Managerial and Organizational Cognition: Notes from a Trip Down Memory Lane

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This cogent review of the managerial and organizational cognition literatures nicely "pulls together" the important ideas and developments in one of the more promising and exciting fields of inquiry in the organizational sciences. While the author's insightful treatment of this eclectic topic is impressive in itself, even more remarkable is the fact that the manuscript's light yet still scholarly style keeps the reader from being overwhelmed by its length and depth of coverage.

Robert W. Zmud

Abstract

The study of cognition in organizations has burgeoned in recent years. Top-down information processing theory suggests that individuals create knowledge structures to help them process information and make decisions. While the benefits of employing such knowledge structures are widely noted, there is a growing concern that they can limit decision makers' abilities to understand their information environments and thus, compromise their decision making. This issue has captured the imagination of managerial and organizational cognition researchers. To date, their inquiry has been eclectic in focus and method. To order and advance this work, the author reviews extant research on the developmental origins and decision consequences of both the content and structure of knowledge structures at multiple levels of analysis. A host of research challenges are identified to help develop a better understanding of knowledge structure representation, development, and use in organizations.

(*Managerial and Organizational Cognition*; *Schematic Information Processing*; *Sensemaking*; *Decision Making*)

Interest in managerial and organizational cognition has burgeoned in the past decade. In part, this interest reflects a classic disagreement about the primacy of situational or dispositional antecedents to firm behavior (Astley and Van de Ven 1983). During the 1970s, we saw the rise of resource dependence (Pfeffer and Salancik, 1978), population ecology (Hannan and Freeman 1977), and transaction cost economics (Williamson 1975) as explanations for firm behavior. These three theoretical perspectives shifted the focus away from individual managers as a locus of firm performance. Indeed, some writers argued that managers are epiphenomenal to this issue (Lieberson and O'Connor 1972). Child (1972), however, served notice that strategic choice processes do matter in the calculus of firm performance. Interestingly, agency theorists agreed (Fama 1980, Jensen and Meckling 1976), but for different reasons. They viewed unchecked, self-interested managers as a cause of diminution of firm value. So, the 1980s began with sociological and economic thinking questioning the ability of individual managers to contribute to firm value. Managers were seen as either a source of variation in environmental selection models, a source of error variance in firm performance equations, or worse, the source of firm failure in these conceptualizations. What was lacking was a fresh theoretical perspective to consider how managers might increase or decrease firm value. Enter cognition. Interest in managerial and organizational cognition slightly lagged what proved to be an explosion of interest in things cognitive in social psychology (Fiske and Taylor 1984).

In the managerial cognition perspective, managers are assumed to be "information workers" (McCall and Kaplan 1985, p. 14). That is, they spend their time absorbing, processing, and disseminating information about issues, opportunities, and problems. The most fundamental challenge faced by managers, however, is that their information worlds are extremely complex, ambiguous, and munificent (Mason and Mitroff 1981, Mintzberg et al. 1976, Schwenk 1984, Starbuck and Milliken 1988). Somehow they must see their way through what may be a bewildering flow of information to make decisions and solve problems. Managers (and

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indeed all individuals) meet this information challenge by employing knowledge structures to represent their information worlds and thus, facilitate information processing and decision making. The intriguing problem for management researchers has been that while these knowledge structures may transform complex information environments into tractable ones, they may also blind strategy makers, for example, to important changes in their business environments, compromising their ability to make sound strategic decisions. This problem-focused appreciation of cognition has been the foundation for much of the work on managerial and organizational cognition during the past 10 years.

Many institutional signs attest to the popularity of this theoretical approach. In addition to conference programs and journal articles, we have seen two special issues of the *Journal of Management Studies* (July 1989, May 1992) and a special issue of *Organization Science* (August 1994) dedicated to cognitive themes. The early Eden et al. (1979, 1983) books, as well as the Sims and Gioia (1986) and the Huff (1990) edited volumes, helped to define this research area. The newly created annual volume entitled *Advances in Managerial Cognition and Organizational Information Processing* will report applied work on cognition in the future. Perhaps most indicative of the popularity of this research area is the Managerial and Organizational Cognition Interest Group in the Academy of Management. At the end of the group's second year, its membership exceeded that of six of the 20 established divisions in the Academy of Management.

In short, much of the management research community has taken a 10-year trip down Memory Lane! The purpose of this article is to identify our fellow travelers and share what we have discovered in our journey. To this end, we briefly review the psychological roots of applied cognitive research, develop a framework that broadly illuminates the important questions we have been asking, conduct an appreciative review of the literature, and end with a critical consideration of previous research and an enumeration of a continuing research agenda. The complementary relationship between basic and applied research is revealed in the process.

Psychology and Management: Some Things Borrowed, Some Things New

The knowledge structure or schema construct found its way into modern psychology from clinical neurology (Head 1920) with the work of Bartlett (1932), Woodworth (1938), and Oldfield and Zangwill (1942). While there was certainly some interest in cognitive process in the ensuing years (Tolman 1948, Festinger 1957), experimental social psychologists were much more fascinated with stimulus-response psychology in the 1940s, 1950s, and 1960s (e.g., Skinner 1953). As Zajonc (1992) points out, it was not until Neisser wrote his book *Cognitive Psychology* in 1967 that things began to change. Researchers began to investigate the cognitions that might mediate stimulus-response relationships. In the 1970s, fascination with information theory (Shannon and Weaver 1949) ushered in a period of intense intellectual interest in what became known as social cognition (Fiske and Taylor 1984). Sometimes viewing humans as a kind of computer, psychologists continue to be intrigued by how information is acquired, stored, and retrieved from their memory (Lord and Maher 1991).

The basic idea is that individuals can approach information processing in two dominant ways. They can use a "top-down" (Abelson and Black 1986) or "theory-driven" (Nisbett and Ross 1980) approach, whereby their past experiences in similar circumstances guide present information processing, or they can let the current information context guide information processing in a "bottom-up" or "data driven" approach. In the former case, the cognitive structures generated from experience affect individuals' abilities to attend to, encode, and make inferences about new information; in the latter case, the information itself shapes individuals' response to it (no doubt including the development of amended knowledge structures to be used later in a top-down fashion). In light of individuals' limited attention (Posner 1982) and information-processing capacities (Miller 1956), theory-driven information processing may be a dominant response in all but the most novel situations (Louis and Sutton 1991). The concept of the knowledge structure lies at the heart of theory-driven information processing.

A knowledge structure is a mental template that individuals impose on an information environment to give it form and meaning. Neisser (1976) points out that this mental template functions just as a format statement does when we set up a SAS or SPSS computer program. The format statement orders a data file and allows for subsequent statistical interpretations of the data. Similarly, an individual's knowledge structure orders an information environment in a way that enables subsequent interpretation and action. Built on past experience in an information environment, this mental template is called a knowledge structure be-

cause it "represents organized knowledge about a given concept or type of stimulus" (Fiske and Taylor 1984, p. 149). A key point to recognize here is that this mental template consists of *organized* knowledge about an information domain. Hence, we must consider both the content and structure of an individual's knowledge structure. This point is consistent with Hayes-Roth's (1977) theory of knowledge assembly (derived from Hebb's (1949) cell-assembly theory), which depicts a schema (or knowledge structure) as both the components and the linkages among those components in memory.

In the service of cognitive economy (Mischel 1981), this theory-driven structuring of information speeds problem solving by furnishing a basis for evaluating the information, often in ambiguous circumstances (Gioia 1986). Thorngate (1980) observed that top-down information processing is typically efficient and effective. Knowledge structures and their links to information processing have been the frequent focus of theoretical and empirical inquiry in psychology (see Alba and Hasher 1983, Brewer and Nakamura 1985, Fiedler 1982, Fiske and Taylor 1984, Galambos et al. 1986, Graesser and Nakamura 1982, Hastie 1981, Markus and Zajonc 1985, Neisser 1976, Nisbett and Ross 1980, Posner and Keele 1968, Rumelhart 1980, Schneider 1991, Sherman et al. 1989, Taylor and Crocker 1981, Tesser 1978, and Wilcox and Williams 1990 for reviews).

