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ABSTRACT

Well-conducted, theory-guided empirical research into school administration is important, but will never by itself provide ultimate answers to questions of human action, choice, and value. This paper describes the theoretical framework studies conducted by the Cognitive Approaches to School Leadership (CASL) Project. The paper explains central constructs in cognitive-science theory, such as problem space, problem structure, expertise, schema, and implications for the study and practice of school administration. Two CASL studies, which compared how practicing and novice principals viewed and talked about their work and problems, are described. Finally, the paper considers two areas of continuing concern: the use of think-aloud protocols (in which subjects think aloud as they work on a presented problem), and the difficult problem of selecting appropriate expert and novice subjects. (Contains 91 references.) (LMI)

Problem processing and the principalship:

Theoretical foundations and the expertise issue.

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More than three decades ago, Hemphill, Griffiths and Frederikson (1962) published their landmark account of *Administrative Performance and Personality* in elementary school administration. Then and now their detailed inquiry into how 232 principals responded to a rich set of simulated administrative problems stands as the most ambitious, detailed, and intensive study of its kind available. But in addition to the sheer magnitude of the data collected and analyzed, their study qualifies for landmark status as an exemplar of the kind of research which was promoted by the New or Theory Movement in educational administration. Research of this kind could be described as disciplined inquiry into theory derived claims about the nature and processes characteristic of organizations such as schools, and the behaviours and other states of individuals and groups who interact within such organizations, inquiry which makes use of and may rely extensively on attempts at measuring and analyzing variation within and between sets of defined variables. Critics of the Theory Movement, notably Thom Greenfield, questioned the relevance of such research to the human realities of life and work within schools. In more extreme criticisms, disciplined inquiry into the mysteries and mechanisms of administration through attempts at measuring theoretically grounded or derived variables is deemed to be not just inappropriate but also epistemologically invalid. As such there are some who wish to proscribe empirical or—to replace an adjective with an epithet—empiricist research in favour of interpretive explorations of the socially constructed worlds we know as schools, and the constantly contested exercise of and resistance to power which we call administration.

A complex set of interacting motives lie behind my decision to begin this paper with the preceding paragraph. The purpose of the paper is to clear the conceptual ground for those that follow by sketching the relevant theory base for the unabashedly empirical research activities which are to be reported and to discuss several central but worrisome concepts. But before jumping into the morass of detail that is needed to achieve these aims I thought it important to frame our research within the broader historical and epistemological context staked out by the first paragraph. One reason for doing so is simply to demonstrate that we are aware of that context and the deep and difficult questions embedded within it. Yet once we begin to immerse ourselves in the technical

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details of the research to be presented the waters of empirical inquiry will threaten to close over our heads making it difficult or impossible to subsequently acknowledge alternate ways of interpreting or explaining the world. In one sense, then, the opening paragraph may serve as a set of metaphorical water-wings which will hopefully keep both us and you from drowning in the empirical waters in which we must bathe. If, in addition to this, these water-wings help remind us all of the characteristic limitations of empirical research, they will have served us well. Chief among those limitations is the narrow, tightly focused, implicitly monochromatic view of the few elements selected for study which inevitably results. Such a view cannot hope to reflect much less fully represent the colourful complexities of administrative action as lived by participants or interpreted by observers—and it does not (or should not) pretend to. What it can do is identify regularities and contrasts within and between otherwise inaccessible states and processes which our best theories portray as underlying and constraining social action in general and administrative practice in particular. When empirical inquiry succeeds in this endeavour—and it may fail as often as not—then we are rewarded with potentially important nuggets of information which may help us better understand the limited area of inquiry addressed by the research responsible, and which may therefore contribute to building or modifying broader accounts of phenomena and processes of interest. In either case the findings which result and, more importantly, the manner(s) in which they come to be interpreted and understood, will help us or others find what appropriately placed arbitrators will eventually decide are better ways of doing important things. That is all that may reasonably be expected of empirical research. One of the unfortunate faults associated with the advent of the Theory Movement was a misplaced belief that properly conducted empirical research would produce something akin to a universal technology for the effective and efficient practice of administration. Such an idea grossly misrepresents the nature of the social world, the task of social science in inquiring into that world, the role of theory in building tentative explanations of aspects of that world, and the powers of empirical research in gathering potentially relevant information. This is not to say or suggest that we should abandon theory guided research into educational organizations and their administration in favour of the many flavours of interpretive inquiry now in vogue. Quite the contrary. In our view well conducted, theory guided empirical research into schools and their administration is more important than ever, provided that we recognize and accept that it will never, by itself, provide ultimate answers to the enduring questions of human action, choice and value. Nor, of course, will any of the trendy interpretive approaches. All that we may reasonably expect is a

steady and hopefully not-too-slow accumulation of reasonably reliable empirically grounded information augmented by insights and appreciations from interpretive inquiry which we will try to interweave into incrementally better accounts—theories if you like—of phenomena and processes of interest and importance. This is the broad end to which we sought to contribute in the research to be reported.

Hemphill, Griffiths and Frederikson (1962) justified their area of inquiry as follows:

> The administrative performance of the elementary school principal was chosen because of the high degree of interest in the problems associated with the principalship. Boards of Education, superintendents of schools, and the general public are demanding improved methods of educating and selecting school principals and of improving the administration of schools. (p.1)

And so it goes. Our reasons, along with those given by many others who have studied school principals in recent decades, were much the same, heightened by the steadily increasing importance of the principalship as the broad trend toward devolving increased responsibility to schools proceeds apace. That we and others should choose to focus for our work on a common topic is as it should be. The elementary principalship is the most numerous post in the profession of educational administration and is clearly a crucial one, being recognized by both theory and conventional wisdom as pivotally important in creating and sustaining good schools, and thus helping make or break the life chances of children and the future of their societies. Accumulating knowledge that will assist principals in enhancing their professional practice and aid aspiring principals to better prepare themselves for the responsibilities they seek is a project that will require a great deal of sustained empirical research, interpretive inquiry and synergetic theory building. So too with the development, testing and improvement of better selection processes. In retrospect, the Hemphill, Griffiths and Frederikson study was a good, useful, still relevant, but strangely neglected, start. Subsequent contributions by many other researchers have moved us along. The work reported in the papers prepared for this symposium[1] was intended to move us a little farther while making a contribution within the cognitive science approach to administrative work which we believe offers a promising way forward.

Background and Context

The research program which led to this symposium is grounded in what Leithwood and Hallinger (1993, p. 296) describe as the "loose, interdisciplinary alliance called cognitive science." As discussed by Simon and

[1] A list of the six papers prepared for the symposium appears at the end of the reference list.

Kaplan (1989) the disciplines numbered among this alliance include experimental, cognitive and social psychology, computer science, neuroscience, linguistics, philosophy—especially formal logic and epistemology—anthropology and economics (p. 3). Simon and Kaplan identify the goal of cognitive science "as the study of intelligence and intelligent systems, with particular reference to intelligent behavior as computation" (p. 1), or, if one prefers, information processing. Readily conceding the enduring absence of any satisfactory definition of intelligence, Simon and Kaplan nonetheless suggest that most of us would agree

> that people are behaving intelligently when they choose courses of action that are relevant to achieving their goals, when they reply coherently and appropriately to questions that are put to them, when they solve problems of lesser or greater difficulty, or when they create or design something useful, beautiful or novel. (p. 1)

The reference to problem solving has particular significance, studies and theories of how people work on and through different kinds of problems having become established as a major and characteristic line of inquiry in cognitive science. Their final comment also has particular significance for it turns out that many of the interesting and important problems worked on by administrators invite them to design innovative solutions, at least some of which have their own beauty.

