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# Expert Performance in Nursing

## Reviewing Research on Expertise in Nursing Within the Framework of the Expert-Performance Approach

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Traditionally, studies on expertise have used social criteria to identify highly respected and experienced individuals and examined how these experts differ from less-experienced individuals. Our article reviews research on nursing expertise during the last decades from the perspective of the expert-performance approach, which focuses on reproducibly superior performance in everyday life. Our review proposes explanations for repeated failures to find reliably superior performance for nurses with longer professional experience. The article concludes with an outline of how the expert-performance approach can be applied to the study of nursing expertise where the focus is on measurement and analysis of superior nursing performance. **Key words:** *academic training*, *clinical performance*, *clinical skills*, *nursing education*, *nursing expertise*, *practice (psychology)*, *professional competence*, *task performance*, *training activities*

RESEARCHERS of novice, skilled, and expert nurses have struggled for decades to develop an adequate assessment of competence. It has been particularly difficult to capture those characteristics[1] that take a nurse beyond mere proficiency toward genuine expertise, as reflected by flexibility and speed.[2] In the last couple of years there has been a renewed interest in the study of nursing expertise[3] and performance of nurses as the quality and cost of services provided by physicians and nurses is compared.[4]

In the domain of nursing, scholars researching expertise have traditionally identified experts by peer nomination and other social criteria, and have focused on the role of knowledge and the effects of extended experience. Recent reviews of the performance of highly experienced and more extensively trained individuals in medicine and other health-related domains[5,6] show that the length of professional experience is often unrelated, and sometimes even negatively related, to performance measures and objective treatment outcomes. Although large-scale studies have found evidence for better patient outcomes with more extensively trained nursing staffs,[7] it has been difficult to demonstrate superior clinical performance in individual nurses with more extended academic training.[8] In spite of the mixed evidence for benefits of college education and/or the lack of evidence for benefits of extended experience, nurses' self-assessment of their own professional abilities show reliable increases with age and professional experience.[9]

In other domains of expertise, such as sports, music, and chess, during the last 2 decades researchers have developed approaches that are not based on social criteria and knowledge-based conceptions

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of expertise. Instead, these approaches are founded on the measurement and analysis of reproducibly superior performance on representative tasks within the domain.[10,11] This approach—the expert-performance approach[10]—replaces the search for socially recognized "experts" or experienced individuals with a search for consistently superior performance in everyday life, such as selecting superior moves by chess players and producing superior treatment outcomes by nurses and medical doctors. Once the superior performance has been identified, investigators can then attempt to recreate the same situations and tasks in the laboratory and include relevant contextual factors such as time stress. The ability to reproduce the superior performance repeatedly under controlled conditions allows investigators to analyze the mediating thoughts and cognitive processes responsible for such superiority.[11,12]

In this article we will integrate the new emerging ideas about expertise as expert performance, many of which were presented in the first handbook of research on expertise and expert performance, namely, the *Cambridge Handbook of Expertise and Expert Performance.*[13] We will then apply this framework in describing the extensive body of research on expertise in nursing—perhaps the only major domain of expertise with a long and valuable history of research that was not covered in the new handbook. This article has 2 major goals related to the state of the art and future of research on nursing expertise. First, it will review the research on nursing expertise; discuss findings within the expert-performance framework; and propose new directions for research on superior performance, competence, and training in nursing. Second, it will assess the validity of some generalizable claims derived from the application of the expert-performance approach in a wide range of domains of expertise, such as chess, music, sports, and some professional domains, to empirical findings in the domain of nursing. Before starting the review, we will briefly discuss how the traditional views of expertise were adapted into the newer expert-performance approach.

## FROM THE STUDY OF EXPERTS TO THE ANALYSIS OF REPRODUCIBLY SUPERIOR PERFORMANCE

In their seminal theory of expertise, Simon and Chase[14] proposed that extended experience led experts to acquire a gradually increasing number of more complex patterns. With experience, experts were thought to be able to use these new patterns as cues to retrieve stored knowledge about which actions should be taken in similar situations. In a subsequent influential development, Dreyfus and Dreyfus[15] extended traditional theories of skill acquisition and proposed that human expertise is developed in stages. During the initial stage, learners try to acquire rules to govern their performance. With additional experience, learners reach a "marginally acceptable level" of performance and experience becomes "immeasurably more important than any form of verbal description." In later stages, the learners are able to transcend "the slow, detached reasoning of the problem-solving processes of the earlier stages."[15(p27)] Eventually, experts will develop the ability to know intuitively what to do and recognize critical aspects of the situation without any need for effortful search. According to the Dreyfus brothers, "experts don't solve problems and don't make decisions; they do what normally works."[15(pp30–31)]