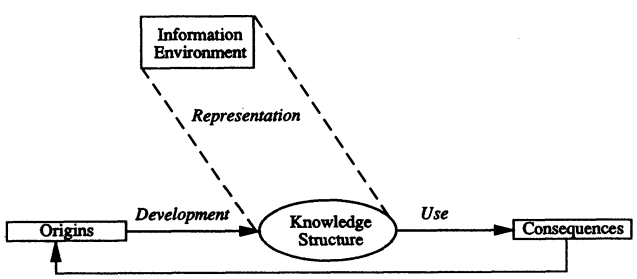
While the benefits of theory-driven information processing are clearly noted, there is concern that some knowledge structures can limit an individual's ability to understand an information domain. Weick (1979, p. 68), for example, pointed out that an inevitable byproduct of such cognitive representations is that organizations' managers sometimes act on "impoverished views of the world." Gioia (1986, p. 346) reviewed a host of potential liabilities associated with the use of knowledge structures. Indeed, the use of knowledge structures may encourage stereotypic thinking; subvert controlled information processing; fill data gaps with typical but perhaps inaccurate information; prompt one to ignore discrepant and possibly important information; discourage disconfirmation of the existing knowledge structure; and inhibit creative problem solving. The paradox, then, is that schematic information processing can be at once enabling and crippling.

Issues from the Management Research Community

Researchers seeking to relate the top-down information-processing perspective to the practice of management need to consider at least four issues that have their origin in a functional logic. First, they must address the fundamental premise that knowledge structures represent some information environment. As a consequence, they need to uncover the attributes of a particular knowledge structure that a manager might use (i.e., its content and structure). Second, researchers must relate the use of this knowledge structure to consequences of substantive organizational importance (e.g., the deployment of a firm's resources). This step would likely involve the detection of cross-level consequences (i.e., group, organization, or industry) following the use of what is often seen as an individual-level construct. Third, researchers must uncover the developmental origins of the knowledge structure if it is shown to have an impact of some consequence. Development, of course, implies a recursive relationship with use. Researchers need to understand how knowledge structures develop so they can guide training or remedial change efforts if the use of a particular knowledge structure is found to promote either beneficial or deleterious organizational consequences. Finally, researchers must be sensitive to the fact that the practice of management is fundamentally a social activity. Hence, the study of information representation and its organizational consequences should consider these processes at the group, organization, and even industry levels, as well as at the individual level of analysis.

Figure 1 is an organizing framework for the research that has addressed these issues. While any conceptual framework carries the risk of reifying and making static a fundamentally dynamic process, the recursive relationship between consequences and origins is meant to convey fluidity. Furthermore, the portrayal of the knowledge structure as an ellipse and the information environment as a rectangle is meant to convey the imperfect nature of these representations. The utility of this framework becomes apparent as we use it to organize a disparate literature. One of the first things we discover is that management researchers have been

Figure 1 Knowledge Structure Research: An Organizing Framework



interested in a set of questions that generally are beyond the scope of basic psychological research.

The Psychological Approach. Psychologists have focused predominantly on understanding the information-processing consequences of holding a particular knowledge structure. That is, they have found that knowledge structures allocate attention (White and Carlston 1983), facilitate encoding (Cohen 1981) and retrieval from memory (Anderson and Pichert 1978, Cantor and Mischel 1977), and so help to interpret experience (Bower et al. 1979), provide a basis for inference (Langer and Abelson 1974, Snyder and Uranowitz 1978), and speed problem solving (Taylor et al. 1978). Knowledge structures have not typically been identified directly in these research efforts. Their presence has been inferred from experimental manipulation (i.e., invoking a knowledge structure in one but not a second group of subjects) and by a variety of process-tracing methods to identify their information-processing consequences. Patterns of recall or recognition primarily have been used to assess whether or not a knowledge structure has been invoked in some experimental task. Fiske and Taylor (1984), Murdock (1982), Taylor and Fiske (1981), and Srull (1984) provide extensive reviews of these process-tracing procedures. The psychological approach, then, typically focuses on the memory implications and the information-processing consequences associated with the use of a knowledge structure. The content of a particular knowledge structure is incidental to assessing its consequences, and so it is typically manipulated experimentally.

With reference to Figure 1, we should note that the psychologist's understanding of knowledge structure development and change is incomplete (Crocker et al. 1984). Indeed, few knowledge structure theorists understand how such structures are formed. Brewer and Treyens (1981), Neisser (1976), and Rumelhart (1980), all interested in the topic, point out that our understanding has been limited mainly to the simple assertion that knowledge structures are formed by experience. Fiske and Dyer (1985) provide some evidence to suggest that schema development occurs in stages. They argue that components of a schema are learned first, then weak links among the components become progressively stronger with continued exposure to the conceptual domain. Nevertheless, we really know very little about how schemas are formed along such a developmental continuum. Broadly, we know that individuals with experience in an information domain have a knowledge structure for the domain, while those without such experience do not (Lurigio and Carroll 1985). More specifically, we also know that individuals who have a great deal of knowledge about an information domain have schemas that can be assessed more reliably than those of individuals who do not have such knowledge (Smither and Reilly 1989).

Very little psychological work has examined how knowledge structures change once they are created. Fiske and Taylor (1984, p. 171) flagged this topic as the "major set of unfinished business" in knowledge structure research. Following the tradition of Inhelder and Piaget (1958), Weber and Crocker's (1983) study of how stereotypes may assimilate new information or accommodate themselves to discrediting information stands out as one of the few such investigations conducted to date. It showed that stereotypes can change (i.e., accommodate new information). Walsh and Charalambides (1990) investigated how individual an social factors might influence knowledge structure change. They found that publicly self-conscious individuals, who were exposed to different knowledge structures in a working group, changed their knowledge structures over time. Interestingly, some evidence suggests that knowledge structures may also change as a result of self-induced reflection. Simply thinking about an attitude object has been shown to affect the representation of that object in memory (Millar and Tesser 1986). These studies suggest that individual, social and informational factors all play a role in knowledge structure development.

In summary, the psychological research to date has established that knowledge structures affect information processing in predictable ways. While psychologists are interested in all of the relationships specified in Figure 1, they have made their greatest contribution by assessing the "knowledge structure → consequences" linkage. The consequences, however, have been generally limited to information-processing consequences. In fact, Taylor and Crocker (1981, p. 125) argued in their review that "the study of biases due to schematic processing in areas where such biases can have severe or fatal consequences may well be one of the most important areas in which research on schema's can move."

Clearly, the link between thinking and deleterious decision consequences has been recognized by management researchers. The management research community has taken the lead in examining the relationships in Figure 1. None of this applied work could have been done, however, without the psychologists' efforts to establish the construct validity of the knowledge structure construct. The questions posed by management researchers have led them to investigate processes that

build on and extend this foundation of psychological research. Indeed, a real partnership between the basic and applied sciences has emerged over the past decade. The following review describes what we have discovered about managerial and organizational cognition in this recent past. Following March and Shapira's (1982) distinction between organizational decision making and behavioral decision making, this review examines the cognitive work in the organizational decision making area. Studies of decision bias in the behavioral decision theory research tradition are not included because they do not typically assess an individual's knowledge structure directly. Moreover, Einhorn and Hogarth (1981), Pitz and Sachs (1984) and Slovic et al. (1977) provide exhaustive reviews of that work.

