A Theoretical Framework for Simulation in Nursing: Answering Schiavenato’s Call

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ABSTRACT

The aim of this article was to provide a response that supports and extends Schiavenato’s call for a theoretically guided approach to simulation use in nursing education. We propose that a theoretical framework for simulation in nursing must first include, as a basis, a theoretical understanding of human performance and how it is enhanced. This understanding will, in turn, allow theorists to provide a framework regarding the utility, application, and design of the training environment, including internal and external validity. The expert performance approach, a technique that recently has been termed Expert-Performance-based Training (ExPerT), is introduced as a guiding framework for addressing these training needs. We also describe how the theory of deliberate practice within the framework of ExPerT can be useful for developing effective training methods in health care domains and highlight examples of how deliberate practice has been successfully applied to the training of psychomotor and cognitive skills.

This article aimed to provide a response that supports and extends Schiavenato’s (2009) call for a theoretically guided approach to simulation use in nursing education. Schiavenato asked nurse educators to clearly articulate their reasons for using simulation as a training tool. He argued that although some educators’ reasons were appropriate (e.g., patient safety, decreased training opportunities), the availability of simulation and current trends were insufficient motivations to warrant its use (Ward, Williams, & Hancock, 2006). Due to the lack of empirical studies validating the effectiveness of simulation methods and systems as a training tool, Schiavenato also expressed concern that simulation itself had become synonymous with high-fidelity or manikin-based systems (particularly high-priced proprietary systems).

We propose that a theoretical framework for simulation in nursing must first include, as a basis, a theoretical understanding of human performance and how it is enhanced. This understanding will, in turn, allow theorists to provide a framework regarding the utility, application, and design of the training environment, including an assessment of the level of internal and external validity attained. Ultimately, the proposed framework will allow continual refining of both theory and application.

In this article, we first briefly describe the debate surrounding the use of simulation in health care. We next outline the theory of deliberate practice and its role in improving human performance. A case is then made for the need to also understand the “how” and the “what” of training, in addition to the “why.” We then introduce the expert performance approach (Ericsson & Smith, 1991) as a guiding framework for addressing these needs. Following this introduction, we discuss how the expert performance approach has been adopted specifically as a means for deriving training—a method that recently has been termed Expert-Performance-based Training (ExPerT; Ward, Suss, & Basevitch, 2009). Finally, we describe how the theory of deliberate practice and the ExPerT method can be effective for developing approaches to training in health care domains and highlight examples of how deliberate practice has been successfully applied to the training of both psychomotor and cognitive skills.
The development of simulation in health care parallels the introduction of flight simulators in aviation approximately 30 years ago (Issenberg et al., 1999; Schiavenato, 2009; Scott, 2006; Tsuda, Scott, Doyle, & Jones, 2009). The current debate regarding the usefulness, and ultimately the status, of simulation in health care also mirrors the debates regarding aviation simulation. Key debated issues regarding simulation in health care include the cost associated with acquiring high-tech simulation systems, with startup costs for simulation centers running as high as $3 million (Kapadia, DaRosa, MacRae, & Dunnington, 2007), and the corresponding dearth of empirical studies validating simulation as a training tool (Schiavenato, 2009).

This concern mirrors an early belief and subsequent criticism of simulation in aviation. Specifically, a given amount of time spent in simulation is assumed to lead to a given level of improvement, regardless of other considerations. Moreover, when time spent in a simulator failed to result in any discernible changes in skill or performance, critics attributed this failure to the ineffectiveness of the simulator rather than to the content of the simulation training itself. Despite some criticism of the effectiveness of some simulation systems (related to training), time spent in an aircraft simulator is now considered equivalent to time spent in actual flight, and pilots are required to log time in simulators to qualify for the certifications needed to pilot an aircraft (Trunkey & Botney, 2001; Tsuda et al., 2009). Similar requirements for competency assessment are now beginning to be discussed and, in some cases, implemented in health care domains (Tsuda et al., 2009).

The current situation in health care is ripe for similar misunderstandings, without a framework for evaluating the effectiveness of simulation. For instance, Korn dorffer, Stefanidis, and Scott (2006) reported that although nearly half of the 253 surgical residency programs in the United States had simulation centers, only approximately one quarter of them had mandatory program requirements. A separate report of 36 skills laboratories indicated that approximately one third of these laboratories did not have a documented curriculum (Kapadia et al., 2007; Tsuda et al., 2009). These numbers are unfortunate, given that the effectiveness of simulation training is intricately tied to how the simulation is implemented (i.e., how it is used). Without appropriate frameworks guiding curriculum development and refinement, and ultimately assessment, educators are at risk of allowing trainees to just “go through” the simulations. Passive participation in simulation, or “going through the motions,” is often ineffective for developing performance (Ward et al., 2006).

Unfortunately, as the lack of a specified curriculum for many simulation programs indicates, much of the implementation of simulation has been unstructured and often atheoretical (Ward et al., 2006). Further, simulation is frequently structured about tasks that poorly represent the sort of complex problems that are representative of the demands of nursing practice (Ericsson, Whyte, & Ward, 2007). However, some educators have recognized the need for structure or a theoretical basis for the use of simulation in nursing education, given the recent proliferation of its use (Jeffries, 2005; Schiavenato, 2009; Waldner & Olson, 2007). In a review of nursing simulation spanning a 40-year period, Nehring and Lashley (2009) suggested that Benner’s (1984) model describing the development of one’s expertise from a novice to an expert is “the most common application of nursing theory” (p. 539) in support of simulation use in nursing education. More specifically, Benner’s model describes five levels of nursing expertise: (a) novice, (b) advanced beginner, (c) competence, (d) proficient, and (e) expert. The model describes the transition of the performer throughout these stages of skill development.