Expertise researchers[14,15] assumed that extended experience would be sufficient for regular, or at least sufficiently talented, individuals to become experts and attain expert levels of performance. However, subsequent studies have shown that those with extensive experience or even vast knowledge in a domain—so-called experts—do not necessarily perform any better than less trained individuals.[11] For example, the length of experience and educational achievements of clinical psychologists, such as doctoral and master's degrees, are not correlated with improved patient outcomes after therapy.

Similarly, when very knowledgeable wine experts are required to detect, describe, and discriminate characteristics of wines without knowledge of their identity (ie, seeing the label on the bottle), their performance is only slightly better than that generated by regular wine drinkers.

In general, the research suggests that most individuals entering a new domain or profession improve their behavior throughout training and initial experience in the domain until they have reached an acceptable level of performance. Beyond this point, further improvements are unpredictable and the number of years of experience in a domain is typically a poor predictor of attained performance.[12]

Ericsson[11] proposed an alternative to the traditional studies of expertise that relied on peer nomination, extensive professional experience, and documented superior knowledge, to identify experts. This alternative approach, that is, the expert-performance approach, proposed that the focus should be on identifying naturally occurring phenomena of reproducibly superior performance that capture the essence of expertise in a domain. For example, if one were interested in the expertise of individuals working in healthcare, one might go to a hospital to observe physicians or nurses while they perform diagnostic procedures, make accurate diagnoses, and administer effective treatments. However, nursing and medical professionals in different settings will essentially never encounter the same patients with same diagnostic and treatment problems, which makes the comparison of patient outcomes problematic as a measure of individual clinical performance. The fundamental premise of the expert-performance approach is that it is possible to identify representative tasks of sufficient difficulty that capture the essential activities associated with superior performance in everyday life and that these tasks can be presented to experts and novices under standardized conditions. In other words, 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. The central claim is that only when some individuals (expert performers) consistently perform at a superior level compared to other individuals under standardized conditions can we legitimately infer that superior performance is attributable to individual differences in ability and skill. In sum, the application of the expert-performance approach to capture superior expert performance with representative tasks has been quite successful in a wide range of domains of expertise.[11,12]

Once the consistently superior performance of experts in representative tasks from the domain has been demonstrated under laboratory conditions, investigators have subsequently studied the cognitive processes mediating this performance using process-tracing and experimental methods and compared it to those of less accomplished individuals. A particularly informative method for tracing cognitive processes has been to instruct expert performers and less-skilled individuals to think aloud while completing representative tasks in their domains, such as chess, music, physics, sports, and medicine.[11,12]

In direct conflict with the traditional theories of expertise, think-aloud protocols from experts while they perform challenging representative tasks show that they are not generating their actions by intuition, that is, automatically recognizing patterns and retrieving their response directly from memory. Instead, they encode the relevant information with mental representations in working memory that allow them to plan, evaluate, and reason about alternative courses of action.[11] The expert-performance approach demonstrates that expert performers in many different domains develop a variety of mechanisms and skills, beyond mere recognition, that promote elaborative encoding and indexing in such a way that future retrieval demands can be anticipated and superior performance monitored and executed. Hence, an important theoretical distinction between these viewpoints is that, from the latter perspective, expertise is not merely a matter of the amount and

complexity of the accumulated knowledge or the ability to recognize patterns and schemas, it also reflects acquired cognitive mechanisms that allow the expert performer to keep refining and modifying representations even after extensive experience in a domain.

