. Each of the categories of passive and active demonstrations is described in more detail below.

Passive-unguided. Passive-unguided demonstrations are the simplest of all cases. Here, learners are given no requirements or information outside of that present in the example of task performance or task environment characteristics. A common instance of this is the pre-flight demonstration of seat belt usage on aircrafts by flight attendants. Aside from being told to watch the flight attendant (information about where to see the demonstration, not where to focus attention within the demonstration), learners are given no direction. Because no efforts are made on the part of the instructional designer to focus attention or to boost the motivation level of the learner, the results of passive-unguided demonstrations can be highly varied (e.g., Austin & Laurence, 1992; Berry, 1991; Blandin & Proteau, 2000). For example, in comparison to text only instructions, demonstrations usually are more effective for immediate performance but skill degrades much more quickly (e.g., Palmiter & Elkerton, 1993). The consensus explanation for this is that passive demonstrations do not require learners to process the content to the same depth as other formats. This illustrates the need to include demonstration features that increase the attention, retention, production, and motivation processes of the learner. As the effectiveness of a passive-unguided demonstration is dependent entirely upon the content of the example, the guidelines involve means of organizing and manipulating the content and presentation of the example. This can be thought of as the 'core' of the demonstration, and following types and guidelines offer means of augmenting the effectiveness of a well designed example with further information and activities.

Passive-guided. Passive demonstrations can also be guided. That is, learners can be given pre-demonstration information intended to increase learning. This pre-demonstration information is intended to either focus attention during the demonstration (e.g., giving advice on what to attend to) or to increase the level of motivation in the learner (e.g., explanations of why learning the demonstrated skill is useful/necessary). A common tool for passive-guided demonstrations involves providing attentional advice on what is most important to attend to in the demonstration. This is often achieved by providing instructions to the learner before observations (Jentsch et al., 2001). Additionally, applications of BMT often include the provision of learning points before viewing an example of performance (Decker & Nathan, 1985). This helps observers to identify and attend to the targeted KSA's.

Active-preparatory. Active-preparatory demonstrations provide activities and information to the learner before viewing the example. These activities are designed to orient and focus the learner for the observation experience to come. These active-preparatory demonstrations go beyond passive-guided demonstrations that merely provide information. Active-preparatory activities require that the learners perform certain tasks. Many tools have been developed for active-preparatory demonstrations including the prompted use of imagery to increase motivation (Cumming et al., 2005), instruction on hierarchical encoding (Hard, Lozano, & Tversky, 2006), instruction on self-regulatory skills for observation, goal setting, and perceived self-efficacy (Ferrari, 1996).

Active-concurrent. In addition to pre-demonstration activities, demands can be placed on learners during a demonstration. Active-concurrent demonstrations require that the learner engage in specific activities while they are viewing the demonstration. Examples of active-concurrent demonstrations include note taking, and perspective taking exercises where learners decompose an example into action units and describe them from multiple perspectives (Lozano et al., 2006). Care must be taken not to overload the learner. The concurrent task must not limit their ability to focus attention on the demonstration, it should enhance this.

Active-retrospective. Retrospective demonstration activities are performed after viewing a demonstration and focus the learner on the aspects of the demonstration that has just occurred. Examples of this include the use of symbolic mental rehearsal to create links between visual images and symbolic memory codes (Davis & Yi, 2004), learner-generated learning points (Decker, 1984) and rule codes (Hogan et al., 1986). Group discussion of the example has been shown to relate to the acquisition of complex skills (Johnson et al., 1985). Research on open ended group discussion during skill acquisition showed increased learning and revealed that group discussions of this type have three main orientations: giving advice, making social comparisons, and motivation (Prislin et al., 1996). This suggests that providing a trainer guided discussion of the example can increase learning by focusing the attention of the learners on the targeted KSA's, prompting mental rehearsal, and increasing motivation levels in the learner. Such activities would be classified as retrospective because they focus the learner on the content of the example just previously viewed.