In addition, Waldner and Olson (2007) suggested that a combination of Benner’s (1984) model and Kolb’s (1984) experiential learning theory could provide the theoretical basis for simulation in nursing education. In particular, Waldner and Olson suggested that learning best occurs via experience (i.e., experiential learning should occur) and nurses of differing skill levels should engage in simulations appropriate to their level of skill. Kolb (1984) stated the following assumptions of experiential learning that are relevant to our present discussion: (a) “ideas are not fixed and immutable but are formed and re-formed through experience” (p. 26), and (b) learning is “a process whereby concepts are derived from and continuously modified by experience” (p. 26). Thus, in a basic sense, any implementation of simulation can be considered to be attempts at providing experiential learning experiences.

An example of a proposed structure for simulation, later termed the Nursing Education Simulation Framework (Jeffries, 2007), is Jeffries’ (2005) structural framework highlighting the interplay between five components: (a) educational practices (e.g., the role of feedback, time on task, active learning), (b) teacher factors (e.g., comfort level, facilitator versus non-facilitator role), (c) student factors (e.g., level of motivation, expectations of students), (d) design characteristics (e.g., objectives, complexity, fidelity), and (e) outcomes (e.g., knowledge learning, skill performance, confidence). Jeffries and Rogers (2007) articulated that simulation in nursing has a theoretical basis of viewing “learning as information processing that is respectively a) a cognitive skill; b) experiential growth and pattern recognition; and c) a sociocultural dialogue” (p. 23). Moreover, the authors suggested that these three components of learning should lead to increased knowledge and expanded cognitive networks and understanding, and that these changes will (or should) occur within the context of health care.

Thus, many models of simulation, including that of Jeffries and Rogers (2007), are based on the premise that student learning will be enhanced via experience (i.e., experiential learning). It is also generally presumed that individuals will differ in their skill levels and, as a consequence, have differing needs for engaging in simulation. However, as noted by Nehring and Lashley (2009), Benner’s (1984) model describes an individual’s development through the various skill levels. Providing a theoretical framework requires not only description but also an explanation of the phenomena. In addition, the utility of a theoretical framework is determined by its ability to predict a set of phenomena (e.g., to indicate when, where, and how learning will occur, given the content and format of simulation) and, ult-
Deliberate practice activities (Ericsson, Krampe, & Tesch-Römer, 1993) are tasks designed by a teacher or coach to address specific weaknesses in one’s performance via attempts at activities just beyond current practice levels. This is a key assertion when considering nursing, as simulation tasks must approximate real-world clinical situations, rather than the largely routine and often only mildly ecologically representative, psychomotor tasks frequently seen in simulation laboratories. Performers must receive feedback throughout, or immediately following, the activities while striving to omit or correct errors. After performance begins to repeatedly reach the specified levels, new goals are set and the process is repeated. This reiterative process allows educators to systematically increase the performance of novices and intermediates, as well as continually refine expert performance. As shown in the Table, McGaghie (2008, p. 995) has summarized the tenets of deliberate practice as applicable to healthcare. It is a consistent finding that world-class performers have engaged in deliberate practice, often on a daily basis, sustained for at least 10 years or 10,000 hours (Ericsson & Lehmann, 1996).

It is important to note that engaging in deliberate practice is more than simply going through the motions. Used properly, deliberate practice provides opportunities for individuals to appropriately develop skills via engagement in tasks and situations that have been determined to be relevant to the domain of interest. Deliberate practice also provides more than just passive experience within the domain, as it is effortful and requires intense concentration. The intent is to guide the performer throughout the stages of skill development, working to correct errors via feedback and debriefings. Even the most highly skilled performers continue to work on correcting the remaining weaknesses of their performance.

Properly administered deliberate practice leads to improvement in planning, analysis, problem solving, and motor control via refined cognitive representations of the task domain (Ericsson & Lehmann, 1996). These cognitive representations include (a) the desired performance goal, (b) how to execute the performance, and (c) the monitoring of one’s performance (Ericsson, 2001). When performance is not satisfactory, a new performance goal is created. This reiterative process allows for a consistency of task performance that may be absent in less-skilled performers. For example, expert performers in music are able to reproduce musical performances consistently, and expert chess players are capable of selecting the best available move consistently (Ericsson, 2001; Ericsson & Lehmann, 1996).

To demonstrate this reiterative process, consider an example of deliberate practice from the domain of chess. Less-skilled chess players spend up to 4 hours per day hypothetically playing through published games between grandmasters, attempting to select the best available move. These less-skilled players then compare their selection to the selection made by the grandmaster player. If a discrepancy exists, the less-skilled players attempt to determine why their selection differed from the grandmaster player. Ultimately, this activity helps less-skilled players develop more refined cognitive representations of chess (i.e., that include the better moves). Because these representations are organized more effectively than previously (i.e., the lesser and better moves are organized in relation to the situational information that implicated the better-move choice), subsequent decisions about the same or similar situations occur more quickly and accurately (Ericsson, 2004). Similarly, the best musicians spend several hours per day refining their representations of their own musical performance by identifying and correcting their errors during performance (Ericsson et al., 1993). In other words, the musicians compare their actual performance with a cognitive representation of how the performance should sound.
making adjustments when there is a discrepancy between the two. Eventually, the errors decrease and performance becomes consistent, presumably because the refined cognitive representation guides performance.