An Appreciative Reading of the Managerial and Organizational Cognition Literature

Probably the first thing people notice as they begin to read the managerial and organizational cognition literature is the evocative language that has emerged around the central construct. Table 1 captures much of this language. Three aspects of the table warrant mention. First, it shows that an impressive number of scholars have been drawn to this research domain. Second, most of the labels are idiosyncratic references to a top-down information-processing construct. The exceptions are labels that describe the consequences of schematic information processing (i.e., bias in search, interpretation, cognitive trails, selective perception, functional fixedness, grooved thinking, and the like). Finally, while many readers might consider this diverse language an indication of imprecise thinking in the field, it suggests the early excitement generated when a host of researchers begin to discover a useful theoretical paradigm. It also suggests that the time is right to develop an agreed upon common theoretical language, consolidate what we have learned in our investigations to date, and conduct our continuing research activity with a full awareness of the established conceptual terrain. In many ways, the table is testimony to the fact that we have been working "alone together" in this research world. This article provides a common ground to enable us all to work together in the future. To this end, we need to elaborate more fully the framework that illuminates this common ground.

Articulating the Research Framework

While Figure 1 appropriately asks us to consider the issues of representation, development, and use when

Table 1 Cognition in Organizations: The Language of Management Theory

Abrahamson and Fombrun (1993)	Collective Strategic Myopia
Anderson and Paine (1975)	Managerial Perceptions
Argyris and Schön (1978)	Theory of Action
Ashforth and Fried (1988)	Blinkered Perceptions
Axelrod (1976)	Cognitive Maps
Barnes (1984)	Cognitive Biases
Bartunek (1984)	Interpretive Schemes
Borman (1987)	Folk Theories
Bougon, Weick and Binkhorst (1977)	Cause Maps
Brief and Downey (1983)	Implicit Theories
Brunsson (1982)	Organizational Ideologies
Cowan (1986)	Cognitive Frameworks
Cyert and March (1963)	Screens; Bias in Search
Daft and Weick (1984)	Interpretation
Dearborn and Simon (1958)	Selective Perception
Deshpandé (1986)	Frames of Reference
Dougherty (1992)	Departmental Thought Worlds
Dunn and Ginsberg (1986)	Frame of Reference
Dutton and Duncan (1987)	Attentional Fields
El Sawy and Pauchant (1988)	Templates
Fahey and Narayanan (1989)	Causal Maps
Ford and Baucus (1987)	Collectively Shared Interpretations
Ford and Hegarty (1984)	Cause and Effect Beliefs
Ginter and White (1982)	Shared Perspective
Greenwood and Hinings (1988)	Interpretive Schemes
Haley and Stumpf (1989)	Cognitive Trails
Hall (1984)	Organizational Cause Maps
Hambrick and Mason (1984)	Selective Perception
Hewitt and Hall (1973)	Quasi-theories
Hopfl (1992)	Provinces of Meaning
Huff (1982)	Strategic Frame
Isabella (1990)	Construed Reality
Isenberg (1986)	Overriding Concern
Jackson and Dutton (1988)	Issue Categories
Janis and Mann (1977)	Quasi-satisficing
Katz (1982)	Functional Fixedness
Klimoski and Mohammed (1994)	Team Mental Model
Langfield-Smith (1992)	Collective Cognitions
Larwood and Whittaker (1977)	Self-serving Biases
Lorsch (1985)	Strategic Myopia
Löwstedt (1993)	Organizing Frameworks; Implicit Thought Structures
Lyles and Schwenk (1992)	Organizational Knowledge Structures
March and Simon (1958)	Frame of Reference
Maruyama (1982)	Mindscapes
Mason (1969)	World View
Mason and Mitroff (1981)	Assumptions; Tunnel Vision; World View
Meyer (1982)	Organizational Ideologies

Table 1 Continued

Miller (1993)	Managerial Lenses; World Views
Murray (1978)	Strategically Sensitive Blind Spots
Poole, Gioia and Gray (1989)	Organizational Schemas
Porac and Thomas (1990)	Cognitive Inertia
Porac, Thomas and Baden-Fuller (1989)	Core Causal Beliefs
Porter (1980)	Blind Spots
Prahalad and Bettis (1986)	Dominant Logic
Ranson, Hinings and Greenwood (1980)	Interpretive Schemes
Reger (1990)	Managerial Thought Structures
Rentsch (1990)	Organizational Meanings
Salancik and Porac (1986)	Distilled Ideologies
Sapienza (1987)	Shared Appreciative System
Schön (1983)	Tacit Understanding
Schultz (1991)	Symbolic Domains
Shivastava and Mitroff (1983)	Frames of Reference
Shivastava and Schneider (1984)	Organizational Frames of Reference
Simon (1955)	Givens
Spender (1989)	Industry Recipes
Stagner (1969)	Personal Bias
Starbuck and Hedberg (1977)	World View
Starbuck and Milliken (1988)	Perceptual Filters
Steinbrunner (1974)	Grooved Thinking
Stevenson (1976)	Cognitive Perceptions
Turner (1976)	Collective Blindness
Walker (1985)	Cognition
Walsh (1988)	Belief Structures
Walsh and Fahey (1986)	Negotiated Belief Structures
Walton (1986)	Organizational Prototypes
Weick and Bougon (1986)	Cognitive Maps
Zajac and Bazerman (1991)	Competitive Blind Spots

reviewing the literature, we need to make a few more distinctions and decisions to bring past research activity into focus. Most basically, we need consistent terminology. As used by Galambos et al. (1986), the term "knowledge structure" refers generally throughout this article to the cognitive structure underlying top-down or theory-driven information processing (given its prominence in the literature, the term "schema" also is used in places). A second obvious but important distinction is that between theoretical and empirical research. This distinction is not drawn to suggest that empirical research is atheoretical but to establish which ideas are supported by empirical evidence and which ideas are not. Researchers must confront tricky measurement issues to do empirical work in this area. It is worthwhile to flag and assess the efforts of those who have made progress in empirical research. Finally, we need to decide on the attributes of knowledge structures that warrant study and the appropriate levels of analysis at which to study them.

The Content and Structure of Knowledge Structures. Both the content and structure of knowledge structures have been investigated. It is important to distinguish between these efforts. In their discussion of content issues more than 15 years ago, Schank and Abelson (1977, p. 10) asserted that "a knowledge structure theory must make a commitment to particular content schemas." Consistent with our interest in the accurate representation of information environments, Abelson and Black (1986) affirmed this view. Knowledge structures, or schemas, are specific to various information domains. Fiske and Dyer's (1985, p. 844) schema for the ideal job candidate is certainly distinct from Fiske and Kinder's (1981, p. 182) Marxist exploitation schema.

The study of knowledge structure content is important for applied research because the identification of content is typically the first step in the study of managerial cognition. After all, one cannot investigate a knowledge structure without identifying it by the information environment it represents. Applied management research must be able to uncover and assess a focal individual's particular knowledge structure. This discovery process presents challenges that are unique to applied research. Social and cognitive psychologists have been able to conduct their research in the laboratory by *invoking* some common knowledge structures (e.g., self (Markus 1977) extrovert (Cantor and Mischel 1977) waitress or librarian (Cohen 1981). They have been able to do their research without having to uncover a person's knowledge structure in a naturalistic decision context. In fact, in their review of social memory, Hastie et al. (1984, p. 153) concluded that "there are very few studies of the structure of the real social world and almost no research that provides analyses of the structure of ordinary social stimulus events." Neisser (1982), in particular, bemoaned this limiting focus of the cognitive psychologist. Attempts to fill this theoretical void have been slow to come forth (Ickes et al. 1986). Management researchers, in contrast, have conducted almost all of their research in the "real social world." We will consider their efforts to identify knowledge structure content.

While no one doubts the importance of discovering the role of knowledge structure content in information processing and decision making, several researchers have been drawn to study issues relating to structure

instead. Weick and Bougon (1986), for example, defended their interest in studying structure by arguing that it is very difficult to understand fully what the content of a knowledge structure truly means to an individual. They stated that "it is more defensible to do content-free analyses that examine structures and the placement of concepts than to puzzle over the meanings of the words themselves" (1986, p. 114).