Active-prospective. Active-prospective demonstration activities take place after the demonstration has occurred and focus the learner on how the example of performance can be applied to other contexts. Examples of active-prospective demonstration activities include goal setting exercises where the learner formally describes how what they have learned will be applied (Lathan & Saari, 1979; Russell et al., 1984), the generation of rule codes and learning points targeted at application to other domains or task contexts (Taylor et al., 2005), and activities where the learner generates their own practice scenarios (Robinson, 1982; Wexley & Latham, 2002). Active-prospective activities focus on transferring the skills learned in training to the work context by having the learner consider how, why and when the KSA's targeted for training should be used in the workplace or how they can be further developed.

What Works? Guidelines and Best Practices So Far

It is generally accepted that demonstrations are an effective component of training programs, but little in the way of theoretically and empirically based guidelines are available for practitioners seeking to develop demonstrations that maximize the utility of time spent viewing demonstrations. If practice, in and of itself, does not necessarily provide for learning (i.e., practice alone may not improve performance, and in fact may have the opposite affect if negative forms of performance are reinforced; Salas, Wilson, Burke, & Bowers, 2002), then the same likely holds for the demonstration component of training. Similarly, the equivocal empirical findings from related research topics (e.g., observational learning, behavior modeling training) suggest that the effectiveness of demonstrations depends upon interrelationships between features of the demonstration, the learner, and the larger training system. Demonstrations must be effectively engineered in order to reach desired learning outcomes.

Guidelines

The tentative conclusion drawn from the literature pertaining to demonstrations for the purposes of training is that there are few readily accessible answers to the questions of what makes a good demonstration or how to best incorporate demonstrations into the broader training system. Although demonstration has been relatively neglected by researchers within training, learning through observation has received large amounts of attention in other research communities. However, much of the existing related research concerns tasks that are more abstract and simple (e.g., generic laboratory tasks) than the types of tasks organizations generally choose to train. Given these limitations, we provide a set of empirically based guidelines.

Guideline 1: The KSA's targeted for demonstration-based training must be perceivable by the learner. A variation of this guideline was offered by Burwitz (1975), whose primary intent was to communicate the need to ensure that the enactment of the KSA's was visible (or audible) in the example of performance provided. This is no doubt fundamental to the effectiveness of the demonstration. Just as scenarios are the curriculum for SBT (i.e., the practice activity is the curriculum), the example is the curriculum for demonstration-based learning. The example of performance must contain the targeted KSA's in a perceivable and comprehendible form. This means that learner's must be able to recognize the targeted KSA's. Jentsch and colleagues (2001) have shown that the level of expertise of the observer is critical to his/her ability to identify critical behaviors in modeling displays. Therefore, when choosing content for demonstrations, the skill levels of the intended learners must be considered in order to maximize attentional processes of the observer.

Guideline 2: The KSA's targeted for demonstration-based training must be commensurate with the intended learner's skill level. The content of the demonstration must be within the learner's behavioral repertoire; that is, even though the demonstration is guiding the observer through the acquisition of new KSA's, these KSA's must be within a reasonable range of the learner's current abilities. Otherwise, the use of demonstration may be less effective than task practice alone. For example, in studies of motor learning it has been found that when observers lack the physical skills to imitate a model's performance strategies, they perform worse than learners in control groups who simply practice the task (Kohl & Shea, 1992; Martens, Burwitz, & Zuckerman, 1976). If the demonstration content exceeds the observer's capacity to perform, it provides an ineffective model of task performance and self-evaluation. Therefore, when choosing demonstration content, a scaffolding approach may be taken in order to build lower level skills before addressing performance strategies outside the skill level of the intended observer to maximize the production processes of the learner.

Guideline 3: Direct the learner's attention to the cues relevant to learning. As discussed in the descriptions of passive-guided and active-preparatory demonstrations, there are many options available to guide the learner's attention through instructions and activities provided before observation occurs (e.g., Lumsdaine, 1961; Miller, 1972). Guiding the learner's attention can also be achieved during a demonstration through such techniques as instructional narratives (discussed below) and visual or auditory cues that make the targeted KSA's more salient than they normally would be (Mayer, 2001).