**Refining Cognitive Skills via Deliberate Practice**

Experts’ enhanced cognitive representations relative to lower-level performers have been proposed as an explanation of their performance within a variety of domains including, but not limited to, chess, musical performance, medical diagnoses, physics, sports, text comprehension, and horse betting (see Ericsson & Lehmann, 1996, for a review). These enhanced cognitive representations improve the performer’s ability to assess and understand the current situation. Expert performers develop an enhanced ability to anticipate future demands and the possible ultimate outcomes of the situation. The ability to forecast the demands and outcomes of situations is made possible by the acquisition of long-term working memory mechanisms (Ericsson & Kintsch, 1995), allowing the expert performer to create a situational representation built rapidly on the fly (Kintsch, 1988). As stated by Ward, Suss, Eccles, Williams, and Harris (2011), this representation allows the expert performer to “create a situational representation built rapidly on the fly” (p. 198). Recent studies measuring performance in soccer (Ward, Ericsson, & Williams, 2011), law enforcement (Ward, Suss, et al., 2011), and nursing (Ward, Torof, Whyte, Eccles, & Harris, 2010) suggest that higher quality, rather than lower quality, cognitive representations of the current situation, as measured by the number of options generated (i.e., possible courses of action, either for oneself or for others in a position to act), result in the best performance. However, one should note that skilled option generation—such as the skill of plotting courses of action for oneself or predicting the possible courses of other’s actions or situational events (e.g., a patient)—is likely to be mediated by situational constraints, such as time pressure and situation complexity (for a discussion, see Ward, Ericsson, & Williams, 2012).

**Refining Psychomotor Skills via Deliberate Practice**

In domains such as music or sport, a performer engaging in deliberate practice consciously works to improve some aspect of his or her performance (e.g., a violin performance or golf swing) with feedback from a coach or knowledgeable performer until an appropriate level of performance is reached. Thus, following prolonged engagement in deliberate practice activities, task performance becomes efficient and most, if not all, errors during performance are eliminated. Expert performers also develop consistency in the motions related to performance on static tasks, such as swinging a golf club (when such consistency is desirable), through this reiterative process of deliberate practice.

Compelling evidence exists that this consistency is acquired over time. For example, precise limb coordination and appropriate freezing is required to play the violin and “only violinists with more than 700 practice [hours] achieved sagittal shoulder range of motion comparable to experts” (Konczak, van der Velden, & Jaeger, 2009, p. 243). Recall that world-class performers have typically engaged in approximately 10,000 hours of deliberate practice. This accumulation of deliberate practice hours should not be confused with simple exposure within a domain (i.e., merely spending time or acquiring experience within a domain), which when considered alone is generally unrelated to improved performance (Ericsson, 2004; Ericsson et al., 2009).

**GOING BEYOND THE “WHY” OF SIMULATION: A GUIDING FRAMEWORK MUST ALSO ADDRESS “HOW” AND “WHAT”**

Schiavenato (2009) specifically called on educators to understand the reason why they incorporate simulation in nursing education. However, a comprehensive framework should also allow for the ongoing refinement of training techniques and ultimately lead to ever-improving human performance. Earlier in this article, we proposed that an appropriate comprehensive theoretical framework for simulation in nursing must begin with a theoretical understanding of human performance, including how expert performance is developed (or novice performance is reiteratively improved). An understanding of expert performance, based on the performance refining consequences of engaging in deliberate practice activities, provides the basis for why simulation should be used by health care educators. In other words, humans require practice to improve, and simulation can provide the opportunities to engage in deliberate practice activities.

In addition, the Nursing Education Simulation Framework (Jeffries, 2007) was a significant advancement for the state of simulation use within nursing education, particularly with regard to imposing structure. However, there is often little guidance generally, or within Jeffries’ approach, with regard to actually creating training or simulation. For example, Jeffries (2005) stated, “Complex decision environments with high levels of uncertainty can also be constructed with high or low levels of relevant information” (p. 100). The question remains as to how one can be certain that the appropriate scenario or complexity is delivered. For instance, how would the relevant information be determined? Would the determination of what is relevant be based on the hunches of the trainers? Similar questions remain regarding how one might appropriately measure improved performance.

In other words, for simulation or any other training to be most effective, the question of how to derive and refine curriculum information must be considered (e.g., from whom). Educators must also determine what to provide during simulation (e.g., was the appropriate curriculum developed? Is it effective?). In the following section, we introduce the expert performance approach (Ericsson & Smith, 1991) as our proposed comprehensive framework for guiding simulation in nursing. This comprehensive approach allows one to address the why, the how, and the what of implementing simulation for training.

The proposed framework also provides the means to evaluate the success of training. This is particularly relevant given the debate over the effectiveness of simulation in nursing. If the training is determined to be ineffective, adjustments to the training curriculum (the what) may be needed. Human performance
also continues to reach ever-increasing heights, and new techniques may be developed in the future, outdating the current curriculum. If training fails to produce results that keep pace with the state of the discipline, then the current highest performers should be explored.

Finally, the proposed framework requires a consideration of the validity of the training environment. The ultimate goal of using simulation during training is to allow the transfer of skills acquired during simulation to the natural ecology. Thus, to be effective, simulation should allow educators enough control over training to target the mechanisms responsible for improving performance (i.e., sufficient internal validity) while effectively mimicking real-world demands (i.e., sufficient external validity). Our proposed framework allows for sufficient internal and external validity by requiring that simulation be guided by tasks representative of nursing practice. Once again, the theoretical understanding of human performance derived from the expert performance approach helps determine what should be considered a valid training environment and how to determine whether the training environment is indeed valid. We now describe the proposed framework in greater detail.