Both research agendas present difficult challenges. These challenges should stimulate investigation, not serve as a rationale for a research moratorium. Obviously, content and structure are conceptually entwined (i.e., it is impossible to conceive of a knowledge structure that has one and not the other). Nevertheless, with very few exceptions (e.g., Tetlock 1984), issues of content and structure have not been considered simultaneously in research efforts. Accordingly, we review the content and structure work separately.

Levels of Analysis. Notwithstanding Allport's (1924, p. 4) admonition that a discussion of a collective mind is likely to leave one in a "state of mystical confusion," the existence of supra-individual knowledge structures has been considered for some time. This consideration, however, has not been without controversy. Douglas (1986, pp. 15, 91), for example, dismisses the idea as "repugnant." She does not believe that any kind of supra-individual knowledge repository exists, but she does acknowledge that "institutional thinking ... is ... in the minds of individuals as they try to decide" (1986, p. 4). For her, group membership might shape an individual's knowledge structure. She writes, "Our social interaction consists very much in telling one another what right thinking is and passing blame on wrong thinking. This is indeed how we build the institutions, squeezing each others' ideas into a common shape" (1986, p. 91). While few would quibble with her ideas about social process and cognition, many scholars have worked to clarify Allport's "mystical confusion" by investigating knowledge structures at the group, organization, and even industry levels of analysis.

Before we review the contemporary applied work on supra-individual knowledge structures, we should place that work in its historical context. First, recall our working definition of a knowledge structure as a mental template consisting of organized knowledge about an information environment that enables interpretation and action in that environment. The idea that a collectivity of individuals can serve as a repository of organized knowledge has been with us for some time, as has the idea that this repository can act as a template for interpretation and action. In his discussion of the social origins of individual behavior, Durkheim (1895, p. lvi) argued that there are "collective ways of acting or thinking (that) have a reality outside of the individuals who, at every moment of time, conform to it." Durkheim's student, Fleck (1983, p. 38), developed this idea further and argued that "cognition is ... not an individual process of any theoretical 'particular consciousness.' Rather, it is the result of a social activity, since the existing stock of knowledge exceeds the range available to any one individual." He argued that this stock of knowledge is housed in a "thought collective." Another of Durkheim's students, Halbwachs (1950, p. 51), believed that "a man must often appeal to others' remembrances to evoke his own past." A group whose members help evoke those remembrances is said to have a "collective memory." For Halbwachs, however, the concept of a collective memory represented an emergent retrieval process, rather than some kind of discrete retention facility. Durkheim and his students are credited (and sometimes lambasted) as being the first to consider that groups of individuals may house knowledge about issues in a way that transcends the cognitive facilities of any one of them. These ideas are the intellectual foundation for the more contemporary considerations of supra-individual knowledge structures. We review the extant theoretical and empirical work on the content and structure of managerial and organizational knowledge structures at the individual, group, organization, and industry levels of analysis.

Investigations of Knowledge Structure Content

Table 2 organizes the applied theoretical and empirical work on knowledge structure content. The table arrays the work in the organization sciences that relates directly to the knowledge structure construct. Following the logic of Figure 1, we review the work on the representation, use, and development of knowledge structure content at each of four levels of analysis. The discussion provides an overview of the kinds of questions and answers that mark our contemporary understanding in each of these areas.

Individual-level Representation. We can spot some early recognition of the importance of managerial cognition in classic management texts. Nearly 40 years ago, management theorists called attention to the importance of understanding an individual's "screens," "frames of reference," and "givens" (Cyert and March 1963, March and Simon 1958, Simon 1955). In recent years, researchers have used a variety of inventive methods to identify empirically the content of these knowledge structures (without regard to their origins or consequences). For example, they have tried to

Table 2 Theoretical and Empirical Discussions of Knowledge Structure Content at Multiple Levels of Analysis

	Knowledge Structure Attributes		
	Representation	Development	Use
LEVEL OF ANALYSIS			
INDIVIDUAL			
Theoretical Work	Argyris and Schön (1978) Cyert and March (1963) March and Simon (1958) Simon (1955)	Bettenhausen and Murnighan (1985) Brief and Downey (1983) Calder and Schurr (1981) Dearborn and Simon (1958) Ginsberg (1989) Gray et al. (1985) Harris (1993) Schneider (1989) Shaw (1990)	Ashforth and Fried (1988) Barnes (1984) Brief and Downey (1983) DeNisi et al. (1984) Duhaime and Schwenk (1985) Dutton et al. (1983) Feldman (1981) Gioia and Manz (1985) Gioia and Poole (1984) Kiesler and Sproull (1982) Lord and Foti (1986) Lord and Kernan (1987) Louis and Sutton (1991) Northcraft et al. (1988) O'Reilly (1983) Schneider and Angelmar (1993) Schwenk (1984, 1988) Smircich and Stubbart (1985) Stubbart (1988) Ungson et al. (1981) Wright (1980)
Empirical Work	Axelrod (1976) Basso (1972) Billings and Cornelius (1980) Blackburn and Cummings (1982) Boal and Peery (1985) Bonhan and Shapiro (1976) Borman (1987) Cossette and Audet (1992) Cowan (1988, 1990) Deshpandé (1986) Dutton et al. (1989) Ford and Hegarty (1984) Pinkley (1990) Ross (1976) Shrivastava and Mitroff (1983) Wacker (1981)	Antes et al. (1988) Bartunek et al. (1992) Calori et al. (1992) Hauenstein and Foti (1989) Ireland et al. (1987) Isenberg (1987) Lurigio and Carroll (1985) Markóczy (1995) Pazy (1994) Poole et al. (1990) Schneider and DeMeyer (1991) Stewart and Latham (1980) Thomas and McDaniel (1990) Wagner (1987) Walker (1985) Walsh (1988)	Bartunek and Ringuest (1989) Cellar and Barrett (1987) Day and Lord (1992) Dearborn and Simon (1958) Fiol (1989) Ginsberg and Venkatraman (1992) Gioia and Chittipeddi (1991) Krackhardt (1990) Lord et al. (1984) Löwstedt (1993) Lurigio and Carroll (1985) Simons (1993) Sternberg (1985) Thomas et al. (1993) Walsh (1988) Westenholz (1993)
GROUP			
Theoretical Work	Axelrod (1976) Byrant (1983) Eden et al. (1981) Klimoski and Mohammed (1994) Prahalad and Bettis (1986) Walsh and Fahey (1986)	Ford and Baucus (1987) Langfield-Smith (1992)	Brown and Duguid (1991) Ford and Baucus (1987) Ginsberg (1995) Walsh and Fahey (1986)