Once the mechanisms that mediate superior performance have been isolated and identified, investigators can start to examine how these complex structures developed, and if and how they were acquired. More generally, Ericsson et al[10] proposed that continued improvement (ie, positive change) in skilled performance is not simply the product of more experience. To improve their performance, future experts need to seek out particular kinds of experience, namely, deliberate practice—activities designed, typically by a teacher, for the sole purpose of effectively improving specific aspects of an individual's performance by offering opportunities to reach performance goals with repetitions, immediate feedback, and time for reflection and problem solving. The expert-performance approach argues that, during deliberate practice, improvements in performance and its mediating mechanisms are acquired. Ericsson and colleagues'[10] major finding was that individual differences between best and least accomplished expert musicians (where expertise was determined by the level of solo performance) by age 20 was the amount of time they had spent during their music development in solitary practice working on tasks and exercises assigned by their teachers during their weekly lessons. The best experts had invested around 10,000 hours in this type of deliberate practice, the least accomplished expert musicians had accrued around 5000 hours, and serious amateur pianists had accrued 2000 hours. The estimated amount of accumulated deliberate practice is closely related to the attained level of performance in many types of domains of expertise, such as chess, music, physics, sports, and medicine.[12]

The expert-performance approach offers a completely different theoretical framework for describing expertise in terms of measurable, reproducible performance that differs from the traditional views of expertise based on intuition and automaticity. The realization that expert performance is actively acquired through the engagement of deliberate practice has significant implications for instruction and for design of continued training environments in many types of professions, such as medicine and nursing.

## EXPERTISE IN NURSING

We now will review the research on expertise in nursing in a historical perspective and concentrate on the difficulties of capturing reliable performance differences. First, we will review the original research in which investigators attempted to describe expertise without any explicit criteria for which behaviors were associated with superior treatment outcomes. Then we will discuss Benner's work[2] on the qualitative differences in expert nurses' thought processes and subsequent efforts to study thinking with retrospective and concurrent verbal reports.[11] After a review of recent research on nursing expertise collected within the knowledge-based frameworks of expertise, we conclude with a search for evidence on reproducibly superior (expert) performance in nursing.

### Pioneering approaches to the study of expertise in nursing

There was much interest in the 1950s in training students to achieve effective nursing performance, but without any clear criteria for objective treatment outcomes. In a pioneering search for effective nursing practice, Bailey[16] used the critical incident technique to examine recollections of specific instances where a nurse had behaved effectively or ineffectively.

In a move away from merely collecting verbal recollections, Highriter[17] observed nursing behavior in actual nursing practice. She compared 2 groups of college- and hospital-trained nurses with respect to patient outcomes and rated their treatment of the patient and interactions with the patient's family. The

failure to find reliable differences between the rated performances of the 2 groups was inconsistent with "widely held assumptions in the nursing profession"[17(p497)]—in particular that more extensively trained nurses with college degrees would be more proficient at most tasks than those with only hospital training. Highriter proposed that most nurses were so busy that they did not have time to provide all aspects of nursing care, especially preventative care.

To control the differences in task-related or situational factors, subsequent researchers designed standardized tasks to permit reliable assessment.[18–20] In the first study assessing observational skills in nurses, Verhonick and colleagues[20] produced brief films (around 2 minutes in length) of different types of patients' behaviors. During each of 5 test trials the participants were presented with some background information regarding the patient before seeing a film clip. After the presentation of each clip, the nurses were asked to write down their observations of the patient from memory, along with suggested treatments and actions, and the associated rationale for their responses. The written responses were scored and points were awarded to participants for observing particular patient behaviors that had been identified a priori by the investigators as being most relevant. In one of the cases, a young woman had been told that she was to undergo radical surgery. Key observations, each receiving a point, are given in italics: "The patient is *lying* in bed *facing the wall* and her shoulder *heaves*. She *turns toward viewer* and is obviously *crying* and *upset*. *Respirations are jerky*. Her hands are *shaking* as she reaches for a *tissue* and *dries her eyes.*"[18(p531)] No statistical analyses were performed but Verhonick and colleagues[20] reported an impression that better-qualified nurses made more relevant observations and recommended more actions.

In a more controlled study with the same set of films, Davis[18,19] demonstrated reliable individual differences in the number of key observations made and actions recommended as a function of the level of academic training. However, the observations and treatment recommendations of the most experienced nurses, who possessed master's degrees and had more than 10 years of service, were rated dramatically "worse"—roughly half of the average score of any other group, including the least experienced nurses. Consequently, the filmed situations generated by Verhonick and colleagues[20] did not capture valid differences in effective nursing performance. We attribute the failure of these test films to the fact that the associated scenarios did not portray situations where a competent nurse would have to intervene immediately to protect or restore patients' health, thus the tasks were too simple to differentiate levels of performance

In a significant methodological advance, del Bueno[21] designed representative tasks with new realistic video scenarios that were explicitly designed to allow easy measurement of the nurses' responses to clearly identifiable pathological conditions. She replicated Highriter's[17] failure to observe differences in performance and found no reliable differences between nurses with different educational background, namely, those with bachelor's degree and diploma nurses. Del Bueno's work[21] appeared to us as the first application of the expert-performance approach to nursing.