Work in education has participated in the interdisciplinary alliance that is cognitive science in three main areas. Pioneering work on student problem-solving and learning by educational psychologists such as Bereiter and Scardamalia (1982, 1989) and Schonfeld (1985) has fuelled the development of new models of curriculum and instruction (Leinhardt, 1992; Murphy, 1991). Studies of the cognitive processes underlying the plans and actions of effective teachers as exemplified in Schulman's (1986, 1987) work and as reviewed by Shavelson and Stern (1981) and Clark and Peterson (1986) have stimulated reappraisals of teacher preparation practices (Clark & Lampert, 1986; Floden & Klinzing, 1990) and produced models of expert teaching (Berliner, 1986; Sternberg & Horvath, 1995). The third area of activity is educational administration wherein, as witnessed by the appearance of Hallinger, Leithwood and Murphy's (1993) *Cognitive Perspectives on Educational Leadership* and a special edition of *Educational Administration Quarterly* (August, 1993) devoted to that topic, increased attention is being paid to how administrators think about and through the problems that define their work.

Problem focused approaches to educational administration are by no means new. The Hemphill, Griffiths and Frederikson study incorporated a problem solving strand grounded in Hemphill's (1958) earlier analysis, while

the noteworthy volume *Problems in Educational Administration* by Strayer and his colleagues appeared as early as 1925. Case study analysis, which is pre-eminently a problem appreciation and solving activity, has long been used for instructional purposes (e.g. Sargent & Belisle, 1955; Hoy & Tarter, 1995), and frequent references to the problems of practice and the administrator's obligation to deal with them can be found throughout the broader disciplinary literature (e.g. Haller & Strike, 1986; Sergiovanni, 1991). But while problem oriented and solving approaches to educational administration are not new, the cognitive science approach as pioneered by Leithwood and his colleagues constitutes an important theoretical departure from established assumptions and approaches.

The key disjunction lies in differences between established theories and normative models of administration as decision making and the applications and implications flowing from cognitive science theories of problem solving. It is important to stress that this distinction is rooted in differences between theories of how individuals and organizations identify and respond to situations, rather than an idiosyncratic preference for thinking and talking of administration as decision making or problem solving. There can be no question that administrators make decisions or that they influence collective and individual decisions made within their organizations: deciding *is* the quintessential administrative act. But how may we best understand and inquire into the processes by which administrators reach—or avoid—their decisions? The models of decision making typically presented in our textbooks as guides for solving administrators' problems (e.g. Hoy & Miskel, 1991, pp. 51-52 & Chapter 10; Hoy & Tarter, 1995; Owens, 1987) are plagued by notorious limitations when it comes answering this question. By concentrating on ways of generating, assessing and choosing between alternatives these models typically focus attention on the resolution and disposition of presented problems while eliding or even ignoring broader information collection, processing and interpretation activities that preceded and underlie initial and final commitments to decision. In consequence, and as has been widely commented on by administrative philosophers such as Greenfield (Greenfield & Ribbins, 1993), Hodgkinson (1978) and Vickers (Open Systems Group, 1984), established theories of administrative decision making cannot readily accommodate the existence and influence of personal values on an administrator's dispositions and actions. Moreover, as shown by Mintzberg's (1973) pioneering observational study and others that followed, established theories of decision making fail to accurately or even adequately reflect how administrators go about their work and actually decide matters. Cognitive science theories of human problem solving promise to help redress these limitations by directing attention to how

administrators and others recognize, think, talk and generally work on problems. This allows an administrator's values, as well as his or her professional knowledge, individual ability, and general reasoning to enter directly into theories and analyses of administrative action. As Leithwood and Hallinger (1993, p. 298-9) put the point, "Cognitive perspectives remind us that what administrators do depends on what they think—their overt behaviours are a result of covert thought processes." More comprehensively, cognitive theories focus attention on *how* administrators recognize, discover, interpret, choose, and work on problems of practice while also providing a framework within which to compare how different administrators view and work on more and less similar problems.

For clarity, a further distinction needs to be made between cognitive science and other theories of problem solving. While the more or less rational models of decision making referred to above have provided the major established theoretical and normative frames for established approaches to considering problem solving in educational administration, contributions by Getzels (1979), McPherson, Crowson and Pitner (1986) and others have addressed administrative problem solving through various alternative frameworks. For the most part these frameworks were derived from Gestalt and associationist psychological theories within which successful solutions to problems flow from finding ways to reconceptualize situations or free otherwise blocked responses. In the broader literature these approaches undergird popular practical techniques such as brainstorming (Osborn, 1953), synetics (Gordon, 1961) and the group problem solving principles discussed by Maier (1970). These approaches have little in common with the cognitive science derived theories of problem solving informing our work and that of Leithwood and his colleagues, to which we now turn.

Theoretical Framework

Problems are generally understood as difficult situations where the appropriate course of action is undecided, unclear, undesirable or all of the above. Haller and Strike's (1986) useful definition reflects these elements by observing that "we have a problem when something is wrong or when something can be made better" (p. 1). Cognitive science approaches to problem solving readily accommodate such definitions, but typically emphasize task completion under conditions of uncertainty. As Simon (1978, p. 272) put it, "a human being is confronted with a problem when he has accepted a task but does not know how to carry it out." As discussed in

greater detail elsewhere (Allison, 1996), the central constructs in cognitive science theories of how people go about doing this are problem space, structure and schema together with the related notion of domain expertise.

Problem space

Problem space is understood as the mental representation of a presented or discovered problem formed by a potential solver. It is thus a conceptual analogue of how someone understands a problem. It is defined by the initial or current state, that is the uncompleted task or the situation to be made better, the goal state, this being the completed task, the corrected or improved situation, and the space, the "distance," between the two. The search for a solution is viewed in terms of seeking a path through the problem space from the current to the goal state. This is attempted by applying and manipulating "operators," that is the rules and procedures, appropriate to the task at hand. A commonplace example would be writing a letter or memo. The goal state is a completed letter that will hopefully have the desired effect on the recipient. The initial state is the blank piece of paper or computer screen and the writer's knowledge about the circumstances that have lead to the need for a letter as well as his or her technical knowledge about how to write letters. The operators that must be manipulated to cross the problem space and complete the task are the words and phrases needed to express what needs to be said, and the rules of grammar and style needed to properly, pleasingly and persuasively combine words and phrases to accomplish the goal.