Guideline 4: Use instructional narratives to make covert aspects of performance accessible to learners. The use of instructional narratives both during and prior to observation of an example have been shown to increase learning outcomes (Jaspen, 1950; Lauret, 1999; Lumsdaine, 1961; Miller, 1972). Instructional narratives are a means of focusing the learner's attention on salient aspects of the example of performance. Additionally, narratives can be used to model covert cognitive aspects of performance (Bandura, 1986). That is, in complex task environments the physically observables of what a person is doing is often less important than the reasons that person is performing the specific physical behaviors. Instructional narratives can be used to make these covert reasoning processes readily accessible to the observer. Therefore, when creating demonstrations of primarily cognitive task performance, having a 'think aloud' narrative provides access to the targeted KSA's that otherwise remain unobservable.

Guideline 5: Present learning points as rule codes, as opposed to behavior summaries. Decker (1982) defined learning points as "the written description of the key behaviors seen performed by the model" (p. 324). Learning points are presented prior to demonstration to inform trainees of the behaviors they will be learning about, practicing, and performing (Decker & Nathan, 1985; Mann & Decker, 1984; Soffey & Reilly, 1997; Taylor, Russ-Eft, & Chan, 2005). They are useful because they help trainees attend to the model's key behaviors (Decker, 1982).

Learning points can be presented in two ways: as rule codes or behavior descriptions. Rule codes "describe the rules underlying the model's behavior" while behavior descriptions just "describe the model's actual behavior" (Decker, 1982, p. 325). Usually learning points are presented as behavior descriptions (i.e., "greets cheerfully" or "provides information"). Research has found, however, rule codes are more effective. Learning points that describe behaviors result in reproduction but not generalization, whereas rule codes enhance generalization. For example, the rule code of "Listen and respond with empathy to reduce defensiveness" is more useful than the behavior description of "Listens empathetically" (Taylor, Russ-Eft, & Chan, 2005, p. 694).

Another example of rule codes is provided by Soffey and Reilly (1997), who offered these five rule codes when training employees to become active participants in their own performance appraisal process. Those rule codes are as follows- "(1) listen openly to how your rater establishes the framework for an appraisal discussion and his/her comments; (2) if it is not clear to you, ask your rater to use a framework of strengths, performance improvement needs and criteria; (3) probe generalizations and inferences by asking for examples where you do not understand or agree with a point; (4) summarize your understanding of where you feel you could improve and ask for his/her suggestions; and (5) discuss your strengths and how to build on them" (p. 224). Rule codes are superior to behavior summaries or descriptions because they help trainees generalize their skills to many situations.

Guideline 6: Encourage trainees to develop their own rule codes. Usually prior to the demonstration phase of training, trainers present a list of learning points to trainees. Research has found that trainees have even greater performance and are better able to generalize across situations when they are involved in the development of rule codes (Hogan, Hakey, and Decker, 1986; Decker, 1980, 1982). In an experiment training supervisors on conflict management skills, Decker (1982) presented trainees with a list of rule codes- "1) focus on the problem, not the person; 2) ask for his/her suggestions and discuss his/her ideas on how to solve the problem; 3) listen openly; 4) ask for his/her expectations about a solution to the problem; and 5) agree on specific steps to be taken and specific deadlines" (p. 327). The participants then identified rule codes as the model was being presented, and afterwards were told to rewrite or add to the codes if they felt this would be useful. Trainees that reworded the existing rule codes and developed new rule codes had higher generalization scores. Hogan, Hakey, and Decker (1986) suggest for trainers to develop and present a few rule codes, as a starting point, and then ask trainees to reword existing rule codes and add to the list. This could be done before or after the demonstration phase of training.

Guideline 7: Utilize mixed models, as opposed to positive-only models, to display both positive and negative behaviors and outcomes. During the demonstration phase, trainers use models to demonstrate behaviors to trainees. Generally these models are only positive, providing an example of the correct behaviors to achieve a goal. Researchers note, however, that these positive-only models often become redundant and unrealistic due to their lack of variability

(Baldwin, 1992). While this consistency is appropriate for some training programs, such as training technical skills, it is not suitable for interpersonal skills training. When training interpersonal skills, the goal is not for trainees to precisely reproduce the behaviors taught to them but to "inculcate generalizable rules or concepts, specifying a class of behaviors to be used when certain stimuli are present" (Baldwin, 1992, p. 147). Using mixed models, or positive and negative models, helps trainees to better generalize to many different situations (Baldwin, 1992) and accounts for greater transfer of training (Taylor, Russ-Eft, & Chan, 2005). Additionally, observers are better able to recognize key behaviors in incorrect versus correct examples of performance (Jentsch et al., 2001).