## A phenomenological approach to the development of expertise in nursing

Between the late 1960s and early 1980s, considerable criticisms were raised against the traditional science of psychology and its problems of describing human expertise.[15] In a groundbreaking approach, Benner[2] studied the practical knowledge of professional nurses. She relied on a combination of observation and small group interviews to collect information on a variety of activities of expert and novice nurses. Of particular interest to our review, Benner discussed many aspects of the practical knowledge and thinking of expert nurses. For example, experienced nurses

reported being able to recognize subtle physiological changes as a result of "many hours of direct observation."[2(p39)] Experienced nurses had also assimilated their numerous experiences with patients and had developed assumptions and expectations that guided their actions and practice.

Drawing on Dreyfus and Dreyfus'[15] model of the acquisition of expertise, Benner viewed the development of expertise as a sequence of stages that result from increased professional experience. At each stage, skill level is primarily differentiated by the learner's ability to appreciate and act upon clinical situations. When an experienced nurse reaches the proficiency stage, he or she "perceives situations as wholes rather than in terms of aspects" and "perceive[s] [their] meaning in terms of long-term goals."[2(p27)] When a nurse reaches an expert level, on the other hand, he or she "operates from a deep understanding of the total situation; the chess master, for instance, when asked why he or she made a particularly masterful move, will just say; 'Because it felt right. It looked good.' "[2(p32)]

There is a considerable body of research that has explored Benner's[2] conception of nursing expertise in terms of a development of intuition and adaptation to specific professional contexts. During recall of critical incidents, Cioffi[22] found that experienced nurses reported experiencing "a feeling, a gut feeling"[22(p110)] when they "recognize deterioration or patients problems prior to explicit changes in vital signs."[2(p31)] However, some of these reports may reflect generalizations and the recollection of old memories. When Ellis[23] interviewed nurses *immediately* after completion of their shift, she found that both experienced and less-experienced nurses reported being engaged mostly in reasoning, and intuitive leaps were rarely reported.

When researchers moved even closer to monitoring thought processes concurrently with performance by having nurses "think aloud" *during* actual nursing practice,[24,25] investigators consistently found that, when assessed on routine cases, the structure and content of the thinking of expert nurses did not reliably differ from that of less-experienced ones. Less-experienced nurses were reported to display similar mechanisms to those of experts and both groups relied on pattern recognition that resembled intuitively guided action.

Greenwood and King[25] asserted that routine or everyday types of cases did *not* "require the accessing and deployment of concepts of the complexity thought to typify expertise,"[25(p912)] and thus expertise differences might only be observable with more difficult cases that would occur only occasionally during actual clinical practice. The rarity and nonroutine nature of these cases poses a problem for researchers who attempt to examine and explain expert-novice differences. A single low-frequency complex case that emerges spontaneously and without prior warning in a naturally occurring situation might take years to record in the average professional life of a given nurse. If the primary goal is to measure performance on complex cases in order to understand the true nature of expertise, timescales of such magnitude are unrealistic, particularly when one considers the low frequency of similar cases in everyday life. The necessity of a complementary solution is painfully obvious. To study those phenomena it is preferable to rely on simulated cases that can be presented in standardized form to many nurses with different training and experience. However, the use of simulated cases has been criticized, primarily for failing to adequately capture complex situations with decision making in the real world by omitting potential contextual influences, such as equipment layout, and staff and patient interaction.[26] The fact that some researchers have used oversimplified simulated cases, such as typed paragraphs of descriptions of patients that fail to incorporate relevant contextual factors, does not mean that the reinstatement of relevant contextual factors during simulation is impossible. In fact, Bryans[27] found that observations of behavior in actual practice corresponded well to behavior in simulated cases where nurses interacted with a trained actor who was coached

to reenact actual home visits of real patients in "realistic home sets."[28(p1246)] Similarly, in other domains of expertise, researchers have been very successful in reproducing real-life phenomena and thought processes in simulated representative tasks in nursing[29] and many other domains.[6]