Searches for a suitable path across a problem space do not all always succeed, in which case the attempt at solution will be postponed subject to the acquisition of additional information, or perhaps abandoned. On occasion, individuals or groups may work on problems for a considerable time, searching for paths through the space, collecting new information to update or refresh the problem space, searching again, and so forth, before eventually abandoning the search for a solution. For this and other reasons, we prefer the phrase problem processing to problem solving so as to recognize that not all attempts at seeking solutions to problems succeed. Moreover, finding an appropriate and acceptable path across a problem space—seeing how to solve a problem—will not necessarily lead to a quick, or indeed, any solution, for a substantial amount of work and or time may be necessary to modify the relevant elements of the physical or social system within which the actual situation is located. This is particularly so for administrators who must typically work through and with other people when attempting to resolve organizational problems, some of whom may have formed quite different problem spaces around alternate

goal states to represent their understanding of the situation, or may prefer alternate paths through a commonly defined space. Because of this, problem spaces formed by administrators to represent other than rapidly resolved situations will be constantly subject to refreshment and revision in the light of changing circumstances and unanticipated developments.

Problem structure

The degree of structure present in a problem is represented by the state of the problem space at a given time. Well-structured problems are those for which the processor is able to construct a accurate representation of current and goal states and readily identify the operators to be applied when seeking a path to the goal, as when writing a straight forward letter. A high degree of structure does not necessarily make the search for a solution path easy or effortless, although that will be so at times, nor does it guarantee that a solution to the problem will be found. It does, however, signify that the solver has a sufficiently firm grasp of the problem to start and continue working on it. An ill-structured problem obtains when there is uncertainty about any or all of the three defining states—when the solver cannot readily identify the current and/or goal state, and/or is unsure about the relevant rules or procedures for moving from one to the other. Confronted with a task for which he or she can only create an ill-structured problem space a potential solver may literally not know where or how to begin working on the problem. Some tasks appear inherently more ill-structured than others. For principals, requisitioning school supplies will likely appear as a more highly structured task than organizing a school trip which in turn is a more structured problem than revitalizing a moribund school. Yet problem structure, like beauty, is determined through the eye of the beholder, for what is an ill-structured problem for one person may be relatively well-structured for another. The difference rests on the familiarity of the task at hand and the amount of relevant knowledge and skill that can be brought to bear on its completion. Most of us would find the task of composing a fugue to be an extremely ill-structured, indeed impossible problem, but for the mature J. S. Bach this was presumably a relatively straight-forward, reasonably well structured, task. So too with specialized problems in other domains. For an experienced school principal, organizing and supervising a school trip will likely be a highly structured chore which can be attended to with little difficulty; as easily, perhaps, as most of us drive our vehicles to work in the morning. For a beginning principal the same task may be less well structured and thus more difficult.

A similar difference is considered to apply in the case of inherently more ill-structured and demanding problems, such as transforming a school. This is clearly a much more open, diffuse and contingent challenge than organizing a school trip, so much so that it qualifies as the kind of highly ill-structured task recognized as a *design* problem by Simon (1973). Design problems characteristically require solvers to invent a unique solution, as in composing a fugue or transforming a particular school. They will also typically have an imprecise goal state—we have a general idea of what is required—an undesirable situation made better, a finished fugue, a transformed school—but the details of the final outcome are unknown when the individual or group concerned begins working on a design problem. Such tasks also typically involve sets of nested sub-problems, the resolution of which will constrain and help shape the final outcome. Working through design problems will also often take an extended period of time, extending over years or even decades in some cases. As shown by Reitman's (1965) analysis of how a composer actually wrote a fugue and illustrated by Lighthall and Allan's (1989) study of attempts at school transformation, the initial open and ill-defined problem space and goal state gradually acquire greater structure as progress is made, initially open constraints are closed, sequential choices made, and sub-problems are resolved in the pursuit of a satisfactory outcome. Just as we would expect an outstanding musician such as J. S. Bach to be better able to set about composing a fugue than a first year music student, it seems reasonable to expect that an experienced and previously successful principal would be able to inject relatively greater initial structure into the problem of transforming a school than a recently appointed colleague. Moreover, we would expect the more experienced principal to be able to draw on and apply a richer set of relevant knowledge and appropriate procedures as she worked on transforming the problem space, and thus the school.

Expertise

From the argument to this point, proficient problem solving hinges on being able to draw on and apply knowledge and skills appropriate to the problem at hand. People who are able to do this reliably are credited with having acquired expertise in solving the problems associated with performing certain tasks. The limitation to "certain tasks" turns out to be important and interesting. Most of us can lay claim to expertise in solving the problems presented by tasks encountered in the course of everyday life. On reflection, such tasks are not inherently easy, they only appear so because of their familiarity. The everyday tasks of communicating through the media of

oral and written language, for example, or of conforming to the social mores and norms of our workplace are inherently complex, yet are so familiar as to be relatively unproblematic. Indeed, most of us have developed rich repertoires of highly automated procedures and scripts cued to linguistic and social conditions which we rely on with little conscious thought as we navigate the complexities of everyday life. When we are confronted with tasks where the appropriate course of action is unclear, such as writing an important letter perhaps, or programming our VCR, or finding our way to a location we have never visited before, we will usually be able to construct a relatively well structured problem space, and then find an appropriate path through that space with little difficulty. Studies of how experts in specialized areas of endeavour, such as physics, chemistry, political science, medical diagnosis and more mundane activities such as taxi driving and typing, suggests that specialized expertise rests on the same cognitive foundations as the more commonplace expertise acquired in the course of everyday life. In much the same way that people become familiar with commonly encountered tasks and problems, experts in specialized domains become familiar with the more esoteric tasks they must accomplish in doing their everyday work. And in much the same way that people develop and rely on automated, proceduralized responses and scripts when reacting to commonly encountered situations in everyday life, experts in specialized domains develop and employ similar routine responses to commonly encountered tasks and problems in their domains. As Simon (1993, p. 403) has expressed it, "any expert can recognize the symptoms, the cues, to the bulk of the situations that are encountered in his or her everyday experience." Having done so, he or she can often readily retrieve an appropriate automated response from memory or, if such a response is not available, draw on relevant knowledge to construct a reasonably well structured problem space within which to search for a solution. Confronted with the same situation, non-experts in the domain concerned typically fail to notice or misinterpret the relevant cues, or if they do recognize their significance, they are often unable to rely on an appropriate proceduralized response and have to fall back on constructing a problem space through which they will search for a solution path using whatever relevant knowledge and operators they can bring to bear.

Expertise, then, is associated with the possession of substantial amounts of domain specific declarative and procedural knowledge, and the ability to accurately retrieve and apply this knowledge to specific tasks and associated problems. Simon (1993, p. 403) notes that expertise in any domain probably requires the acquisition and integration of at least 50,000 familiar, retrievable memory chunks. His comparison in this respect to the

100,000 or more words in the vocabulary of an educated person helps illustrate the dimensions of what might be called everyday linguistic expertise. Still, knowing a lot of words will not by itself ensure that someone can navigate the problem space defined by the need to write a sentence or a letter. As noted earlier, one must also master the elements of grammar and style necessary to operate on the problem space. Moreover, and more interestingly, one must also develop an accurate and efficient means of locating and retrieving appropriate words, phrases and combinatorial rules from memory. Working through all the words that one knows alphabetically in search of an appropriate term will clearly not do. So too with the specialized chunks of domain knowledge held by experts in their specialist areas. As with everyday vocabulary, the knowledge which is the raw material of domain expertise appears to be stored in memory in interconnected ways which facilitate task relevant access and retrieval. The schema construct has emerged as a powerful way of modelling this process. As VanLehn (1989, p. 569) put it "it looks as though schemas are the key to understanding expertise."