Guideline 8: Show the consequences of behaviors. Observers are more likely to recognize the key behaviors in an example of performance when the consequences of the behavior were shown, especially for examples of incorrect performance (Jentsch et al., 2001). Therefore, when designing demonstrations, the consequences of the correct and incorrect enactment of targeted KSA's should be shown. This increases the attentional processes of the learner by making the critical behaviors more salient.

Guideline 9: Ensure that visualizations of performance are performed by individuals perceived as experts or high in social status by the intended learners. The social status of the model (the person exhibiting performance in the demonstration) has been found to be an important determinant of the success of the demonstration. McCullagh (1986) found that individuals viewing demonstrations performed by high-status individuals had higher levels of performance (but not of knowledge retained) than did individuals viewing demonstrations of performed by lower-status individuals. This indicates that the social status of the model increases the production processes of the learner (likely through increasing motivation to perform). Therefore, when relevant, examples where the individuals are performing the targeted KSA's should utilize high social status models (Jentsch et al., 2001; McCullagh, 1986). This increases production and motivation processes in the observer.

Guideline 10: Instruct learners to create their own scenarios in which to rehearse behaviors. When rehearsing behaviors, trainers generally develop a series of situations in which trainees practice. By allowing trainees to develop their own scenarios in which to practice, trainees take examples from their actual work experiences and have greater training transfer to their specific job or role because their learning experience is more authentic (Taylor, Russ-Eft, & Chan, 2005). Instructor created scenarios, which possibly better planned, may not be as authentic. Additionally, trainees will have greater self-efficacy due to social reinforcement from the trainer and other trainees after completing the behaviors in their developed scenario (Taylor, Russ-Eft, & Chan, 2005, Tulving & Thompson, 1973).

Guideline 11: Instruct learners to symbolically or mentally rehearse behaviors and skills before physically rehearsing them. After a demonstration, trainees are usually instructed to practice the demonstrated behaviors. Research has shown that by having trainees mentally rehearse behaviors before actually performing them, trainees have an increase in knowledge about the procedure or skill (Taylor, Russ-Eft, & Chan, 2005). Mentally rehearsing behaviors leads to increased declarative knowledge, increased task performance, and better generalization to novel situations (Davis and Yi, 2004; Decker, 1980). Mental rehearsal has been suggested to alter the trainee's knowledge structure, which causes the positive results (Davis & Yi, 2004).

Guideline 12: Encourage learners to set personal goals for using the new skills on the job. Taylor, Russ-Eft, and Chan explain that “goal setting has been found to be an effective posttraining strategy” (Taylor, Russ-Eft, & Chan, 2005, p. 705). After demonstration and practice, trainees should set personal goals to practice the newly learned skills on the job. Trainees that set goals are more likely to perform new skills on the job than trainees who do not set goals (Russell, Wexley, & Hunter, 1984).

The Larger Training Context

In addition to the characteristics outlined above, like simulation-based training in general, the effectiveness of the demonstrations is affected by the larger training context (Hays & Singer, 1989). For example, demonstrations can be (and most frequently are) placed in a more or less linear progression within SBT (see Figure 1). However, demonstrations can be interlaced with practice episodes for increased effectiveness. For example, Shebilske and colleagues (Shebilske, Gildea, Freeman, & Levchuk, 2006; in press) found that demonstrations can be used effectively in iterative cycles of practice and demonstrations of ‘near-optimal’ performance used as feedback. Additionally, Baggett (1987) found that longer term retention was better for individuals who performed practice episodes first and subsequently were shown a demonstration of how to perform the task. There is a need to further explore how to best include demonstrations and practice episodes in the larger training system.

Concluding Remarks

The typology we have just presented serves as an organizational framework for the types of activities that can be incorporated into demonstration-based training to increase the attention, retention, production, and motivation of the learner and ultimately the effectiveness of the training (i.e., better learning outcomes and transfer of training). It is evident that more is known about passive-unguided demonstrations than the other types. Even though there is strong theoretical support and empirical evidence that the other types of demonstrations are effective, there is need for more systematic research and development of methods for maximizing the effectiveness of examples by including additional guiding information and activities. Specifically, future research is needed to provide guidance on the practical issue of understanding how to match the instructional features described in the presented typology to different types of training tasks, trainees, and the larger training and work context.