Table 2 Continued

	Knowledge Structure Attributes		
	Representation	Development	Use
Empirical Work	Bennett and Cropper (1987) Gioia et al. (1989) Langfield-Smith (1992) Roberts (1976) Wacker (1981)	Barr et al. (1992) Fahey and Narayanan (1989) Isabella (1990) Milliken (1990) Poole et al. (1989) Rentsch (1990) Ward and Reingen (1990)	Barr et al. (1992) Dougherty (1992) Dutton and Dukerich (1991) Eden (1988) Fiol (1993) Mitchell (1986) Narayanan and Fahey (1990) Roos and Hall (1980) Shetzer et al. (1990) Shlaim (1976) Starbuck and Hedberg (1977) Wilensky (1967) Wyden (1979)
ORGANIZATION			
Theoretical Work	Daft and Weick (1984) Dunn and Ginsberg (1986) Krippendorff (1975) Levitt and March (1988) Sandelands and Stablein (1987) Schneider and Shrivastava (1988) Shrivastava and Schneider (1984) Walsh and Ungson (1991) Weick and Roberts (1993)	Greenwood and Hinings (1988) Hopfl (1992) Lyles and Schwenk (1992)	Bartunek and Mock (1987) Bernstein and Burke (1989) Brunsson (1982) Donnellon et al. (1986) Ranson et al. (1980) Shrivastava et al. (1987) Walsh and Ungson (1991)
Empirical Work	Dougherty and Kunda (1990)	Bartunek (1984) Bartunek and Franzak (1988) Poole et al. (1990)	Barley (1983) Hall (1984) Meyer (1982) Smith et al. (1991) Weick and Roberts (1993)
INDUSTRY			
Theoretical Work	Abrahamson and Fombrun (1994) Huff (1982) Porac et al. (1989) Spender (1989)	Abrahamson and Fombrun (1994) Huff (1982) Porac and Thomas (1990) Spender (1989)	Abrahamson and Fombrun (199 Fiegenbaum et al. (1995) Huff (1982) Porac and Thomas (1990) Spender (1989)
Empirical Work	Baum and Lant (1995) Calori et al. (1992) Gripsrud and Grönhaug (1985) Grönhaug and Falkenberg (1989) Porac et al. (1989) Reger (1990) Reger and Huff (1993) Stubbart and Ramaprasad (1988) Walton (1986)	Baum and Lant (1995) Gripsrud and Grönhaug (1985)	Fiegenbaum and Thomas (1995) Gripsrud and Grönhaug (1985) Porac et al. (1989) Spender (1989) Yates (1983)

delimit individuals' knowledge structures of work unit structure (Blackburn and Cummings 1982) and work outcomes (Billings and Cornelius 1980), as well as of organizational problem types (Cowan 1988, 1990), organizational structure (Ford and Hegarty 1984), and a broad organizational assessment (Wacker 1981). Moreover, researchers have attempted to represent Native Americans' understanding of ice (Basso 1972), management students' cognitive structure of corporate social responsibility (Boal and Peery 1985), the idiosyncratic schema of a small business owner/manager (Cossette and Audet 1992), Port Authority executives' orientations to strategic issues (Dutton et al. 1989), middle managers' frames of reference about the usefulness of market research (Deshpandé 1986), disputants' interpretations of conflict (Pinkley 1990), U.S. Army officers' folk theories of subordinate effectiveness (Borman 1987), the frames of reference managers employ when purchasing computer systems (Shrivastava and Mitroff 1983), the cognitive maps of British cabinet members deciding on their Middle East policy (Axelrod 1976), a cognitive map of a U.S. Middle East specialist (Bonham and Shapiro 1976), and the cognitive map of an 18th century Pennsylvania governor (Ross 1976). Taken together, these efforts have been successful in documenting the content of knowledge structures that span a variety of information domains. The impact of this work has been at once limited and broad. It is limited in the sense that by describing specific knowledge structures, these researchers have done little more than illustrate the potential an information-processing perspective might hold for the organization sciences. The eclectic mix of content areas, however, illustrates the wide appeal of this theoretical perspective. The broad impact of this work has been to stimulate researchers to take the important next step of trying to understand the origins and decision consequences associated with the use of such knowledge structures.

Individual-level Use. Dearborn and Simon's (1958) investigation of selective perception was one of the first studies to suggest that dysfunctional decision consequences might follow the use of knowledge structures. The researchers reported a relationship between managers' functional area work experiences and constrained (functionally consistent) problem identifications in ill-structured decision situations. While this research foreshadowed the psychological information-processing research tradition that was to follow (i.e., inferring the presence of knowledge structure by its information-processing consequences), it caught the attention of a generation of management researchers who saw it as a harbinger of the kinds of problems top-down information processing can engender. Interestingly, 30 years later, Walsh (1988) traced the relationship between functional area work experiences, knowledge structure content, and information processing consequences only to find little support for the kind of parochial information processing noted by Dearborn and Simon. Nevertheless, the latter researchers' early work challenged management researchers to consider the role of knowledge structures in the practice of management. Many others have subsequently articulated this generic challenge (Ashforth and Fried 1988, Brief and Downey 1983, Gioia and Manz 1985, Gioia and Poole 1984, Kiesler and Sproull 1982, Lord and Kernan 1987, Lord and Foti 1986, Louis and Sutton 1991, O'Reilly 1983, Schneider and Angelmar 1993, Ungson et al. 1981, Wright 1980).

Since 1958, applied work examining the impact of knowledge structures has taken us in two distinct directions. Researchers in both industrial-organizational psychology (including "micro" organizational behavior) and strategic management have developed interest in the topic. Industrial-organizational psychologists recognized that top-down managerial information processing could have a powerful influence on performance evaluations in the context of human resource management decision making (Northcraft et al. 1988). Their greatest concern was how such information processing may bias the performance appraisal process (DeNisi et al. 1984, Feldman 1981). DeNisi et al. (1984), for example, argued that once a rater invokes a particular schema for a worker, performance appraisal information is acquired and interpreted in light of that schema. A rater who categorizes a subordinate as a "good worker" may feel (perhaps inappropriately) that it is unnecessary to collect much performance information about that person (p. 368). Similarly, if a rater sees a subordinate as a "hard worker," he or she may interpret sitting back as "planning time" rather than as "loafing" (p. 377).

Empirical investigations of knowledge structures and their effects on such performance decisions have been sparse, but a few studies illustrate the potential for research in this area. Each collecting a direct measure of a knowledge structure, Lord et al. (1984), Lurigio and Carroll (1985), and Sternberg (1985) found that individuals make evaluative judgments within the parameters set by their knowledge structures. These researchers looked respectively at the evaluations of leaders, parolees, and potential job applicants. More recently, Conlon and Stone (1992) inferred the presence of an absence schema from two studies examining how managers make sense of employees' absence records.

Other studies represent the kinds of contributions such cognitive work can make to established research areas in organizational behavior. In particular, these studies help to improve our understanding of motivation, bargaining, power, and leadership in organizations. In the area of motivation, Cellar and Barrett (1987) found that a play script (as opposed to a work script) was a significant predictor of intrinsic motivation. Simons' (1993) study of bargaining behavior revealed strong evidence in support of the idea that disputants' representation of utility in their cognitive maps would predict the quality of the agreements reached in a bargaining episode. With respect to power, Krackhardt (1990) found that individuals with an accurate picture of the power relationships in their company were seen as more powerful by their coworkers than those whose understandings were less accurate. Bartunek and Ringuest (1989) offered a different look at the relationship between cognition and power in organizations. Their work complements Gray et al.'s (1985) idea that the struggle for power in an organization is often a struggle to impose and legitimate a self-serving construction of meaning for others. Bartunek and Ringuest (1989) discovered some empirical evidence in support of this thesis. They found that individuals who held interpretive schemes that differed from those of their superiors during periods of organizational transformation subsequently received less recognition for their talents and were more likely to leave the organization than their peers who did not hold such challenging cognitive structures. Finally, Lord and Maher's (1992) book summarizes many years of research by Lord and his colleagues about how followers' representations of leadership in memory affect the nature and quality of leadership in organizations.

A second stream of work examining the utility of knowledge structures is represented by research in organization theory and strategic management. The strategic choice paradigm asserts that an organization's leaders can both willfully design their organization and enter into negotiations with environmental actors to alter that environment to suit its ends. Thus, the positioning of an organization within its environment is considered to be the result of purposeful choice (Child 1972). Many writers in the strategic management area are aware of the psychological work on knowledge structures. Barnes (1984), Duhaime and Schwenk (1985), Dutton (1993a, 1993b), Dutton et al. (1983), Dutton and Jackson (1987), Johnson (1990), Lyles and Thomas (1988), Porac and Thomas (1990), Schwenk (1984, 1988, 1989), Smircich and Stubbart (1985), and Stubbart (1989) have all exhorted their colleagues to conduct cross-level research examining the impact of a top executive's knowledge structure on strategic choice and, ultimately, organizational performance. Indeed, Stubbart argued that managerial cognitions play a key role in each activity that comprises the strategic decision process (goal formulation; environmental analysis; strategy formulation, evaluation, and implementation; and strategic control).