Schema

As defined by Gick (1986, p. 102) a schema[2] is "a cluster of knowledge related to a problem type. It contains information about the typical problem goal, constraints, and solution procedures useful for that type of problem (Gick & Holyoak, 1983)." The more detailed definition proposed by Taylor and Crocker (1981) in their extensive review draws attention to important organizational properties of schemata:

> A schema can be thought of as a pyramidal structure, hierarchically organized with more abstract and general information at the top and categories of more specific information nested within the general categories. The lowest level in the hierarchy consists of specific examples and instances of the schema (e.g. specific people or events). The schema is connected to other schemas through a rich web of associations, particularly at the lower levels of greater specificity. (p. 92)

Experts' domain specific schemata are thought to be much more richly organized and interconnected than those of non-experts. They are considered to contain many embedded sub-schemata, sets of pre-formed problem spaces with known solution paths and short cuts, many automated responses and scripts keyed to diagnostic cues, as well more hierarchical levels of abstraction (Rumelhart & Norman, 1983). As expressed by Reimann and Chi (1989, p. 172) "experts have developed several layers of this hierarchy, whereas only the first level ... seems to be developed for

[2] Both Taylor and Crocker and Schacter (1989, p. 692) credit Sir Frederick Bartlett with the first use of the term schema in the psychological literature. As quoted by Schacter, Bartlett (1932, p. 201) originally defined a schema as "... an active organization of past reactions, or of past experiences, which must always be supposed to be operating in any well-adapted, organic response".

the very beginning novices. As skill is developed, the hierarchy develops into a complete tree with many levels of embedding." These higher levels of abstract representation enable experts to recognize general principles, cues and "second-order features" (Chi, Feltovich, & Glaser, 1981) characteristic of particular types of problems which typically escape novices.

Schemata serve to guide the way people perceive the world by directing attention toward or away from aspects of a task. As illustrated in the Lesgold *et al.* (1988) study of X-ray interpretation, experts in this domain literally saw X-rays differently from novices, noticing more elements and making more connections between them. Schemata also serve to filter and match task relevant information to appropriate elements or variables in pre-formed problem spaces. These variables, or *slots,* are associated with default values that are assumed to hold until replaced with specific data, or *fillers*, from the task to be completed (Mandler, 1979; VanLehn, 1989). When the appropriate slots are filled with task specific information, a standard solution procedure can often be activated by firing an automated response or retrieving an appropriate script. This represents the most straight-forward form of schema driven problem processing, called routine problem solving by VanLehn (1989, p. 545). But while it may be routine in the sense that it provides experts with a usually reliable and relatively rapid means of responding to commonly encountered problems, the amount of work to be accomplished may still be substantial. Extracting the relevant information from a task environment and then fitting it, or *instantiating* it, into a schema may be demanding and time consuming. When dealing with more difficult problems, domain experts also seem to rely heavily on their schematic knowledge, the major difference between experts' responses to routine (for them) and more difficult problems hinging on schema selection. In Larkin's (1983) study of expert physicists' responses to difficult problems, some immediately activated an appropriate schema, but others initially applied one or more incorrect schemata, only to abandon these in favour of another choice when it became clear they would not lead to an acceptable solution. Such behaviour is behind Simon's (1993, p. 404-6) earlier noted observation that expertise is largely a matter of recognition and habituated response.

Reimann and Chi (1989, p. 180) caution "We do not yet have enough data about how experts work on 'difficult' problems, at least not in physics." Research based knowledge addressing problem processing in less well structured knowledge domains, such as administration and similar social action domains is even scarcer, and it may yet turn out that the theory of expert problem processing developed in these paragraphs does not capture or

satisfactorily address the more open and inherently uncertain task environment within which administrators act. The Voss and Post (1988) inquiry into expert and novice differences in responding to a political science problem constitutes one major, frequently cited, study that addressed problem processing under uncertain conditions. Voss and Post's subjects were asked to work on the design problem of increasing crop productivity in the then Soviet Union. The experts characteristically relied on two general tactics: *decomposition*, in which the main problem was broken down into a set of sub-problems, usually no more than three, and *conversion*, in which a sub-problem was converted into a solvable problem—that is one to which an existing schema could be applied. The initial diffused and ill-structured design task was thus broken down into sub-problems which could be addressed by drawing on schematically indexed knowledge to derive an initial plan in much the same way as experts in physics and similarly well organized knowledge rich domains also responded to difficult problems. A important addition is that Voss and Post's experts "built a case for why the proposed solution would work" (p. 274). In other words, in addition to devising a plan which satisfied their own criteria, they recognized that any acceptable solution would have to satisfy fellow members of the relevant problem solving community. This is a condition which must be presumed to apply in other specialized domains where practitioners often encountered design problems, such as administration.

Implications for study and practice in school administration

The ingredients of the theory of human problem processing sketched above appear to offer a valuable framework within which to study the nature and practice of administration in general and educational administration in particular. Among the more obvious lines of inquiry presented are the identification of the tasks characteristic of particular positions, such as the school principalship; exploration of how the degree of structure associated with or attributed to those tasks varies with experience, expertise, context, and personal characteristics such as values, training, leadership style and so forth; investigation of how experts and novices understand more and less highly structured problems in the domain—the nature of the problem spaces they construct; studies of how more and less expert administrators process problems—how they find their way across characteristic problem spaces; and inquiry into how proficient administrators organize and access schematic memory—the cues they rely on to identify and classify particular situations so as to retrieve potentially appropriate schemata together with the

procedures, scripts and other stored knowledge accessed through those schemata, and the slots and default values embedded in them. The implications for the improvement of professional practice and the training and selection of future administrators may be substantial. Building informed understandings of how more expert school administrators recognize, classify and process important domain problems and clarifying differences between how they and less proficient practitioners understand the domain of practice will certainly provide useful models for critical examination and reflection in training and developmental activities. But while such models will undoubtedly be valuable, the theory sketched above implies that they will not provide shortcuts to the acquisition of expertise, which requires the mediated learning that can only be gained through direct experience. Indeed, the theory predicts that true novices will likely be unable to appreciate or even fully understand the subtle and rich complexities of expert problem recognition and processing, and thus may be unable to learn much of value by directly studying expert behaviour. More direct training benefits will likely stem from developing informed understandings of the tasks and situations novices see as unstructured and difficult, in the creation of appropriately sequenced learning and development activities for those preparing for administrative positions, and in the provision of supporting processes which may help new appointees learn more efficiently from their experiences.. Better informed models of administrative expertise will also help in the more reliable selection of mentors. These and other potential benefits will nonetheless require considerable direct research into the nature of administrative work and problem processing before they are likely to be sensibly realized. For this reason we share Leithwood and Steinbach's (1995, p.314) concern that in the absence of a more solid research foundation, the rapidly growing popularity of Problem Based Learning techniques in training school administrators (e.g. Boud, 1985; Bridges, 1992) may put the practical cart before the theoretical horse.