References

Ashby, F. G., Ell, S. W., & Waldron, E. M. (2003). Procedural learning in perceptual categorization. *Memory & Cognition, 31*(7), 1114-1125.

Astleitner, H., & Wiesner, C. (2004). An integrated model of multimedia learning and motivation. Journal of Educational Multimedia and Hypermedia, 13(1), 3-21.

Austin, S., & Laurence, M. (1992). An empirical study of the SyberVision golf videotape. *Perceptual and Motor Skills, 74*(3, pt 1), 875-881.

Baddeley, A. (1997). *Human Memory: Theory and practice*. New York: Psychology Press.

Baggett, P. (1987). Learning a procedure from multimedia instructions: The effects of film and practice. *Applied Cognitive Psychology, 1*(3), 183-195.

Baldwin, T. T. (1992). Effects of alternative modeling strategies on outcomes of interpersonal-skills training. *Journal of Applied Psychology, 77*(2), 147-154.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Rockville, MD: National Institutes of Mental Health.

Benaroch, M. (2001). Declarative representations of strategic control knowledge. *International Journal of Man-Machine Studies, 55*(6), 881-917.

Berry, D. C. (1991). The role of action in implicit learning. *The Quarterly journal of experimental psychology, 43*(4), 881-906.

Blandin, Y., & Proteau, L. (2000). On the cognitive basis of observational learning: Development of mechanisms for the detection and correction of errors. *The Quarterly Journal of Experimental Psychology, 53A*(3), 846-867.

Bransford, J. D., Franks, J. J., Morris, C. D., & Stein, B. S. (1979). Some general constraints on learning and memory research. In L. S. Cermak & F. I. M. Craik (Eds.), *Levels of processing in human memory* (pp. 331-354). Hillsdale, NJ: Erlbaum.

Chou, H. W. (2001). Effects of training method and computer anxiety on learning performance and self-efficacy. *Computers in human behavior, 17*(1), 51-69.

Cox, R., McKendree, J., Tobin, R., Lee, J., & Mayes, T. (1999). Vicarious learning from dialogue and discourse. *Instructional science, 27*, 431-458.

Craik, F., & Lockhart, R. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior, 11*, 671-684.

Cumming, J., Clark, S.E., Ste-Marie, D.M., McCullagh, P., & Hall, C. (2005). The functions of observational learning questionnaire (FOLQ). *Psychology of sport and exercise, 6*, 517-537.

Davis, F. D., & Yi, M.Y. (2004). Improving computer skill training: Behavior modeling, symbolic mental rehearsal, and the role of knowledge structures. *Journal of Applied Psychology, 89*(3), 509-523.

Decker, P. J. (1980). Effects of symbolic coding and rehearsal in behavior-modeling training. *Journal of Applied Psychology, 65*(6), 627-634.

Decker, P. J. (1982). The enhancement of behavior modeling training of supervisory skills by the inclusion of retention processes. *Personnel Psychology, 35*, 323-332.

Decker, P. J. (1984). Effects of different symbolic coding stimuli in behavior modeling training. *Personnel Psychology, 37*(4), 711-720.

Decker, P. J. & Nathan, B. R. (1985). *Behavior modeling training: Principles and applications*. New York: Praeger.

Dictionary.com. (2006). *Demonstration*. Retrieved 12-28-2006, 2006, from http://dictionary.reference.com/browse/demonstration

Doane, S. M., Alderton, D.L., Sohn, Y.W., & Pellegrino, J.W. (1996). Acquisition and transfer of skilled performance: Are visual discrimination skills stimulus specific? *Journal of Experimental Psychology: Human Perception and Performance, 22*(5), 1218-1248.

Doo, M. Y. (2005). The effects of presentation format for behavior modeling of interpersonal skills in online instruction. *Journal of Educational Multimedia and Hypermedia, 14*(3), 213-235.