THE EXPERT PERFORMANCE APPROACH AS A FRAMEWORK FOR DEVELOPING AND ASSESSING TRAINING

Although the desired outcome(s), and thus specific training agendas, are specific to the needs of the individual or organization, the expert performance approach (Ericsson & Smith, 1991) provides an overall framework that can be used to set training goals, develop training, and assess training effectiveness (Williams, Ward, Knowles, & Smeeton, 2002).

The expert performance approach allows for objectively (thus scientifically) examining performance and, in particular, the processes responsible for superior performance that can be translated into effective training regimens and outcomes. The steps of the expert performance approach are to (a) objectively identify expert performers; (b) develop representative tasks that allow for the capture of expert performance; (c) identify the mediating mechanisms responsible for performance, via process tracing or other means; and (d) trace the developmental history of the performer to elucidate how the mediating mechanisms were acquired. Ultimately, knowledge of the processes and mechanisms responsible for superior performance then can be transformed into evidence-based training and instruction (Ward et al., 2006). This approach recently has been termed ExPerT (Ward et al., 2009) or expertise-based training (XBT; Fadde, 2009a). The steps of ExPerT are outlined in the following sections and depicted in the Figure.

**Objective Identifying Expert Performance**

Objective identification of expert performance is accomplished by requiring that the designation of expert be restricted to those consistently exhibiting high-level performance attainments and rejecting designations of expertise based on subjective criteria, such as the reputation of the performer, professional certifications, self-identification, peer nomination, or accumulated time in a domain (Charness & Schultetus, 1999; Ericsson & Lehmann, 1996). These traditional means for identifying experts have often proven to be problematic. For instance, nurses scoring well on tests measuring knowledge of the nursing domain are not always able to translate that knowledge into performance. Professional certification and even extensive domain knowledge is not sufficient for identifying individuals capable of delivering the highest levels of performance (Whyte, Ward, & Eccles, 2009).

Self-identification is also a poor means for identifying expertise, and the lowest performers are the least capable of judging their own competence (Regehr & Eva, 2006), as evidenced by a systematic review by Davis et al. (2006). These authors reviewed 725 articles published between 1966 and 2006 in which physicians’ self-assessments had been measured. Self-assessments of skill level were compared with external assessments in only 20 of these articles. Of these 20, 13 (65%) reported little, no, or inverse relationships between self-assessments and external assessments. Although the remaining 7 articles reported a positive relationship between self-assessments and external assessments, these cases represent less than 1% of all studies published on physician self-assessment over a 40-year period. Self-assessment has been so consistently unreliable that Eva and Regehr (2008) proposed that for the medical field, self-assessment should not be used in the absence of other external assessments. It is also essential that external assessments of performance should be limited to objective and observable aspects of performance, rather than other factors, such as peer or supervisor ratings, which are often highly subjective.

Accumulated time in a domain is not, by itself, an appropriate means for identifying expert performers. Performance levels can easily stagnate without attempts by the performer to actively move beyond current performance levels. Common everyday activities can become automated quickly, and this automaticity is often considered to be the indicator of expertise (Fitts & Posner, 1967). In the case of nursing, routine tasks, such as medication administration, hygiene-related activities, and the administration of routine treatments, are the sort of activities that become automated, as opposed to the complex situational assessments that nurses make with a patient who is displaying subtle signs of deterioration. Counter to this view,
 recent findings indicate that skilled performers actively avoid automaticity in many aspects of performance, especially when they involve higher cognitive functions (e.g., situational assessment, decision making), to continue to improve performance. That is, the attainment of automaticity is not always the best outcome (Bond et al., 2008; Ericsson, 2008). Yarrow, Brown, and Krakauer (2009) recently summarized this view:

Crucially, it is not automaticity per se that is indicative of high proficiency but rather the skill level at which automaticity is attained…Hence, automaticity is more a false ceiling than a measure of excellence. (p. 588)

Thus, time in a domain is often not indicative of expertise. Representative of this are the remarks of an air-traffic controller instructor, who noted that after 7 years of training, some of the trainees are well on their way to becoming expert performers, yet “others are just seven years older” (Fadde, 2009b, p. 361). Also, there is evidence that some physicians perform worse as their time in the medical field increases (Beam, Conant, & Sicke, 2003). Presumably, this decrease in performance occurs because these physicians are not actively seeking to improve (or even maintain) performance levels and hence do not necessarily receive or seek objective feedback about their performance.

Developing Representative Tasks to Capture Expert Performance

Rather than rely on such means for identifying expert performers, representative tasks under controlled conditions should be used to capture, as well as confirm, high levels of performance (Ericsson & Lehmann, 1996; Ericsson & Ward, 2007). As described by Ericsson (2004), a representative task should, “capture the essence of expertise in the domain where the superior performer can exhibit their superior performance in a consistent and reproducible manner” (p. S71). For example, selecting the best move for a given chess board configuration would be a representative task for chess, or typing as much of the presented text as possible in 1 minute would be a representative task for typing (Ericsson & Lehmann, 1996). In other words, one can expect that the best chess players and typists would consistently outperform less-skilled performers at these tasks. Similarly, the best nurses within a facility would be expected to outperform other nurses as manifested by higher levels of performance on representative nursing tasks and more effective clinical decision making, with correspondingly positive outcomes of their care. Ericsson et al. (2007) elaborated on the appropriate use of representative tasks within the healthcare domain:

Each professional should be examined on the same case or scenario, ideally via some means of simulation or real-world representation that recreates the actual task, which allows each participant to perform under the same or similar conditions. (p. E60)

It is essential that scenarios based on the expert performance approach require the nurse to engage in the full range of assessment techniques to arrive at well-founded conclusions while avoiding training scenarios that focus heavily on routine psychomotor skills.