Related research

Four bodies of research literature are pertinent to the development of problem processing approaches in educational administration. The first, obviously, is the cognitive science literature underlying the theoretical frame sketched above, particularly the past two decades of research investigating the nature of domain expertise. Reviews by Ericsson and Charness (1993), Reimann and Chi (1989) and VanLehn (1989) summarize much of this literature while Simon (1993) has recently provided a richly informed yet colloquially rendered account. The second body of

pertinent research is the varied set of studies in the broader literature considering how administrators think. Some of this literature, such the studies of problem classification by Cowan (e.g. 1986 & 1991) and Day and Lord (1992) and the discussion of strategic decision making by Schwenk (1988) is explicitly grounded in cognitive science theory. Other valuable contributions, including chapters in Srivastva's (1983) *The executive mind*, and Isenberg's (1984) *How senior managers think* adopt more inductive approaches. Earlier work, especially Mintzberg's (1973) now classic *The nature of managerial work* which incorporated an information processing approach and some of Vickers' (e.g. 1984) essays make particularly insightful contributions to this literature, many of which are readily accommodated by the cognitive theory of problem processing outlined above.

The third body of literature consists of previous empirical and interpretive studies of educational administrators and their work which, while not conducted within a cognitive science framework, can yield data relevant to and interpretable within the problem processing approach. The Hemphill, Griffiths and Frederikson (1962) study with which we began provides a good case in point. One of their more powerful and consistent correlates of principal performance as gauged by both subjective ratings (p. 242) and scored responses to simulated tasks (p. 152) was participants' scores on a standardized test of declarative knowledge about then current principles of school supervision and administration. While Hemphill *et al.* concluded from this that formal tests of professional knowledge could be useful in screening candidates for the principalship (p. 337), they were unable to provide any coherent theoretical explanation for the predictive power of the observed relationship beyond the common-sense conclusion that more professional knowledge is a good thing. Contemporary cognitive science theories of expertise predict and provide a coherent explanation for the observed relationship, possession and accurate retrieval of substantial domain relevant declarative knowledge from schematically organized memory being engine of expertise. This should not surprise us, of course, as we should expect newer and hopefully better theories to explain historical data while also predicting new relationships. Hence findings from previous studies, as in the example given, will be pertinent to the future development of problem processing theory and research. A less obvious bonus of cognitive theories of administrative problem processing is that in addition to accommodating empirical data they are also readily applicable to extant interpretive accounts of school administration. Wolcott's (1973) ethnographic study of the work of principal Ed. Bell provides examples and illustrations of domain tasks and actions readily accommodated by problem processing theory, as do Gronn's (1984; 1985) studies and,

although they explicitly reject a cognitive approach in their introduction. Lighthall and Allen's (1989) rich account of attempts at school change. The fourth body of literature is the research which has adopted an explicit cognitive science approach to the study of educational administration.

Cognitive based studies of educational administration

By far the bulk of this work has been conducted by Kenneth Leithwood and his associates, who must be credited with pioneering cognitive science derived research into school and school system administration. Leithwood's initial interest in this line of inquiry grew out of his earlier studies of school principals which culminated in *The principal profile* (Leithwood & Montgomery, 1986). That work produced a behaviourally based stage model of principal effectiveness, in which the highest level, most effective performers were described as "systematic problem solvers." The theoretical framework accompanying the profile (Chapter 7, pp. 114—133) was derived from an information processing view of administrative action grounded in Newell and Simon's (1972) early work on human problem solving which was a precursor for contemporary cognitive science theories of problem processing. A subsequent study by Leithwood and Stager (1986; 1989) explicitly incorporated major elements of cognitive theory and provided the foundation for further work by the Leithwood group.

The Leithwood and Stager (1986; 1989) study probed how 22 elementary principals, six of whom were designated as experts, attributed structure to six case problems and then thought their way through those they considered most and least structured. In general conformity with the theory outlined earlier, analyses of the transcripts of how these principals responded to the case problems showed that while they were all able to retrieve automated responses from memory for those they saw as well structured, differences were apparent between how members of the designated expert group and the more typical principals viewed and thought about the presented problems, especially with regard to those they saw as less structured. While less structured situations were regarded as complex and difficult to solve by most subjects, members of the expert group typically regarded them as manageable and often outlined detailed plans—provisional paths through the problem space—for dealing with them. In contrast, principals in the non-expert group appeared less confident when dealing with the problems they saw as poorly structured, gave less attention to planning a response, and the plans they did develop were much less detailed and complete. In short, the designated experts seemed markedly more willing and able to handle the

situations they saw as less structured than did the more average principals. Leithwood and Stager summarized their findings by observing "our data suggest that in response to ill-structured problems, highly effective principals use processes similar to those used by experts in other fields. We collected no obviously disconfirming data" (Leithwood & Steinbach, 1995, p. 66). Given that the bulk of previous research into cognitive models of expertise had dealt with more highly organized knowledge domains such as physics, chemistry and chess, this was an important finding which cleared the way for further work in the less well organized knowledge domain of educational administration.

Much of the subsequent work by the Leithwood group, which has included studies of individual and group problem processing by principals and superintendents as well as an attempt at mapping the task domains of principals, has recently appeared in a collected edition of the original research reports (Leithwood & Steinbach, 1995). Throughout this work the framework originally developed for analyzing the transcripts generated by the original Leithwood and Stager study has been further developed and refined to yield what can be called the Leithwood model of administrative problem processing. This model contains three main processes: Understanding, which incorporates problem *interpretation* and *goal* setting activities; Solving, which subsumes identification of *constraints* to reaching a solution and *solution processes* employed in dealing with a problem situation, and Disposition, which refers to the *values* underlying and guiding a search for solution and the *mood* states of solvers as they work on problems. Within this framework, the more expert principals studied by the Leithwood group have been found to typically (1) take greater care and work harder when seeking to understand difficult problems (seek to create more representative problem spaces) and anticipate that other participants will likely understand the situation differently; (2) seek to achieve multiple, generally broad, coherent and clearly articulated goals (develop a clearly defined goal state) while remaining open to new information and ideas; (3) anticipate constraints—difficulties to be overcome—and develop or retrieve from memory plans and procedures for dealing with or circumventing anticipated constraints (plan flexible paths through the problem space); (4) appear able to draw on a richer and more complete sets of solution processes (deploy generally appropriate operators for traversing the problem space); (5) are more aware of and more frequently articulate their values, which generally encompass commitment to the pursuit of socially approved educational and professional goals and practices together with respect for others; (6) typically appear calm and confident when working on problems.

There are currently very few other published studies that directly apply a cognitive based problem processing approach to educational administration. The collection of relevant work recently published by Hallinger, Leithwood and Murphy (1993) contains valuable chapters reviewing pertinent theory (Ohde & Murphy; Wagner; Yekovich) and reports and studies of instructional applications (Hart; Kelsey; Prestine), but the only chapters reporting original research into how educational administrators worked on problems were two studies from the Leithwood group (Raun & Leithwood; Leithwood & Steinbach) and a report on some of our own work (Allison & Allison). A recently reported study by Bullock, James and Jamieson (1995) helps shed light on how novice and expert educational managers in the United Kingdom view and interpret their work, but neither the design nor the analysis takes explicit stock of cognitive theory as outlined above.