In her observations of expertise, on typically routine tasks in naturalistic settings, Benner[2] has focused on the central role of intuition in expertise, when expertise is defined by the nomination of nurses by peers and their extended length of experience. However, these claims have been criticized in several articles[30,31] and concerns have been raised about whether experts, based on such definitions, would actually exhibit superior performance. Since Benner used self-reported critical incidents to infer performance characteristics of the nurses in her study, it is very difficult, if not impossible, to infer findings that indicate high levels of performance. In response to these criticisms, especially those raised by Cash,[30] and counter to the Dreyfus and Dreyfus[14] stage-model, Benner[32] committed herself to a definition based on excellent performance rather than experience: "Expert performance always occurs in a context. One who performs excellently in most situations might be considered an expert."[32(p672)] Consistent with the goal of defining expertise based on superior representative performance and identifying the mechanisms responsible for that performance, Simmons and colleagues[33] suggested that nursing expertise should be defined in terms of observable clinical reasoning skill, as reflected in thinking aloud for representative problems, rather than by the length of someone's clinical experience. From Benner's work we now turn to a discussion of expertise research that has taken a knowledge-based approach to examining individual differences.

## Knowledge-based approaches to nursing expertise: Expert-novice studies

The seminal laboratory studies of expertise in the domains of chess and physics found large and qualitative differences between novices and experts in the organization of their knowledge and thought processes[14,34] even with small samples consisting of only a handful of participants. Within this knowledge-based conception of expertise, researchers searched for any differences between novices and socially recognized experts rather than restricting the focus only to differences in representative performance.

Even when the tasks were representative and performance was evaluated, researchers were unable to discover differences between nurses differing in experience. Corcoran[35] found no statistically reliable differences between the rated accuracy of experienced and novice nurses' treatment plans (as assessed by a consulting expert). In a larger-scale study with 3 groups of around 15 practicing, advanced, and beginning nurses, Tanner and colleagues[36] presented a designed change-of-shift report followed by a short video and then asked the nurses to think aloud while preparing a treatment plan. Surprisingly, Tanner and colleagues[36] found that "there were basically no differences among groups which should have differed markedly in their knowledge relevant to the task."[36(p362)] As a result, they recommended a more focused study on a small number of individuals involving a large number of clinical cases.

The difficulties of finding reliable performance differences led researchers to examine data that could be collected for large samples of participants. However, even in studies with very large groups of participants there are documented failures to find reliable differences between differentially qualified and experienced staff. For example, Hamers and colleagues[37] had more than 200 pediatric nurses and more than 400 nursing students rate the level of pain experienced by children portrayed in a dozen video recordings of actual children. Surprisingly, Hamers and colleagues[37] found no reliable differences between pain ratings of groups. The pediatric nurses were, however, reliably more confident in the accuracy of their ratings than both students' groups.

In a study of 116 nurses with bachelor's and nonbachelor's education, Sanford and colleagues[38] failed to find any reliable differences between the 2 groups. They attributed the lack of difference and low performance primarily to the nature of the test environment used, and in general to the insufficiency of simulations to capture actual situations and everyday performance: "The videotaped scenarios only present specific cues based on sight and sound. The nurse has no history with the patient. She cannot ask questions, feel, touch, smell, or see the whole environment. It is like peering through a key hole and being expected to judge a situation."[38(p73)] These concerns about the lack of validity of the simulated testing situations have, however, not been supported by subsequent experimental studies. In a particularly interesting study, Corcoran-Perry and colleagues[29] found no structural differences in the diagnostic reasoning of expert and novice coronary care nurses while they thought aloud for hypothetical cases (derived from actual cases) and similar cases experienced during their normal practice. They concluded that "subjects' performances on hypothetical cases were valid representations of their decision processes in clinical practice."[29(pp57–58)]

More generally, reviews of the differences in competence between nurses with different training[8] verify the lack of evidence on validity and reliability of differences in performance when comparisons rely upon nurses with an adequate level of work experience. The lack of differences on tasks that do not capture representative performance but, instead, attempt to tap into the underlying knowledge base is consistent with research in several other domains of expertise. Social criteria of expertise, self-rating, and extended experience are not closely related to superior performance on representative tasks in medicine,[5,6] clinical psychology, and financial investment.[12] If the primary goal is to study individual differences in superior nursing performance then the expert-performance approach recommends that the first step involve identifying phenomena for which stable individual differences in nursing performance can be observed in everyday life.