Within the context of the expert performance approach (Ericsson & Smith, 1991), a task is any activity capable of capturing the essence of expertise. Thus, a task could range from the micro level of returning a difficult serve in tennis to the macro level of winning a game (or match). Consistently high performance on either task would allow for identification of expert performance. Thus, within the nursing domain, a task could be provided at the micro level (e.g., task trainers) to the macro level (e.g., full-blown simulation of a dangerous medical situation). The degree to which the simulation recreates the demands of the actual task or situation will provide high (or low) levels of both internal and external validity. For instance Cormier, Hauber, and Whyte (2010) found that performance differences among novices materialized when making complex assessments regarding a deteriorating patient’s status rather than while completing a host of routine nursing tasks. In addition, an expert performer will consistently perform well on the majority of tasks within a domain. As stated above, they are able to “exhibit their superior performance in a consistent and reproducible manner” (Ericsson, 2004, p. S71).

Identifying the Mediating Mechanisms Responsible for Performance

After expert performance has been confirmed, the mechanisms underlying the high performance can be identified. In the typing example above, the fastest typists (i.e., the expert performers) perceive text well ahead of the text currently being typed, allowing them to prepare their next strokes by moving their fingers in advance to upcoming keys (Gentner, 1988). In addition, the speed advantage of the skilled typists is removed when they are prevented from looking ahead (Salthouse, 1984).

In healthcare scenarios, the mediating mechanism of expert performance could be the rapidity or quality of the decisions made by the health care practitioner. Similarly, the ability to determine which patient or environmental information is relevant versus irrelevant when encountered could also be the mediating mechanism allowing for high levels of performance. In other words, the goal is to identify what allows one individual to perform faster than another or to make better decisions with fewer errors.

Process tracing techniques, such as eye-tracking or collecting verbal reports, are useful for identifying mediating mechanisms (Eccles, 2012; Ericsson & Simon, 1993). For example, Williams et al. (2002) found, via eye-tracking devices, that expert tennis players’ ability to return the fast serves of opponents was based on an anticipatory mechanism, created by focusing on the midsection of the opponent rather than the ball itself. This mechanism was absent in the less-skilled tennis players, most of whom focused on the ball itself. Similarly, having several expert health care providers think aloud during a scenario could provide insight into the mediating mechanism separating the better from the less-er performers. Scenarios allowing one to capture performance differences between skill levels is desirable. For example, Whyte, Cormier, and Pickett-Hauber (2010) used verbal report methods to reliably differentiate the performance of novice nurses performing in a simulated task environment. The study by Whyte et al. (2010) determined that nurses engaging in more effective courses of action did so based on accurate situational assessment and decision making that was oriented toward forecasts regarding the likely outcomes of the situation.
Tracing the Developmental History of the Performer

After the mediating mechanisms underlying performance have been identified, the developmental history of the performer can be elucidated. In other words, the training and practice activities in which the performer engaged that were responsible for acquiring the mediating mechanisms can be identified. The examples, described above, derived from studies of expert performance demonstrated by chess players and musicians, demonstrate well this point of the approach. More specifically, it is the reiterative process of refining performance and correcting performance errors used by expert performers that is identified during this step.

EXPERT-PERFORMANCE-BASED TRAINING (ExPerT)

After the effective training regimen of the best performers (i.e., most appropriate forms of deliberate practice) or the specific mediating mechanisms underlying performance have been identified, the information can be used to train less skilled performers.

ExPerT allows for the identification of the highest performers and subsequently allows educators to identify the means by which an expert’s performance capabilities were acquired from their time as a novice all the way through their current expert level of performance. As evidence is accumulated regarding the most appropriate deliberate practice activities for developing performance along the trajectory from novice to expert, this information can be more widely disseminated. Although deliberate practice activities are generally tailored for individual needs, such dissemination reduces potential training false-starts or the tendency to focus on aspects of training that may not be useful in developing performance. Avoiding these pitfalls would be of particular benefit for novice, and also most intermediate, performers. Moreover, because the model elucidates that highly skilled nurses (i.e., expert performers) went through a process of becoming skilled and did not suddenly become an expert, there is a possible motivational benefit for novice and intermediate performers. It should be noted that proponents of the ExPerT framework are not making an assumption that every performer will eventually become an expert performer. To the contrary, many performers never move beyond the stagnant performance levels, as described above (Bond et al., 2008; Ericsson, 2008; Yarrow et al., 2009). The benefit of applying the ExPerT framework is that performers making the choice to improve beyond current levels can be provided with the tools needed to make attempts at improving performance. Moreover, the path to skill acquisition can be made as transparent as possible.

ExPerT as a framework for developing, administering, and assessing training also requires more than subjective evaluations of training (e.g., “I learned a great deal from the simulation”). Thus, the effectiveness or ineffectiveness of the training can be objectively measured in the simulated, or training, environment. In addition, because the simulation (i.e., representative task) is designed to represent “real-world” task demands, some measure of the transfer of training to the actual task can be made (e.g., the clinical setting).