The CASL Project

Our Cognitive Approaches to School Leadership project had its roots in earlier studies by Nagy and P. Allison (1988, 1989) and Nagy and Moorehead (1990) of how principals thought through case study problems. Initial attempts at producing diagrammatic models of how subjects constructed and worked through problem spaces were unsatisfactory, but other lines of inquiry suggested that the use of checklists and similar kinds of case grounded marking schemes could identify meaningful differences in how principals worked on the presented problems. Building on this earlier work, we embarked on what we have come to think of as the first round study in the Principal Problem Processing strand in the CASL Project. Other studies underway as part of the CASL Project include inquiry into how principals view and talk about their work and problems (Allison, Morfitt & Allison, 1996) and a study of task complexity and time-span of discretion in school systems based on Jaques' (1976, 1989) theories of organizational depth structure and cognitive power (Allison & Morfitt, 1996), some elements of which were also addressed in our second PPP study as discussed in the paper on cognitive complexity prepared for this symposium.

As described by Allison and Nagy (1991), our first round PPP study collected data on how 29 elementary principals and 10 true novice subjects thought aloud when responding to a case problem in school leadership. As reported in Nagy (1991) and Allison and Allison (1993) we made some progress devising techniques for analyzing the think aloud transcripts generated in that study. A second round of data collection involving 30 principals and

24 naive subjects was undertaken in 1993 and 1994 incorporating design features to overcome what we had come to recognize as weakness in the first study. This second study constitutes the prime focus of the papers prepared for this symposium although some use is also made of data from the first round study. The design of the second study together with an explanation of how various measures of imputed expertise were derived is dealt with in one of the accompanying papers, others reporting results from different lines of analysis. This introductory paper moves now to consider two areas of continuing concern in studies attempting to explore how people represent and work on domain problems through comparative studies of experts and novices in the domain concerned, namely think-aloud protocols and the difficult problem of selecting appropriate expert and novice subjects.

Think aloud protocols

As Simon and Kaplan (1989, p. 21) observed, "Protocol analysis, the use of verbal reports as data, has become an increasingly important (but often misunderstood) technique for studying human intellegence"—by which they mean the broad set of problem processing and design activities referred to in their earlier quoted description. Much of the misunderstanding associated with this method stems from confusion over purpose. The objective is not, as is sometimes assumed, to have subjects *explain* their thought processes as they process a task—to provide us, as it were, with their theory of how they think. To the contrary, the objective of the exercise is to collect data, data which will then be analyzed to test and develop externally generated theories and models. These data may be generated in several ways, but the most widely used technique involves asking subjects to think aloud as they work on a presented problem. This technique generates what Simon and Kaplan call concurrent protocols. What they refer to as retrospective protocols are generated by asking subjects to report everything they can remember about a problem processing activity immediately or as soon as possible after completion. We used both techniques in our PPP studies, having subjects think aloud as they worked on a case problem and then, when they had finished, asking them to tell us everything they could remember about how they tackled the problem. Both episodes were audio taped and then transcribed. The concurrent protocols are analyzed to identify what elements of the case and related knowledge subjects heeded, and to try and map their thought processes. The retrospective protocols are used primarily to model how the case was understood and the goals subjects were seeking to achieve.

Another potential misunderstanding confuses data with action. The objective of a think aloud session, once again, is to generate data about how a participant thinks about a problem, and not to predict how he or she would handle a similar situation in real life. We would naturally expect some correlation to exist between the two circumstances, for the theory under investigation holds that the subject will draw on the same problem relevant schematic memory in both cases. But this does not mean that a case response will or could model, still yet predict, how a subject might respond to a similar situation in reality. Regardless of how realistic a presented case may appear, thinking about how one might respond to a baldly described situation under clinical conditions is a vastly different proposition from having to actually deal with a similar problem within a complex, contingent, information rich reality where the stakes are also real. Thus, faced with a real life, real time problem a principal might well adopt a plan of action very different from the one she constructed when asked to think aloud about a case study describing a similar problem. The two response conditions are fundamentally different. Not that it matters. The main objective remains the generation of problem processing data and the bland case study stands as a serviceable trigger to achieve this end. Moreover, while it would be desirable for some purposes to collect real time data about how principals understand, think about, plan and deal with the real problems they encounter in the real world, this is currently and may always be impossible. We can, of course, collect data from and about real administrators in real contexts, and the accomplishments of the Leithwood group and others, particularly Gronn, in attempting this are noteworthy. Still, as every graduate student knows who has pondered trees falling in forests, the intrusion and presence of data gathering methods ensures the circumstances will not fully equate with real reality. More to the point, given the limitations of current and likely future methodology and technology, attempts to probe how an actor understands and thinks about a real life situation in real time must necessarily rely on retrospective protocols and accept the limitations they impose. As the contributions of the Leithwood group show, much can be accomplished within these limitations. Even so, concurrent protocols generated from think aloud problem working sessions remain as the most powerful tool for generating the data needed for refining and extending our understandings of administrative problem processing.

The expert (and novice) problem

Novice-expert studies employing verbal protocols have been the engine driving the development of current cognitive science theories of problem processing. Attempts at testing or applying these theories to administration in general and educational administration in particular face the difficult issue of reliably identifying experts and novices. Most of the pioneering studies dealt with domains with relatively well organized knowledge bases, such as physics and chemistry. In such cases the novice expert continuum can be reasonably assumed to correlate with the time invested in learning and applying domain knowledge. Application, that is working with the domain knowledge by frequently applying it to the completion of domain tasks, is considered to be crucial for the development of the more richly interconnected and extensive schematic knowledge thought to underlie expertise. On this basis VanLehn (1989, p. 560) explains that in much cognitive science research "The term 'expert' is usually reserved for subjects with several thousand hours of experience" in the domain under study. By placing quotation marks around expert, he is alerting us to a less than obvious distinction between the "expert" subjects in most studies and those accorded similar status in others. This distinction lies at the heart of Hayes's (1981) claim that it takes ten times as long, that is 20,000 hours or at least ten years of work and practice, for anyone to develop "world-class" expertise. Clearly "world-class" experts are in a different category from those qualifying under the initial standard recognized by VanLehn, who might be more appropriately termed "everyday" experts. Some appreciation of the magnitude of the difference is given in a recent discussion of expert performance by Ericsson and Charness (1994, p. 731) wherein they suggest that a performance level "at least two standard deviations above the mean level for the population" characterizes expert performance. How well this metric captures the difference in performance between an "everyday," first level expert, such as a regular tenured professor of cognitive science or administrative studies, and a world class, Nobel prize expert in these domains, such as Herbert Simon, is open to debate, but would not seem to misrepresent the differences involved. Even so, ten or more years of "intense application," (Simon, 1993, p. 407) in a knowledge domain does not, by itself, guarantee that someone will become a "world class" expert, such as a chess grandmaster or a nominee for a Nobel prize. Clearly there are other factors at work, factors that influence how well practitioners learn from extended experience. Yet while practitioners with ten or more years of intense application in their domain may not display the outstanding skills and accomplishments associated with world-class expertise, they could be reasonably expected to have developed

greater expertise than those that meet the threshold standard of only several thousand hours of experience, a standard that allows for the not uncommon research practice of designating instructors of undergraduate classes as "experts" and their students as "novices."