## Toward capturing superior expert performance in nursing

Research on measurable performance of nurses and associated treatment outcomes has recently gained new momentum. Some of these studies are motivated by the issue of whether appropriately trained nurses are able to perform at a level matching or surpassing those of trained medical doctors. In a meta-analysis, Horrocks and colleagues[4] reviewed studies published until the end of 2001 and found that patient satisfaction is reliably higher when treatment is offered by nurse practitioners than when it is offered by doctors. They found no systematic differences in health outcomes, but nurse practitioners were found to keep more complete records and were more likely to identify physical abnormalities.

Even more relevant to assessment of individual differences in performance, several recent studies have used very large samples to examine the influence of characteristics of nurses on patient outcomes. Aiken and colleagues[7] examined the effect of educational level, number of years of experience, staffing levels, and workload on 30-day postoperative mortality. Mortality was significantly improved as the nurses' average educational level increased. Furthermore, lower nurse-patient ratios led to better quality of outcomes. In a recent study, Estabrooks and colleagues[39] reported that educational level of nurses was the most important determinant of outcomes; they also discovered that a richer nursing skill mix and higher quality nurse-physician relationships contributed to superior patient outcomes. Both Aiken and colleagues[7] and Estabrooks and colleagues[39] found that the average length of clinical experience of nurses was unrelated to patient outcome, in agreement with the earlier reviewed research.[5,6] The influential studies by Aiken and colleagues[7] and Estabrooks and colleagues[39] show clearly that when many

differences between and within hospitals are controlled statistically, reliable differences in patient outcomes due to individual differences in nurses can be identified. Unfortunately, these studies do not provide any clear direction for research at the level of individual nurses for several reasons. These studies are based on more than 200,000[7] and 15,000[39] patients, respectively, and those large samples permit investigators to demonstrate relatively small effects that would never be found to be statistically reliable with the number of patients treated by a single nurse or even on a single ward.

Let us therefore turn from these overall average outcome measures toward specific performance on tasks and procedures, where the mechanisms mediating superior performance of individuals can more easily be studied with laboratory methods. The expert-performance approach starts by identifying reproducible phenomena in everyday life and then attempts to capture these phenomena by designing representative tasks that preserve as much of the complexity and contextual factors as are necessary to reproduce the phenomena in the laboratory. In his review of expert performance in medical doctors, Ericsson[6] identified 3 promising areas of medicine where superior performance of some expert physicians had been documented, namely, perceptual diagnosis of pathology, diagnosis of diseases using patient information, and execution of procedures and treatments, such as surgery.

In a recent review of judgment and decision making in nursing, Dowding and Thompson[40] cited several studies of perceptual diagnosis of pathology by nurse practitioners. Most studies, however, were unable to demonstrate superior performance. An interesting exception is a recent dissertation by Henderson-Everhardus,[41] who measured the accuracy of vascular assessment in the detection of peripheral arterial disease by 76 nurses, with around 15 nurses at each of the 5 levels of Benner's expertise model, where novices had less than 1 year of cardiovascular nursing, advanced beginners and competent nurses had between 1 and 2 years of experience, and the proficient and expert nurses had more than 2 years of experience and frequent experience of these types of measurements. The only difference between expert and proficient nurses was that the experts had attained a specialty nursing certification. When comparing the nurses' assessments with a criterion standard (MRI/MRA scans and arterial ultrasound of the legs), only the expert group showed a clearly superior performance. The superior performance of the expert group is thus linked to its specialty nursing certification, which involved extended supervised training with feedback of the type that would be considered deliberate practice.[41]

A very attractive domain to study diagnostic performance is telephone triage. The duration of a client interaction is brief and the presented information is restricted and relatively easy to describe, and a criterion standard for accuracy is provided by additional diagnostic testing that almost invariably follows. Leprohon and Patel[42] found that nurses were mostly accurate in their handling of high-urgency situations and made mistakes primarily by having patients seek emergency help unnecessarily. A subsequent study by Marsden[43] showed even higher levels of decision accuracy for telephone triage of ophthalmic problems with no errors in denying service to patients in real need. None of these studies were designed to identify nurses with reproducibly superior performance and given that the observed level of diagnostic performance was quite high, it would be necessary to identify more challenging diagnostic situations that could be administered to all nurses to identify the superior performers.