Selected Examples of ExPerT Success

The Williams et al. (2002) study described above in which the researchers used eye-tracking devices to identify that expert tennis players’ ability to return the fast serves of opponents was based on an anticipatory mechanism, created by focusing on the midsection of the opponent rather than the ball itself, provides an example of the successful use of ExPerT (Ward et al., 2009). The researchers used the information derived from tracing the mediating mechanisms of objectively identified expert performers (based on actual tennis performance records) to train less-skilled performers. The less-skilled players were instructed to focus either in a general area, or the specifically identified area, of the midsection of the serving opponent. The performance of the tennis players (measured on actual on-court conditions) improved in this manner significantly improved, whereas players receiving no instruction or watching a video on playing tennis did not improve. It is important to note that all of the steps of ExPerT, as described above, were followed in this example.

Staszewski and Davison (2000) provided another example of how the principles underlying ExPerT were used to improve the performance of mine detector operators having already completed standard mine-detection training. The researchers first identified an expert mine detector operator (with 30 years of experience) by confirming his high performance, measured as extremely high-detection accuracy. The researchers subsequently determined the methods he used to locate mines, which were different from the methods outlined in the military-issued training manual. The identified methods were then used by the researchers to develop a training program that improved detection of all types of mines, particularly the most difficult to detect mines. In some cases, the training resulted in a tripling of mine detection performance for the lesser-skilled operators. In the following section, we discuss how the theory of deliberate practice and the framework of the expert performance approach can be used as a basis for developing simulation training (i.e., ExPerT) in health care domains.

BASES SIMULATION TRAINING ON THE THEORY OF DELIBERATE PRACTICE

The use of deliberate practice principles for training in health care has been advocated for at least a decade (Issenberg et al., 1999). Ericsson (2004) further advocated the adoption of deliberate practice in health care by highlighting that skills in this domain should not be considered unique to the degree that they are viewed as exempt from the mechanisms responsible for improved performance in most, if not all, other domains. The theory of deliberate practice has since gained significant traction within health care (McGaghie, Siddall, Mazmanian, & Meyers, 2009; Tsuda et al., 2009). However, if becoming an expert performer requires such a large investment of time, there is a need to provide appropriate opportunities for the development of skills. Simulation provides an excellent opportunity to engage in deliberate practice activities needed to develop performance (Ericsson, 2004) while also considering the safety of patients. The need for enhancing health care education (providing hands-on opportunities) and patient safety are ultimately the reasons that leaders in the health care domain have adopted simulation.
Becoming an expert performer takes considerable amounts of both time and effort. This theoretical understanding of how human performance is enhanced is particularly relevant, given the current focus in nursing on reducing medical errors. Using simulation for training in nursing provides the opportunity for acquiring the desired skills in a safe environment. Actual patients are not harmed, and the safety afforded through simulation also extends to trainees by allowing them to make mistakes, fail, and, consequently, learn in an environment with a lower risk of negative psychological consequences. Instructors also benefit from the opportunity to control and repeat the scenarios presented to the trainee. This reiterative process allows for the performer to receive feedback on one’s performance, which is considered crucial for developing performance within the deliberate practice framework. On a similar note, the instructor can confidently allow the trainee to work independently for longer periods of time on both high- and low-frequency cases of varying difficulty and complexity. Low-frequency cases include rare cases that one may encounter only once or twice over an entire career (Ericsson et al., 2007).

Debriefings following the simulations also allow for valuable feedback in the form of instructor-provided information and via the learner’s own reflections on their performance. Furthermore, instructors can actively stimulate such reflections by prompting learners to consider the thoughts and actions they experienced during the simulation. Expert performers are generally successful at monitoring their own performance and have developed this capability via engagement in domain-related activities (Macquet, Eccles, & Barraux, 2012; Ward et al., 2010). Thus, debriefing and similar feedback techniques are crucial steps in skill development. Debriefing, with the aim of promoting reflection on performance, provides an excellent opportunity for the trainee to work with a skilled instructor to maximize the benefits of having experienced simulation, with the ultimate goal of enhancing subsequent performance.

Other needs for which simulation may be useful include training with new and emerging technologies, maintenance of skills, and identifying and rectifying poor performance. Jeffries (2005) pointed out the need for simulation in nursing by noting the challenges caused by “the shortage of nursing faculty, the diminishing availability of clinical sites, and an exponentially growing knowledge base” (p. 96). She added that despite such challenges, employers “expect new graduates to transition quickly into the role of independently functioning caregiver” (p. 96).

**ExPerT FOR SIMULATION IN HEALTH CARE DOMAINS**

Expressing concern that manikin-based, full-scale simulation systems have become synonymous with training in nursing, Schiavenato (2009) argued that the training of what he called actions has a long history in nursing education in the form of skills training laboratories and that simulation in nursing is not a new development. For example, Schiavenato (2009) cited evidence that less complex forms of simulation, such as practicing intramuscular injections on an orange, have been effective (or at least well-established) for training. We acknowledge the usefulness of appropriately applied low-fidelity simulation methods for training psychomotor skills. However, psychomotor skills comprise a small proportion of what would be considered professional nursing practice, and they often fail to provide a means of differentiating the skill levels of nurses (Cormier et al., 2010). Many psychomotor tasks are delegated to professionals with less training, such as licensed practical nurses, nursing technicians, and paramedical personnel. However, for the broader issue of increasing overall competence, knowing both when and how to apply treatment (i.e., cognitive skills), more full-scale simulations might be required. As stated by Decker, Sportsman, Puetz, and Billings (2008):

> It is relatively simple for educators to prepare learning environments that foster knowledge acquisition or skills development. It is much more difficult for them to provide a realistic opportunity for skills and knowledge application in dynamic patient care situations (pp. 75-76).