As it turns out then, expert status is a much more ambiguous and variable category than it may at first appear. Indeed, it appears that "expertness" is best thought of as a continuous rather than a discrete variable, some experts being more expert than others. Expressed another way, the base variable of expertise is properly conceptualized as varying within as well as between novice and expert categories. Even within more highly structured knowledge domains, then, partitioning the expertise continuum to create a valid expert group may be problematic. VanLehn (1989, p. 565) also alerts us to a similar difficulty at the lower end of the expertise continuum, noting that some studies define the novice category in terms of subjects with no or very little domain knowledge—which he defines as a "pre-novice" category—whereas others recruit novice subjects on the basis of "several hundred hours of training (approximately a college course's worth)."

Becoming aware of some of the less obvious difficulties in identifying novice and expert categories in more structured knowledge domains assists in grappling with the problem of partitioning the expertise continuum in the less well understood and less organized knowledge domains of administrative practice. One point that emerges is that defining a valid novice category may be a more crucial design problem than might first be assumed. When we began our first round PPP study we assumed that experience-in-role could serve as proxy for administrative expertise, domain experience being the criterion underlying most other novice-expert designs, as discussed above. On this basis we recruited subjects in four experience groups: Aspirants, individuals who had recently completed officially specified formal training but had not been appointed to the principalship; Rookies, principals with less than three years on-the-job experience; Seasoned principals, with between 10 and 15 years of experience, and; Veterans, with more than 20 years experience in role. We reasoned that combining the Aspirant and Rookies would create an appropriate novice group, and combining the more experienced groups would create an appropriate expert group while comparisons across all four groups would allow for finer analysis. In accord with the previously made distinction between world-class and "everyday" experts, we recognized that not all of the more experienced subjects would necessarily have learned as well or as much from their interaction with domain problems, and thus expected some to demonstrate greater proficiency than others. This was indeed the case. What

we did not anticipate was that a few members of the novice groups gave better quality responses to the case problem we asked them all to process than did some members of the "expert" group. Closer examination of the background experiences of our subjects pointed to some plausible explanations for this. Whereas members of the expert group had an average of 19 years experience as principals as opposed to a mean of 1.6 years for the novice group, members of the expert group were on average only six years older than the "novices." Moreover, there was only 8 years difference between the mean years of total full-time, in-school work experience in all possible roles. One of the important reasons for this two year difference was that members of the novice group had to meet higher qualification standards to enter teaching than did members of the Veteran category. Thus, while there were substantial differences in experience as a principal, members of the novice group had received more extensive pre-professional training than some members of the expert group, gained extensive if indirect exposure to administrative practices and problems through their in-school experience, and been actively preparing themselves for entry to the principalship. All in all, then, the extensive domain relevant experience and training acquired by the members of our initial Rookie and Aspirant groups clearly disqualified them as novices under the "approximately a college course's worth" of domain training identified by VanLehn, let alone the zero experience pre-novice standard.

Our first round PPP study thus gave us a salutary lesson in the complexities inhering in domain relevant experience in administrative work. Given the many opportunities for anticipatory socialization to aspects of administrative work usually present in formal organizations, together with the in-house training and other development programs available for those aspiring to administrative responsibilities, then recently appointed administrators cannot be uncritically accepted as true domain novices. As well as satisfying applicable formal training requirements, some new administrative appointees must also be expected to have gained variable amounts of potentially relevant domain experience, through, for example, committee work, serving in administrative roles in volunteer organizations, self-study, and informal mentorship. Selection and appointment processes typically recognize the potential relevance of such experiences, and designers of novice-expert studies of administrators could profitably take note of such experience when recruiting potential novice subjects. The professional culture of schools together with their ubiquity in contemporary society further complicates matters when it comes to studying the school principalship. Teachers are typically aware of at least some of the problems with which principals must

deal: indeed, they are often part of those problems and have a stake in how they may be resolved. Consequently it is not unusual for a principal's actions or inactions on current problems to be critically reviewed in staffrooms and elsewhere. Such discussions may often be ill-informed, but they nonetheless provide opportunities for non-principals to gain some domain relevant knowledge, although the knowledge generated fails to satisfy the important "intense application" standard. So to with parents and other members of a school community who become involved in school problems in one way or another. While their exposure to the work of school leaders may often be even more one sided than that of teachers, it will provide some exposure to domain relevant knowledge. Then again, it seems that many taxpayers who have no direct connection with schools are nonetheless willing to claim some knowledge about how they could be made better. As a result, it may be impossible to find more than a few, if any, educated members of modern society that would qualify as complete novices in some aspects of the operational, administrative, and leadership challenges facing school principals. The domain knowledge held by such external observers will necessarily be partial and fall far short of the rich, schematically organized knowledge expected of expert principals. But that is not the point, for it may qualify them as *novices* under the criteria specified by VanLehn.

We attempted to control for these confounding factors in our second PPP study when recruiting members of our novice group. We sought to approximate the standards discussed by VanLehn by recruiting an initial set of novice subjects from student teachers—who have had some professional training and school experience, and thus approximate VanLehn's working definition of novices—and an additional set of graduate students from domains other than education, who approximate VanLehn's true naive pre-novices. The initial comparison groups in our second PPP study were thus the novice group as described above and a group of practising principals. For the purposes of this initial comparison, all of the principals were recognized as experts solely by virtue of being in a school leadership position. As hopefully demonstrated in the preceding paragraphs, this design conforms to the principles underlying most other novice-expert comparisons in other domains. As such, we reasoned that it would provide a more robust and potentially fertile framework within which to test the presence of novice-expert differences identified in previous studies, as well as to isolate elements of schematic knowledge developed by school principals, all of which can claim at least first level, "everyday" expert status, solely by virtue of their position.

The problem of differentiating levels of expert performance within the principal group remained. That there are variations in the level of performance among principals cannot be denied. Indeed, it may not be unreasonable to expect that the performance of some may approach or even match the two standard deviations above the population criterion suggested by Ericsson and Charness, where the population would be all principals appointed under a set of broadly comparable criteria as manifest at a national or culture area level. Under the Ericsson and Charness metric, such "national class" principals would clearly be statistical outliers, and thus very few in number. It follows that truly exceptional performers would likely not be captured in a random or opportunity sample of the population but would have to be deliberately searched for. Given that there is no standard and reliable comparative method for ranking principal performance as there is, for example, in chess and contract bridge, then any attempt at identifying exceptional principals (and other administrators) will have to make use of other criteria, especially reputational indicators. The obvious problem with reputational data is that it may be inaccurate. Because of this Ericsson and Charness caution that rather than relying solely on reputation when searching for outstanding experts, researchers (and others) should also look for *evidence* of superior performance (p. 732). This is the approach adopted by the Leithwood group. In the initial Leithwood and Stager (1989) study and some others, members of their designated expert group had to pass through two screens. First, two central office administrators were independently asked to nominate highly effective principals. Second, the nominees were interviewed to assess their self-reported administrative behaviours against the criteria associated with high performance contained the *The Principal Profile* (Leithwood & Montgomery, 1986). Of the 22 subjects in that study, six—a little over a quarter—satisfied both the reputational and the more objective tests of superior performance. Even so, this does not necessarily mean that those designated as experts by these methods satisfied the statistical outlier criteria suggested by Ericsson and Charness.