Several investigators have collected measures of managers' knowledge structures and attempted to relate them to strategic choice variables. Day and Lord (1992) found that the knowledge structures of a group of managers in the machine tool industry explained some of the variance in measures of their organizations' strategies. Fiol's (1989) examination of the chemical industry revealed that chief executive officers' perceptions of strong interdivisional boundaries within their organizations, and weak boundaries with other firms in their external environment, predicted the formation of joint ventures. Ginsberg and Venkatraman (1992) found that CPAs' interpretations of the advent of technology for electronic filing of tax returns (in 1987) predicted their personal adoption of the technology a year later. Gioia and Chittipeddi (1991) documented how a university president's sense-making and sense-giving activities facilitated a change effort in the university. Löwstedt (1993) provided evidence suggesting that the different ways three Swedish engineering firms implemented new computer-aided design technology may have been a function of content differences in the cognitive structures of the "key actors" in those three firms. Finally, Thomas et al. (1993) reported evidence showing that the scanning and interpretation behavior of 156 hospital CEOs compiled in 1987 predicted strategic action and performance in the hospitals three years later. Taken together, these recent empirical studies of knowledge structure use begin to fulfill the promise established by the cognitively oriented strategic choice theorists. That is, the dispositional attributes of key decision makers seem to matter in the conduct of firm performance in ways that sociologists or economists might not envision.

Individual-level Development. Administrative scientists have long been interested in understanding the kinds of work experiences that might prevent the functional-area tunnel blindness observed by Dearborn and Simon (1958). For example, job rotation across functional areas has been recommended as an antidote to "functional fixedness" (Katz 1982, p. 165) and "strategic myopia" (Lorsch 1985, p. 84). Gupta (1984) went so far as to argue that corporate-level general managers with functionally diverse career histories will

make the greatest contribution to their organizations' effectiveness. These ideas represent an intuition that "flexible thinking" is a key to organizational effectiveness (as opposed to the kind of myopic thinking that concerns so many authors listed in Table 1).

Numerous scholars have examined the likely individual, group, organizational, and national origins of a manager's knowledge structure. Brief and Downey (1983) argued that an individual's reinforcement history will determine the content of these perceptual screens. Both Bettenhausen and Murnighan (1985) and Calder and Schurr (1981) posited that groups can instantiate a particular knowledge structure in members, although they were vague about the specifics of this instantiation process. At the organizational level, Brief and Downey (1983), Gray et al. (1985), and Harris (1993) reasoned that an organization's culture can shape knowledge structure content, while Ginsberg (1989) hypothesized that the degree of firm diversification shapes such content. The Schneider (1989) and Shaw (1990) work on intercultural management suggests that national culture should also be considered as a source of schema content. This theoretical work has sparked a number of empirical efforts whose results support many of these ideas.

At the individual level, an individual's tenure in a company (Walker 1985) and years of work experience (Lurigio and Carroll 1985, Wagner 1987) have been shown to result in particular knowledge structure content. In his study of cognition in a software products firm, Walker (1985, p. 12), for example, found that "industry veterans gradually failed to distinguish between the different ways of achieving short- and long-term product goals." Moreover, a person's position in an organization's hierarchy (Hauenstein and Foti 1989, Ireland et al. 1987, Pazy 1994) or network (Walker 1985), and even the overall success of the individual's employing organization (Stewart and Latham 1980) have been shown empirically to be related to the content of an individual's knowledge structure. Westenholz (1993) showed how the experience of a paradoxical situation can promote a change in a person's frame of reference. Thomas and McDaniel (1990) illustrated how a firm's strategy and the information-processing structure of the top management team (i.e., participation, interaction, and formalization norms) affected CEO's interpretations of strategic issues. Even gender may play a role in knowledge structure development. Antes et al. (1988), for example, found that women updated their cognitive maps of a city's streets more accurately than men after a change in the city's travel paths. Work examining the effects of national differences on individual knowledge structure development has been equivocal. Schneider and DeMeyer (1991) and Calori et al. (1992) suggest that national culture may affect managers' interpretive processes, while Markóczy (1995) found evidence to the contrary.

Finally, research on the process of knowledge structure development suggests that a dramatically altered information environment is often the locus of knowledge structure change (Isenberg 1987). Such alteration may follow a leader's articulation of a new vision for an organization (Bartunek et al. 1992). Additionally, Poole et al. (1990) pointed out that schemas can be maintained and developed through both direct (i.e., repetition) and indirect (i.e., stories, myths, and role models) experience. The effect of indirect experience may explain why Walsh (1988) did not find a clear association between managers' functional area work experiences and the functional orientation of the contents of their knowledge structures. That is, managers with unifunctional experience may be capable of developing a schema reflecting multifunctional concerns through their indirect, vicarious learning about organizational life. In all, researchers have clearly made progress in articulating the kinds of experiences associated with knowledge structure development.

Group-level Representation. Levine et al. (1993, p. 599) recently observed that "outside the laboratory and the school, cognition is almost always collaborative." Such sentiment has prompted a number of writers to examine the work on individual knowledge structures and conclude that when a group of individuals is brought together, each with their own knowledge structure about a particular information environment, some kind of emergent collective knowledge structure is likely to exist. This group-level representation of an information environment would act just like an individual's knowledge structure. It too functions as a mental template that when imposed on an information environment gives it form and meaning, and in so doing serves as a cognitive foundation for action. The key challenge in considering knowledge structures at the supra-individual level of analysis is to account for the role of social processes in the acquisition, retention, and retrieval of information. The study of cognition at this level of analysis truly becomes a study of *social* cognition. The hypothesized group-level knowledge structure has been called a collective cognitive map (Axelrod 1976) a team mental model (Klimoski and Mohammed 1994), a collective cognition (Langfield-Smith 1992), a hypermap (Bryant 1983), an intersubjectivity (Eden et al. 1981), a dominant logic (Prahalad and Bettis 1986), and a negotiated belief structure

(Walsh and Fahey 1986). As a group approaches a decision issue, then, information is thought to be acquired, retained, and retrieved within the parameters set by this group-level knowledge structure. A point of controversy here may be that by focusing on group-level cognition and action, researchers are challenging a Western orthodoxy that considers the individual to be the independent locus of social action (Markus and Kitayama 1991). While consideration of group-level cognition and action may be problematic for some people, it is important to face the controversy and wrestle with ideas that ask us to develop a theory of "sociocognition" (Levine et al. 1993).

A key point to recognize is that the knowledge structure discussed by all of the authors cited is seen as the aggregation of individual knowledge structures. The composition rule that underlies this aggregation process may accommodate political processes and hence, can allow for uneven individual representation in the group-level structure. To date, theory in the organization sciences views the group-level knowledge structure as an aggregate construct. The aggregation process has been treated with varying degrees of sophistication. This conceptualization is very much akin to Halbwach's (1950) idea of the collective memory. Of course, it is also possible to consider the construct at a system level. Glick (1985) made this same point about research on organizational climate.