Thus, there is a distinction between designing training intended to enhance the acquisition of psychomotor skills (e.g., inserting a catheter or administering an intramuscular injection) versus acquisition of more cognitively based skills (e.g., deciding when to notify the on-call physician rather than administer a scheduled medication when the patient’s condition has changed significantly). The following examples demonstrate the usefulness of the application of deliberate practice activities for training both psychomotor and cognitive skills in health care domains. We propose that many additional success stories will arise from implementation of ExPerT as a framework guiding simulation.

**Acquiring Psychomotor Skills**

The use of deliberate practice methods for teaching psychomotor surgical skills has been adopted by many surgical residency programs with great success (see Tsuda et al., 2009, for review). For example, students receiving simulated laparoscopic camera operation training outperformed those not receiving training with regard to maintaining an optical surgical view, which includes expectations for image centering, steadiness, horizontal orientation, and sizing (Kornforff et al., 2005). Similarly, Seymour et al. (2002) found that residents with only five hours of laparoscopic simulator training were 29% faster than controls during actual surgery. More importantly, controls made six times more errors and were five times more likely to cause injury and damage than the simulator-trained residents during actual surgical procedures.

These reduced patient injury rates following training can be attributed to the more consistent performance execution demonstrated by skilled performers. In Harris and Ericsson’s (2012) study of skilled 10-pin bowlers, motion analysis could differentiate the expert performers from those with less ability. Similarly, motion analysis can differentiate among the skill of performers for laparoscopic surgical skills (Tsuda et al., 2009). More specifically, higher-skilled surgeons exhibited less variability in the path of their instruments (i.e., movement was more consistent) than lesser-skilled surgeons.

**Acquiring Cognitive Skills**

As mentioned above, Jeffries (2005) noted the expectation that nursing graduates quickly develop into an “independently...”
functioning caregiver” (p. 96). Despite such expectations, evidence indicates that performance and training are falling short, and effective training of cognitive skills is desperately needed. For example, when the ability of new nurses to identify a problem and initiate an appropriate course of action was measured by a series of 10 video-based patient situations, known as the Performance-Based Development Assessment (Performance Management Services, Inc., 2012), the number of nurses not meeting minimal levels of expectations ranged from 25% (Fero, Witsberger, Wesmiller, Zullo, & Hoffman, 2009) to as high as 64% to 75% (25% of experienced nurses also failed to meet expectations; del Bueno, 2005). The situation has become so critical that the Joint Commission on the Accreditation of Healthcare Organizational Standards has stated that inadequate training and assessment was a major threat to patient safety (Fero et al., 2009). As noted by Fero et al. (2009), critical thinking, communication, and problem-solving abilities are integral to initiating appropriate courses of action, particularly given the typically fluid conditions of health care. These abilities are components within the overall umbrella of skills that we have deemed cognitive skills (i.e., Schiavenato’s “processes”).

Improvements in cognitive skills require prolonged engagement within a domain, including deliberate practice. Because expert performance is highly domain specific, the focus can be placed on providing consistent and real, or realistic, opportunities to refine domain representations. The selection of relevant and challenging tasks or scenarios is key to fostering the development of high-level performance. That is, rather than having students negotiate only mundane and routine patient care activities (which often foster going through the motions), challenging, less routine situations should also be used to foster the development of highly adaptive abilities. (This adaptability should not be seen as inconsistent with the consistency derived from deliberate practice. The consistency of the expert performer also refers to their ability to perform well in novel situations.) By taking the form of deliberate practice activities, the acquisition of long-term working memory mechanisms and the creation of accurate cognitive representations of the situation will be enhanced. High-fidelity simulation provides educators with an excellent tool for providing realistic scenarios on a consistent and repeated basis.

Recall that skilled performers have spent thousands of hours engaged in deliberate practice activities. Steadman et al. (2006) provided evidence that using simulation to train acute assessment and management skills has immediate benefits. The researchers compared the effectiveness of simulation training versus problem-based learning for teaching about dyspnea. Fourth-year medical students (n = 15) in the simulation condition were initially given the patient’s chief complaint and vital signs and subsequently engaged in several scripted scenarios with the Medical Education Technologies patient simulator. Students in the problem-based learning condition received the same information, but rather than interact with the patient simulator, they were given a scripted scenario guided by verbal feedback from an instructor. When tested on a previously unseen dyspnea scenario with the simulator, the simulator-trained group outperformed the problem-based learning group (both groups had received simulation training for either dyspnea or acute abdominal pain). In addition, compared with baseline performance, the simulator-trained group improved 25 percentage points versus 8 percentage points for the problem-based learning group.

More recently, Jeffries et al. (2011) reported the effectiveness of a simulation-based cardiovascular assessment curriculum for advanced practice nurses that was derived directly from the input of experts. This curriculum, created in conjunction with the Miami International Alliance for Medical Education Group, is theoretically aligned with the ExPerT model and serves to demonstrate its effectiveness. (Although Jeffries et al. [2011] did not take the step of objectively identifying performance, there is no reason to believe that the superior performance of the expert advisors could not be readily verified.) For example, the rate of detection of a pulmonary systolic murmur increased from 1% to 81% following training incorporating deliberate practice. Because of this success, Jeffries et al. suggested training incorporating deliberate practice should receive a “best practices” designation.