Driskell, J. E., Copper, C., & Moran, A. (1994). Does mental practice enhance performance? *Journal of Applied Psychology, 79*(4), 481-492.

Dyck, J., Pinelle, D., Brown, B., & Gutwin, C. (2003). Learning from games: HCI design innovations in entertainment software. In *Proceedings of Graphical Interface 2003*.

Ferrari, M. (1996). Observing the observer: Self-regulation in the observational learning of motor skills. *Developmental review, 16*, 203-240.

Garris, R., Ahlers, R., & Driskell, J. (2002). Games, motivation, and learning: a research and practice model. *Simulation and Gaming*, 33, 441-467.

Goldstein, I. L., & Ford, J.K. (2002). *Training in Organizations: Needs Assessment, Development, and Evaluation* (4th ed.). Belmont, CA: Wadsworth.

Hard, B. M., Lozano, S.C., & Tversky, B. (2006). Hierarchical encoding of behavior: Translating perception into action. *Journal of Experimental Psychology: General, 135*(4), 588-608.

Harrison, J. K. (1992). Individual and combined effects of behavior modeling and the cultural assimilator in cross-cultural management training. *Journal of Applied Psychology, 77*(6), 952-962.

Hays, R. T., & Singer, M.J. (1989). *Simulation Fidelity in Training System Design: Bridging the Gap Between Reality and Training*. New York, NY: Springer-Verlag.

Heyes, C. (2001). Causes and consequences of imitation. *TRENDS in Cognitive Sciences, 5*(6), 253-261.

Hogan, P. M., Hakel, M.D., & Decker, P.J. (1986). Effects of trainee-generated versus trainer-provided rule codes on generalization in behavior-modeling training. *Journal of Applied Psychology, 71*(3), 469-473.

Jentsch, F., Bowers, C., & Salas, E. (2001). What determines whether observers recognize targeted behaviors in modeling displays? *Human Factors, 43*(3), 496-507.

Johnson, R. T., Johnson, D. W., & Stanne, M. B. (1985). Effects of cooperative, competitive, and individualistic goal structures on computer-assisted instruction. *Journal of Educational Psychology, 77*(6), 668-677.

Kontogiannis, T., & Shepherd, A. (1999). Training conditions and strategic aspects of skill transfer in a simulated process control task. *Human-Computer Interaction, 14*, 355-393.

Latham, G. P., & Saari, L. M. (1979). Application of social-learning theory to training supervisors through behavioral modeling. *Journal of Applied Psychology, 64*(3), 239-246.

Lozano, S. C., Hard, B.M., & Tversky, B. (2006). Perspective taking promotes action understanding and learning. *Journal of Experimental Psychology: Human Perception and Performance, 32*(6), 1405-1421.

Lumsdaine, A. A. (1961). *A symposium on experimental studies of cue and response factors in group and individual learning from instructional media*. Washington, DC: National Academy of Sciences--National Research Council.

Maddox, W. T., Bohil, C. J., & Ing, A. D. (2004). Evidence for a procedural-learning-based system in perceptual category learning. *Psychonomic Bulletin & Review, 11*(5), 945-952.

Malone, T. W., & Lepper, M. R. (1987). Making learning fun. A taxonomy of intrinsic motivations for learning. In R. E. Snow & M. J. Farr (eds.), *Aptitude, learning, and instruction. Volume 3: Conative and affective process analyses* (pp. 223-253). Hillsdale, NJ: Lawrence Erlbaum.

Mann, R. B., & Decker, P.J. (1984). The effect of key behavior distinctiveness on generalization and recall in behavior modeling training. *Academy of management journal, 27*(4), 900-910.

Mayer, R. E. (Ed.). (2005). *The Cambridge Handbook of Multimedia Learning*. Cambridge, UK: Cambridge University Press.

McCullagh, P. (1986). Model status as a determinant of observational learning and performance. *Journal of Sport Psychology, 8*(4), 319-331.

Moreno, R. (2006). Learning in high-tech and multimedia environments. *Current directions in psychological science, 15(2)*, 63-67.

Moses, J. L. & Ritchie, R. J. (1976). Supervisory relationships training: A behavioral evaluation of a behavior modeling program. *Personnel Psychology, 29,* 337-343.