Throughout the review it was difficult to find studies that attempted to measure representative performance of nurses and relate their performance to education, skill, and other individual differences. In one exception, Ung and colleagues[44] rated the performance of peripheral intravenous (IV) catheter placement and related the ratings to patient and nurse characteristics. They found that

years of general nursing was negatively related to quality of performance and, consistent with Aiken and colleagues[7] and Estabrooks and colleagues,[39] the best predictor of superior performance was the completion of a graduate diploma in specialization of nursing, such as critical care and emergency nursing.* Similarly, in a review Frey[45] found that the success rate of inserting peripheral IV cannulas by specialists (IV team nurses) was 60% higher than that for other nurses. These differences in success rate were even larger for children. Frey[45] recorded success rates of inserting peripheral IV cannulas by IV nurse specialists to be around twice those of staff registered nurses and around 4 times superior to those of physicians. In a more recent study, Jacobson and Winslow[46] trained volunteering nurses to collect data on their IV insertions and gathered several hundred instances with information on the outcome, the duration, difficulty, site and type of procedure, and characteristics of the patients (eg, age and race) and the nurse (eg, age, education, experience, and self-rated IV skill). They found that specialty certification was reliably associated with the highest level of success, which was 20% higher than that of nurses without this certification. Finally, they also summarized a number of methods that skilled nurses have developed when facing challenges, such as sclerosed veins, anxious patients, skin lesions, and "blown" veins. Of particular note, Frey[45] commented on an IV specialty nurse who demonstrated an accuracy of 98%, even for children who had been classified as "difficult access" by other nurses and physicians.

In sum, instances with consistently superior nursing performance discussed in this section were all linked to specialized training—a pattern observed by Ericsson[6] in his analysis of expert performance by medical doctors. We make a point of noting here that specialized training, higher levels of education, and experience are not one and the same, which would account for absence of a relationship between experience and performance, and the equivocal results for differentially educated nurses. Although the empirical studies documenting superior performance by select nurses in perceptual diagnosis of pathology, diagnosis of diseases using patient information, and execution of medical procedures are fewer than for medical doctors,[6] we attribute this scarcity to the virtual absence of studies explicitly designed to uncover and measure individual differences in performance. There is every reason to believe that when nurses are regularly assigned similar types of diagnostic and procedural tasks as those performed by doctors then nurses will exhibit a similar range of stable individual differences in acquired level of expert performance.

*This is a diploma awarded for specialized training beyond standard entry-level training of diploma nurses in Europe.

## GENERAL DISCUSSION AND CONCLUSIONS

Our review found that research on the experience and professional behavior of nurses started in the 1950s with a search for observed behaviors that typify perceived professional excellence. Research in nursing showed pioneering efforts to develop observations of behavior in representative nursing situations but had difficulties identifying tasks that elicited a reproducible performance advantage of college-trained nurses and nurses with extended experience. Our review suggested that a redirection away from the most typical situations to less frequent situations that are challenging and consistently reveal individual differences will allow researchers to identify superior performers for nursing tasks that require speed and flexibility. During the second phase of research on nursing expertise,[2] Benner pioneered the study of highly experienced expert nurses and focused on the special effects of extensive experience and the development of self-reported effects of intuition.

This focus on identifying professional experts in nursing matches the paradigms used to study expertise in other domains.[11,12] Our review revealed a trend in these studies of experts away from interviews and recollections of critical incidents toward concurrent and immediate retrospective reports of thinking in constrained professional practice. We even found studies with concurrent and retrospective reports of thinking in tasks with simulated patients or video-based case scenarios. Consistent with findings within the expert-performance approach we found support for the claim that to identify reliably superior nursing performance we need to search for challenging (often relatively rare) situations that require immediate responses where the associated performance can be captured and repeatedly reproduced in the laboratory.[11] Furthermore, we found that reproducibly superior performance in nursing was linked to more extensive training or activities where there was immediate feedback about outcome, such as IV insertions. When we limit generalizations to stable superior performance then the expert-performance approach has gathered considerable evidence that learning and improvement of performance is not a passive accumulation of experience but mediated by active engagement in deliberate practice, where aspiring experts acquire mental representations to monitor, control, and refine their performance.[11]

Related ideas of the development of superior performance have been expressed, albeit without sufficient recognition by researchers studying expertise in nursing. For example, Benner and Wrubel[47(p13)] wrote: "Experience is necessary for moving from one level of expertise to another, but experience is not the equivalent of longevity, seniority, or the simple passage of time. Experience means living through actual situations in such a way that it informs the practitioner's perception and understanding of all subsequent situations." The expert-performance approach has developed a theoretical account of how only some individuals keep improving their performance with experience and it specifies the nature of deliberate practice activities that have been found to be necessary for acquiring essential prerequisites for continued learning,[11] such as mental representations to allow monitoring, planning, and retrospective evaluation of different types of performance.