The development of the Jeffries et al. (2011) curriculum was created via a concentrated effort with the intent of seeking the input of experts. The ExPerT model allows for both these large-scale implementations—as well as much smaller scale curriculum developments—by measuring the best performers at a given training facility. Consider how local experts might be used for smaller-scale curriculum developments. Having identified a task that instructors want to train (e.g., intubation), the best performers of the task within a given training facility might be identified. These performers, who may include training facility instructors and faculty, are effectively experts local to the facility. These local experts are identified by measuring objectively their performance on multiple attempts on the task as it is undertaken in conditions representative of the real world. Collecting protocol analysis measures (e.g., think-aloud reports) from these local experts might provide additional insights into expert performance and how it can be developed. It also will allow for refining and validation of the current curriculum. Such techniques allow confirmation that aspects of performance, from early undergraduate training onward, deemed crucial by skilled performers, are important.

Future studies derived from the ExPerT approach can continue to explore the effectiveness of the approach (Jeffries et al., 2011). Other directions for future research include: (a) an understanding of the types of situations that best allow performance differences and superior performance to be demonstrated, (b) identifying the typical amount of deliberate practice required to reach performance mastery, (c) capturing changes in performers’ cognitive representations (e.g., enhanced situation models) as a result of engagement in deliberate practice activities, (d) exploring the specific cognitive skills that are improved via engagement in deliberate practice activities (e.g., improved monitoring and predictive skills), and (e) determining the effectiveness of attempts to promote active, online monitoring of, and reflection on learning and performance (Macquet et al., 2012).

**DOES OUR FRAMEWORK MEET THE PROPOSED GUIDELINES FOR A THEORETICAL APPROACH?**

We proposed above that a theoretical framework for simulation in nursing must provide explanatory and predictive power,
as well as be based on a theoretical understanding of human performance, including how it is enhanced. We then proposed that this understanding would, in turn, guide the design and application of the training environment, including the utility of the training (e.g., success in improving nursing performance so that some tangible benefit can be derived, such as increased patient safety).

Following the section discussing the debate surrounding the use of simulation for health care training, we introduced the theory of deliberate practice (Ericsson & Simon, 1993). This theoretical approach formed the basis for an understanding of human performance, or how humans improve their performance. More specifically, appropriate and consistent engagement in deliberate practice activities results in improved cognitive and psychomotor skills, and world-class performers have engaged in deliberate practice sustained for at least 10 years or 10,000 hours (Ericsson & Lehmann, 1996).

The time and effort necessary to become a skilled performer, combined with reduced training opportunities for health care providers, often results in a void of safe training alternatives. Simulation is being increasingly adopted to fill the resulting void, but as some authors have noted (Schiavenato, 2009), a framework guiding the use of simulation is needed. Schiavenato (2009) called for health care educators to ask why they are incorporating simulation into training. We proposed that one must also answer how to derive and refine curriculum information (e.g., from whom), as well as what to provide during simulation (e.g., was the appropriate curriculum developed? Is it effective?).

We then introduced the expert performance approach (Ericsson & Smith, 1991) as our proposed comprehensive framework for guiding simulation in nursing by addressing the why, how, and what of implementing simulation for training. This approach of developing training based on what is learned from the study of highly skilled performers has been termed ExPerT (Ward et al., 2009) or XBT (Fadde 2009a). Our proposed framework also provides the means to evaluate the success of training, which allows refinement if training is or becomes ineffective.

The proposed framework of the expert performance approach should also allow for both sufficient internal and external validity of the training environment by permitting educators enough control over training to target the mechanisms responsible for improving performance (i.e., sufficient internal validity) while effectively mimicking real-world demands (i.e., sufficient external validity). Moreover, the approach requires that simulation be guided by tasks that are representative of the domain of interest. Ultimately, the goal of simulation is to allow for performance improvement on real-world tasks.

Research on deliberate practice demonstrates that guided, consistent engagement in domain-related tasks is the means by which novice performance is improved and world-class performance is reached (Ericsson & Lehmann, 1996). In addition, because deliberate practice is an essential component within the overall framework of the expert performance approach, the approach provides both explanatory and predictive power about how one can improve performance. Moreover, our proposed approach provides guidance with regard to the appropriate design, implementation, and assessment of training. Thus, our approach meets the proposed guidelines for a theoretical approach to training in general, as well as for simulation in health care.

**CONCLUSION**

Deliberate practice is an active process, and simply going through the motions, either during simulation or during everyday tasks, will not result in significantly improved performance. However, the expert performance approach (Ericsson & Smith, 1991) combined with ExPerT (Ward et al., 2009) provides the framework required for developing and assessing training based on what we have learned from the best performers. In other words, our proposed framework allows not only confirmation of suggested best practices but the creation of them via an exploration of how the best performers developed their own performance. The ExPerT framework can also be a tool for developing the content of training intended to enhance psychomotor, cognitive (including critical thinking), and social skills for all performance levels. Jeffries et al. (2011) demonstrated the tenets of the proposed framework to be successful for training advanced nurses include deriving training based on experts, engagement in deliberate practice, and objective measures to measure the results of training. In addition, by using the expert performance approach as a framework for validating simulation for improving performance, validation of simulation as a tool for measuring competency is also possible. In conclusion, the framework presented in this article meets the broad requirements expected of a rich and explanatory theoretical approach for the use of simulation in nursing.

**REFERENCES**