Palmiter, S. L., & Elkerton, J. (1993). Animated demonstrations for learning procedural computer-based tasks. *Human-Computer Interaction, 8*, 193-216.

Petrosini, L., Graziano, A., Mandolesi, L., Neri, P., Molinari, M., & Leggio, M.G. (2003). Watch how to do it! New advances in learning by observation. *Brain Research Reviews, 42,* 252-264.

Prislin, R., Jordan, J. A., Worchel, S., Tschan Semmer, F., & Shebilske, W. L. (1996). Effects of group discussion on acquisition of complex skills. *Human Factors, 38*(3), 404-416.

Renkl, A. (2005). The worked-out examples principle in multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 229-245). New York, NY: Cambridge University Press.

Rizzolatti, G., & Craighero, L. (2004). The mirror-neuron system. *Annual Review of Neuroscience, 27,* 169-192.

Robinson, J. C. (1982). *Developing managers through behavior modeling*. San Diego, CA: Learning Concepts.

Rubinsky, S., & Smith, N. (1973). Safety training by accident simulation. *Journal of Applied Psychology, 57*(1), 68-73.

Russell, J. S., Wexley, K. N., & Hunter, J. E. (1984). Questioning the effectiveness of behavior modeling training in an industrial setting. *Personnel Psychology, 37,* 465-481.

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

Salas, E., Wilson, K.A., Burke, C.S., & Bowers, C.A. (2002). Myths about Crew Resource Management Training. *Ergonomics in Design, 10*(4), 20-24.

Shlechter, T. M., & Anthony, J. (1996). *An Examination of the value of demonstration tapes for the virtual training program* (No. 1688). Fort Knox, KY: US Army Research Institute for the Behavioral and Social Sciences.

Scully, D. M., & Newell, K.M. (1985). Observational learning and the acquisition of motor skills: Toward a visual perception perspective. *Journal of Human Movement Studies, 13,* 33-47.

Scully, D., & Carnegie, E. (1998). Observational learning in motor skill acquisition: A look at demonstration. *Irish Journal of Psychology, 19*(4), 472-485.

Shebilske, W., Gildea, K., Freeman, J., & Levchuk, G. (2006). *A Benchmarked Experiential System for Training (BEST) and Dynamic Systems Theory*. Paper presented at the 50th Annual Meeting of the Human Factors and Ergonomics Society.

Simon, S. J., Werner, J.M. (1996). Computer training through behavior modeling, self-paced, and instructional approaches: A field experiment. *Journal of Applied Psychology, 81*(6), 648-659.

Stoffey, R. W. & Reilly, R. R. (1997). Training appraisees to participate in appraisal: Effects on appraisers and appraisees. *Journal of Business and Psychology, 12*(2), 219-239.

Tannenbaum, S. I., & Yukl, G. (1992). Training and development in work organizations. *Annual Review of Psychology, 43,* 399-441.

Taylor, P. J., Russ-Eft, D.F., & Chan, D.W.L. (2005). A Meta-analytic Review of Behavior Modeling Training. *Journal of Applied Psychology, 90*(4), 692-709.

Tulving, E. & Thompson, D. M. (1973). Encoding specificity and retrieval processes in episodic memory. *Psychological Review, 80,* 352-373.

Wexley, K. N., & Latham, G. P. (2002). *Developing and training human resources in organizations*. Upper Saddle River, NJ: Prentice Hall.

Wiktionary. (2006). *Demonstration*. Retrieved 12-28-2006, 2006, from http://en.wiktionary.org/wiki/demonstration

Williams, A. M., Davids, K., & Williams, J.G. (1999). *Visual perception and action in sport*. London: Spon.

Willingham, D. B., Nissen, M. J., & Bullemer, P. (1989). On the development of procedural knowledge. *Journal of Experimental Psychology: Human Learning & Memory, 15*(6), 1047-1060.

Wouters, P., Paas, F., & van Merriënboer, J. F. (2004). *Observational learning from animated expert models*. University of the Netherlands Educational Technology Expertise Centre.

Yi, M. Y., & Davis, F.D. (2003). Developing and validating an Observational Learning Model of Computer Software Training and Skill Acquisition. *Information Systems Research, 14*(2), 146-169.