Traditional theories of expertise[2,14,15] can easily explain successful regeneration of previously generated behaviors and even how extensive experience may lead to its effortless and automatic elicitation. However, the mechanisms of intuition and automatic access cannot easily explain successful behavior in infrequent situations that have not been encountered previously and the ability to recover from unintended errors or misinformation. Paley[31] points out that Benner[2] had also thought deeply about the limits of intuition and explicitly discussed the need for expert nurses to respond appropriately to situations that they had not previously experienced as shown by this quote:

> Highly skilled analytical ability is necessary for those situations with which the nurse has had no previous experience. Analytic tools are also necessary for those times when the expert gets a wrong grasp of the situation and then finds that events and behaviors are not occurring as expected.[2(p34)]

Although many researchers have recently advocated the importance of reflection,[48] we believe that only by linking it tightly to activities designed to improve one's performance, ideally in situations that allow deliberate practice, will reflection lead to clear, reproducible performance differences.

Recent advances in the study and measurement of expert performance,[11,12] using tasks that capture performance with simulators, offer unique opportunities for assessment and training in medicine.[6] There are now several published studies on the use of simulation in the training of nursing students.[49,50] Larew and his colleagues[49] developed innovative simulations of "unstable patients"[49(p16)] using SimMan® inspired by Benner's[2]

theoretical framework of expertise. Their work was designed to deal with the large individual differences in students' ability to act appropriately in simulated situations and they generated a series of increasingly informative hints that would eventually allow all students to generate the correct diagnosis and the associated actions. Although this project was primarily designed to provide around 30 minutes of clinical experience for each advanced nursing student, they discuss future developments of methods for "valid and reliable methods of evaluating student's performance."[49(p21)] Alinier and his colleauges[50] focused on the effects of 2 to 3 hours of simulation training with SimMan for each student and demonstrated an associated improved performance on a 15-station Objective Structured Clinical Examination compared to a nontreatment control group. We believe that the expert-performance framework offers a complementary perspective on assessment and training that would enhance the use of simulators in the development of nursing expertise. It provides methodological tools for developing standardized tasks that capture and measure individual differences in performance on representative nursing tasks with an appropriate level of difficulty. It also provides direction to the analysis of possible methods for generating the appropriate actions (task analysis) and for identifying those cognitive mechanisms that mediate reproducibly superior performance using protocol analysis and experimental variation of critical situational factors. The assessment of the weaknesses in the development of the cognitive mechanisms should guide the design of individualized training for each student.

With the rapid progress of simulation technology it is becoming possible to use this methodology for both assessment and training of nurses at all levels of skill and expertise. With recent efforts to incorporate time stress and interruptions within the training scenarios, we believe that these scenarios will provide even skilled nurses opportunities to encounter challenging situations that will identify areas of potential improvement in cognitive mechanisms involved in awareness of relevant situation factors and appropriate plans for action.[35] These assessments can then, with help from master nurses, be converted into goals for deliberate practice and training tasks in which individuals can engage outside the simulator. We support Benner's proposal[2] to focus on attaining expert levels of performance in a few specific skills to help the developing nurse understand the process of attaining high levels of proficiency that can be generalized to the large number of required skills. By adjusting the rarity and complexity of the simulated condition and reducing the available time before the appropriate action must be taken before irreversible damage to patients will occur, it will be possible to challenge even the best performing nurse and thus provide feedback on aspects of performance suitable for continued training and improvement.

Most generally, the expert-performance approach and its application to a very large number of domains of expertise will offer an extensive body of integrated knowledge about the structure of human skill and expertise. In addition, it offers effective methods for attaining improvements. For example, researchers of nursing can rely on the work in medicine and many other domains on the development of expert systems, interviews of experts, and formal task analysis, as provided in reviews in the new handbook of expertise and expert performance.[13] Furthermore, researchers and teachers in the domain of nursing can contribute both insights and knowledge as well as find solutions developed in other domains of expertise, such as medicine, acting, and sports, to various measurement and training problems. The expert-performance approach can offer a conceptual framework that complements other existing ones[3] to increase reliability and validity of measurement and the effectiveness of future efforts to facilitate the acquisition of genuine nursing expertise, as reflected by accuracy, flexibility, and speed.[2]

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