Several empirical attempts to aggregate individuals' knowledge structures have been reported in the literature. Bennett and Cropper (1987) illustrated how four government planners' cognitive maps could be blended to discover the "hypergame" lying beneath the surface of a conflict in their workplace. Relatedly, Roberts (1976, p. 151) gathered a group of experts to build a collective cognitive map about commuter transportation policy that was "likely to be more accurate than the cognitive map based on the views of any one person." He was able to combine the experts' judgments into a single map that he felt could be very useful for guiding policy making, but did not demonstrate how this map might be helpful. Finally, Wacker (1981) showed that individuals' maps could be synthesized into collective work group assessments of a variety of aspects of their employing organization. Incidentally, Langfield-Smith (1992) tried to use a similar methodology to assess a shared cognitive map among members of a fire department. She had to abandon her effort because of the ambiguity of language and meaning in the creation of the group map and the strain induced by revealing the differential power relationships among the group's members in this exercise. Her study raises a caution for persons interested in assembling a working group to build a collective cognitive map.

Gioia et al. (1989) took a different approach to this issue. Instead of experimentally demonstrating how a collective knowledge structure might come to exist, they went into the field to discover whether or not any do exist. They found that managers appear to share consensual and distinct scripts for the conduct of appraisal interviews. These scripts vary, depending on whether the subordinate is seen as a good one or a poor one.

Group-level Use. Theoretical discussions of the consequential use of group-level knowledge structures in organizations is fairly sparse. Focusing on the top management team, Walsh and Fahey (1986) hypothesized that the commingling of power and belief among the team members will yield negotiated belief structures, which in turn affect strategy making and implementation in predictable ways. Taking a similar conceptual stance, Ford and Baucus (1987) posited that top decision makers' collectively shared interpretations of a performance downturn will predict their organization's response to the downturn. More recently, Ginsberg (1995) articulated a link between socio-cognitive capability in a top management team and competitive advantage. Looking more broadly within the organization, Brown and Duguid (1991) posited that innovative and flexible organizations would comprise a number of linked "autonomous thought communities." Most of the evidence collected to date, however, has pertained to the top management team.

Case studies represent the preponderance of empirical work in this area. Many of these studies link organizational blunders to dysfunctional information processing among the organizations' leadership groups. Zahra and Couples (1993) provide a good introduction (with examples) to how blind spots can produce crippling flaws in a company's competitive analysis. More developed case analyses include Starbuck and Hedberg's (1977) analysis of the Facit Corporation's inability to recognize the electronic calculator as a threat to its mechanical calculator business, Wilensky's (1967) examination of the Allied commanders' unwillingness to accept the futility of the saturation bombing of Europe in World War II, Wyden's (1979) report of the U.S. military strategists' unyielding and disastrous interpretation of reconnaissance photographs showing seaweed instead of coral in the Bay of Pigs, and Narayanan and Fahey's (1990) study of the decline of the Admiral Television Company over a 15-year period. All concluded that the problems were rooted in the cognitive

shortcomings of each organization's key decision-making group. Each group could be seen as holding some kind of supra-individual knowledge structure that skewed its understanding of its information world in such a way that it was blind to certain aspects. Less damning case analyses were conducted by Dougherty (1992) and Dutton and Dukerich (1991). Dougherty found that information is interpreted differently in an organization's various "departmental thought worlds." Dutton and Dukerich illustrated how the organizational identity that managers held for the Port Authority of New York and New Jersey affected their interpretations of, and reactions to, the issue of how to cope with the homeless people that populate their facilities.

In a more positivistic research tradition, Shetzer et al. (1990) used imagery analysis to operationalize Walsh and Fahey's (1986) four types of negotiated belief structures. They found some support for their hypothesized relationships between those belief structures and attributes of the group decision-making process (e.g., mode of decision resolution, decision speed and flexibility). Roos and Hall (1980) represented a collective cognitive map of the staff members in a hospital's extended care unit. From this map, they were able to show how the director of the unit was able to gain influence in the hospital. They also drew implications for the role of cognitive maps in organizational efficiency and innovation. Fiol (1993) studied collective patterns of interpretation in a financial services firm as it wrestled with a new venture idea over a two-year period. She found that the venture group took action only when it discovered a shared interpretive frame that allowed the occasionally diverse subgroup perspectives to be reconciled. In a provocative study, Barr et al. (1992) traced the changes in the cognitive maps of the top managers of two railroads over a 25-year period. Interestingly, one railroad is still viable today (C & NW) and the other went out of business in the 1970s (Rock Island). The researchers found that the managers in both companies altered their cause maps in the face of environmental change, but only the surviving company showed evidence of continued experimentation, change, and learning in its maps. The defunct company made a change and never changed again. This study is important because it asks us to weave our understanding of cognition with our understanding of the organizational learning process. It also suggests that we need to consider issues of representation (i.e., noticing a changed environment) and development (i.e., linking cognitive change to learning) when we strive to understand the basic issues of knowledge structure use.

Given the many deleterious consequences that are thought to follow from the use of a group-level knowledge structure, it should come as no surprise that the explicit recognition of these structures has been argued to promote effective decision making. Eden (1988) may have more experience with this practice than anyone. He has helped to refine a cognitive mapping procedure over the years that enables him to uncover individual and team maps as a step toward the creation of a decision-enhancing natural dialectic among members of an organization's decision-making group (Cropper et al. 1990, Eden and Jones 1984). He concluded that one of the major attractions of cognitive mapping is that it "may act as a tool to facilitate decision-making, problem-solving, and negotiation within the context of organizational intervention" (Eden 1992, p. 262). Relatedly, Mitchell (1986) conducted an experiment showing that team members' relationships were enhanced after disclosure of their frames of reference. Perhaps Rock Island's top managers would have seen the utility of continuing to update their cause maps in the face of their environmental changes if these action researchers had been able to work with them. This prescriptive work and the Barr et al. (1992) study challenge us to improve our understanding of group knowledge structure development.

Group-level Development. Only Ford and Baucus (1987) and Langfield-Smith (1992) have offered a theoretical assessment of group-level knowledge structure development in organizations. Ford and Baucus considered how decision makers' interpretations can be shaped in part by their organizational context (i.e., strategy, structure, and culture). Langfield-Smith argued that one must understand the interaction of cognition and social process to understand how collective knowledge structures are formed. She makes the point that as a group comes together, some aspects of the individuals' cognitive maps will overlap and some will not. A shared cognitive map emerges from a social process marked by negotiation and argument, as well as by a host of unarticulated internal and external triggers for change.

A few empirical attempts have been made to document group knowledge structure development in organizations. None have tested Ford and Baucus' (1987) ideas directly, but some have explored the kinds of social processes that Langfield-Smith (1992) identified. Empirical researchers seem to have two kinds of developmental processes in mind. On the one hand, individuals may update their knowledge structures themselves as they come to terms with changing information environments. This is a rather asocial process. On the

other hand, knowledge structure change may be a function of social influence processes. Four studies have examined the former process and three studies have shed light on the latter.

The evidence about how groups of individuals accommodate changing information environments is mixed. Fahey and Narayanan (1989) examined the revealed causal maps of the dominant coalition in the Zenith Electronics Corporation over 20 years (1960–1979). After identifying five distinct periods in this time span, they examined the extent to which the objective characteristics of the corporation's environment influenced the content of a group of senior executives' revealed causal maps. They found that although "the content of the maps changed consistently from period to period... little interconnectedness between elements of the macro environment and the industry was present in the maps" (1989, p. 374). While they acknowledged certain methodological challenges that might have compromised their efforts, they speculated that the lack of association may reflect the difficulties managers encounter when they try to map a changing environment. Perhaps the observed changes in the executives' cause map represent their best approximation of this changing information environment. Relatedly, Isabella (1990) investigated how such environmental changes affect collective frames of reference. In contrast to Fahey and Narayanan (1989), she found connections between changes in managers' information environments and changes in their frames of reference. She conducted an inductive study of how the frames of reference of 40 managers in a medium-sized financial services institution changed in response to key organizational changes (e.g., an acquisition, a succession event, and a company reorganization). She discovered that their collective frames of reference went through a four-stage change process, moving from unformed to well constructed. These cognitive changes paralleled the evolution of the organizational changes. This study is the first to demonstrate empirically how changes in an information environment can prompt alterations in organizational members' cognitive structures. Similarly, Barr et al. (1992) found evidence that cause maps change in response to environmental discontinuities. Finally, Milliken's (1990) evidence suggests that top-level administrators' interpretations of environmental change can be explained in part by their organization's resource constraints.