Still, the Ericsson and Charness metric might not apply to domains such as administration where practitioners are required to act under conditions of uncertainty. As discussed by Johnson (1988), a number of studies of everyday experts in diverse domains such as graduate admissions, economic forecasting and medical diagnosis have documented what appear to be disappointing levels of performance. In a study of bankruptcy judgements, for example, an unwieghted, single variable regression model predicted business failures much better than did a sample of experts in that domain (Johnson, 1988, p. 212; Libby, 1976). Johnson (1988, p. 212)

comments, that in these studies of problem processing in social action domains "The superiority of [everyday] experts to novices is surprisingly small." Yet when one reflects on the performance standards that might serve to distinguish better from more average practitioners in uncertain task environments such as administration, it seems unrealistic to expect even the most proficient performers to be universally successful in dealing with the wide variety of situations with which they are confronted. Indeed, it is surely unreasonable to expect that expert principals could create and consistently maintain, in the words of my colleague Jim Sanders (1983, p 12), schools with "unfailing leadership, error-free decision-making, unsinkable faculty morale." If we accept this, then what might constitute standards of exceptional performance in the principalship? Leithwood (Hallinger, Leithwood & Murphy, 1993, p. 271; Leithwood & Steinbach, 1995, p. 13) has contributed some valuable observations on this point. He begins by noting that the extensive amounts of domain relevant knowledge and skills held by experts does not guarantee success in achieving desired goals in difficult circumstances. What counts, he suggests, is an individual's accumulated record of accomplishment, rather than success in achieving a given goal, completing a particular task, or handling a specific problem. He then notes that the standards conventionally applied to judge what constitutes an acceptable or exceptional record of performance vary enormously across domains, depending, it appears, on the degree of control which individuals have over the task environment in which they must act. Thus, a designated hitter in professional baseball is considered to have established an exceptional record of performance by hitting only 30 per cent or so of the pitches faced during his career. Might a similar standard of accomplishment hold for how well principals deal with the problems encountered in their domain? I suspect that we would want to apply a higher standard, but in seeking to do so we would have to take school and environmental variations into account. We would expect an exceptional principal to have a lower batting average—record of performance—in a difficult school where she is able to gain less control over the task environment than she would have in a school where the internal and environmental circumstances are more conducive to success. In the latter circumstances it would be reasonable to expect a markedly higher batting average, but it would surely be impossible for even the most outstanding principal in the most conducive environment to "bat a thousand."

A necessary consequence of the preceding analysis is that some principals will have poorer records of performance than others and, if we accept that those with outstanding performance records will fall short of perfection due to the inherent complexities and uncertainty of the work to be done, then we may also expect that

poorer principals will have depressingly low "batting averages." This produces the semantic paradox of the poor expert. It is a paradox which nonetheless helps drive home the broad point developed above—that some experts (as defined in terms of extended exposure to domain problems) will have better, and some worse, records of performance than others, and that the variation may be substantial. The important question that follows is why should this be? Within the theoretical framework adopted for the CASL Project as reviewed in this paper, two main explanations emerge, which are in effect two sides of the same coin. The first is that while less proficient principals were able to acquire the declarative and procedural knowledge (or at least survive the formative and training experiences deemed necessary to acquire such knowledge) so as to satisfy initial appointment standards, they were somehow unable to organize and integrate this knowledge in schematic memory so as to ensure the usually reliable and efficient retrieval necessary for satisfactory performance. In such cases, poor job performance is directly attributable to weak training and selection procedures. The second explanation is that while more proficient principals were able to learn successfully from their on-the-job experiences, and thus enrich their domain schemata, less proficient principals did this less well—they were unable to learn from their work experience as efficiently as others were. Ideally, this "learning curve" explanation for variable levels of proficiency should also be detectable through training and selection processes, but the cognitive and other factors underlying a person's ability to learn rapidly and efficiently from a new and more challenging work environment are not sufficiently well understood to produce reliable tests. It does appear that the cognitive elements involved are not well correlated with whatever is measured by standard IQ tests. There are reasons to suspect, however, that various theories of practical intelligence, such as Wagner and Sternberg's (1986, 1990) "street smarts" and related theories of cognitive power (Jaques, 1986) and cognitive complexity (Streufert, & Nogami, 1989; Streufert & Swazey, 1986) may apply.

In designing our second PPP study we attempted to capitalize on many of the points made above. We recognized that some members of our first level expert group, that is the principals participating in the study, would likely be more expert than others. Given this, we wanted to find a reasonably valid and defensible way of distinguishing between both more and less proficient principals so as to facilitate comparison and analysis of the think-aloud transcripts. In line with the reasoning presented by Ericsson and Charness we recognized that we would have to make use of reputational data, but would also have to incorporate some independent screen, as was

done by Leithwood and Stager. Even so, we wanted to avoid having potential subjects nominated by peers or subordinates so as to minimize halo effects during data collection. We eventually decided to rely on a multiple set of performance measures, all of which would be collected independently of the think-aloud session. Principal participants were recruited by simply requesting volunteers from area school systems, who were invited to spend a day with us on campus, where they participated in the think-aloud session and other data collection activities. At the end of the day, we asked their permission for us to seek evaluations of their work as a principal from three subordinates (teachers) and two superordinates whom they were invited to nominate. We then mailed a questionnaire containing various rating scales to these nominees with an appropriate explanatory letter. These ratings provided us with our reputational data. We also sought another measure of work performance by having the principals and some of their teachers complete the Index of Perceived Organizational Effectiveness (Hoy & Miskel, 1991, p. 400). Once all these data collection activities had been completed, but before the data were analyzed, we convened a jury of reputationally expert principals who rated the quality of responses given to the case problem used for the think-aloud session. A set of decision rules were then devised to identify, on the evidence collected, those principals who appeared to have achieved a record of superior performance in the eyes of nominated co-workers, and who had also demonstrated superior performance in processing a sample task, as judged by a jury of their peers. Of the 30 principals in our first level expert group (as opposed to the true novice group) six (20%) satisfied the relevant criteria to be assigned to the High imputed expertise category for the purposes of our analyses. A separate set of criteria were developed to identify potentially weaker principals on the basis of the reputational and school effectiveness data. Five of the 30 were subsequently classified as falling into a Low imputed expertise category.

In sum, our second round PPP study which provided the data discussed in the other papers prepared for this symposium was designed so as to allow true novice-expert comparisons as well as proficiency based analyses within the first level expert group. To try and avoid the confusions associated by referring to different levels of expertise, the papers that follow will generally refer to the various comparison groups in terms of their members rather than their theoretical status, using the following conventions. the true novice group will generally be referred to as "others," and the first level expert group as "principals"; within the true novice group, the novices will be referred to as either B.Ed. students or novices, and the pre-novices as naives; within the principal group,

those identified as more proficient will be referred to as members of the High imputed expertise group; principals identified as least proficient are classified in the Low imputed expertise category, with the remainding principals comprising the Medium imputed expertise group.

Conclusion

This paper has reviewed the theory and literature base for the remaining papers prepared for a 1996 AERA symposium reporting aspects of our CASL Project. The second paper in the set reviews the research design adopted for our second PPP study in some detail.

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