Poole et al. (1989) developed some interesting theory and reported some ethnographic evidence about induced schema-change processes in organizations. They argued that a leader can attempt to change subordinates' schemas in any of four ways (enforcement, manipulation, instruction, or proclamation), depending on whether the influence attempt is direct (e.g., personal confrontation) or indirect (e.g., send a memo) and whether the forum for this attempt is a private or a public one. The authors were mildly surprised to discover that enforcement (i.e., change initiated by private personal confrontation) proved to be the most effective means to change schemas in the bank they studied. Rentsch (1990) examined the interaction networks in an accounting firm and found that individuals in an interacting group interpreted organizational events similarly, but differently from those in different interaction groups in the same firm. While she did not articulate how these homogeneous interpretations evolved, her work does ask us to consider the relationship between cognition and behavior in discussing group level cognitive structures. In a related study, Ward and Reingen's (1990) sociocognitive analysis of group decision making in a sorority house revealed that subgroup communication patterns can interact with initial beliefs to explain shifts in shared beliefs over time. These three studies are important because they implicate both formal and informal influence processes in the development of shared knowledge in organizations. When we combine these insights with those about the effects of the information environment on knowledge structure development, we can begin to see the outlines of a promising research agenda that should tell us more about the frequency and relative efficacy of these two developmental processes.

Organization-level representation. Contemporary writers in the administrative sciences have built on Durkheim's (1895) and Fleck's (1938) early ideas about collective thought. Skepticism about those ideas has ebbed recently. Building on previous work (Shrivastava and Schneider 1984, Schneider and Shrivastava 1988), Schneider and Angelmar (1993, p. 356), for example, recently concluded that "the 'thinking organization' is not just a metaphor, (it) refers to an empirically demonstrable capability of organizations." Tiring of the debate about distinctions between maps and territories, Bougon (1992) argued that "there is no 'underlying' or 'deeper' reality to be discovered. The socially constructed reality of a system of cognitive maps congregated by cryptic labels *is* the social reality" (p. 381). By understanding organization-level cognition, then, we may be closer to appreciating the essence of organizing. Theoretical work in this area is moving in two directions. Some theorists remain tethered to the dominant computer metaphor and examine the distributional aspects of the organizational mind, while oth-

ers look to social processes as the substrate for the organizational mind.

In the distributional school of thought, Krippendorff (1975, p. 16) argued that "a system possesses social memory if its history-determining behavior can be explained neither by the psychological processes of its human constituents nor by the technological processes of the machines being used, but by reference to the underlying super-individual processes." He posited that such information is stored in the process of information transmission between individuals, in records of past events, and in organizational structure. Levitt and March (1988) would likely agree. In their review of organizational learning, they raised the possibility that experience can be conserved and retrieved by the socialization and control systems that constitute organizational memory (i.e., routines, rules, apprenticeships). With similar reasoning, Walsh and Ungson (1991) reviewed the history of the concept of organizational memory and developed a theory of organizational memory and its role in decision making. They argued that an organization can retain its past in the minds of its individual members as well as in its culture, transformations, structures, ecology, and external archives. They also speculated about how information might be retrieved in either an automatic or controlled fashion from these "storage bins" that constitute the organization's information retention system. Dougherty and Kunda's (1991) analysis of the photographs of customers portrayed in five computer equipment manufacturers' annual reports over a ten year period provided some evidence to suggest both that organizations' beliefs about their customers are enduring and that these beliefs are manifest in their public documents.

The other school of thought builds on Daft and Weick's (1984) idea that organizations are interpretation systems. Consistent with Dunn and Ginsberg's (1986) idea about sociocognitive connectedness, the idea here is to understand the relationship between social processes and knowledge representation at the organizational level of analysis. Sandelands and Stablein's (1987) work best represents the reasoning in this area. They too argued that "organizations are mental entities capable of thought" (p. 136). They proposed that organizations meet three criteria for establishing a mind. First, the patterns of behavior in organizations establish the physical substrate or the "hardware" of an organizational mind. Second, such patterns serve as a code or vehicle to represent ideas. Third, these ideas interact in a complex manner. Their key point is that we need to consider patterns of behavior as the critical unit of analysis when we explore the organizational mind Weick and Roberts (1993) pushed these ideas further. Their theory centers on the nature of this patterning and interaction of behavior. They considered how individual action (i.e., representation, contribution, and subordination) informs social processes (i.e., recapitulation, conversation, and resocialization) to produce a "heedful" collective mind. They illustrated how such heedful organizational thinking yields highly reliable behavior on an aircraft carrier deck.

The two broad perspectives on the organizational mind are not mutually exclusive. We review the extant work on the use and development of organizational cognition as a foundation for considering how these provocative ideas might shape future work.

Organization-level Use. Theorists have argued that the collective representation of knowledge in an organization can either enhance or detract from the process of organizing. On the positive side, Donnellon et al. (1986) and Ranson et al. (1980) pointed out that shared interpretive schemes in an organization allow for a continuity of understanding and behavior in changing circumstances. Brunnson's (1982) discussion of the objective ideology of a firm and Walsh and Ungson's (1991) discussion of organizational memory recognized that both positive and negative consequences might follow actions guided by such understanding. Focusing on the negative, Shrivastava et al. (1987) offered the most succinct statement of the possible failures associated with the use of what they called an organizational frame of reference. They argued that nonrational organizational action can often be traced to a) failures of cognitive elements and maps; b) failures in reality testing; and c) failures related to the articulation and codification of the domain of inquiry. They developed each of these ideas in some depth and illustrated them with brief examples of the problems faced by Texas Instruments, Citibank, and International Harvester. It is this kind of reasoning that lead Bartunek and Moch (1987) and Bernstein and Burke (1989) to argue that organizational development consultants should address these issues and help their clients uncover and perhaps change their organizational schemas. Argyris and Schön's (1978) discussion of double-loop learning can be read as an affirmation of this prescriptive logic.

Notwithstanding this theoretical concern about decision failures that might be attributed to organization-level knowledge representation and use, most empirical work in this area illustrates the functional aspects of such use. The work consists largely of case analyses. Barley (1983), for example, identified a common inter-

pretive scheme in funeral homes and showed how it contributed to the effective conduct of their business. Weick and Roberts' (1993) argued that the highly reliable conduct of work on an aircraft carrier deck can be explained by a "heedful" collective mind that exists on aircraft carriers. Taking a different tack, Meyer (1982) found that harmonious organizational ideologies can supplant formal organizational structures. In those situations, ideological control appears to act as a substitute for structural control. Only Hall's (1984) work might be seen as contributing to our understanding of the failures of organizational actions. In this study of the demise of the *Saturday Evening Post*, he demonstrated a linkage between the organizational cause maps in the company and the firm's policy decisions over a 20-year period. These case analyses illustrate the power and potential of ideas about organization-level knowledge representation and use.

Finally, one positivist study showed the decision effects associated with the organizational retention and use of knowledge, but did not directly assess such knowledge representation. Smith et al. (1991) examined the organizational information processing attributes of firms challenged by a variety of competitors' actions. They found that firms having a number of marketing and customer service employees (representing an external orientation) were much quicker to respond to such challenges than those with a more internally focused organization. This study is important because it moves away from a case methodology and begins to examine the structural substrate associated with the Sandelands and Stablein (1987) and Weick and Roberts (1993) conceptions of organization-level knowledge representation.

Organization-level Development. Greenwood and Hinings (1988) established the basic framework for thinking about how organization-level knowledge structures might change and develop. They argued that an organization's interpretive scheme typically exists in a mutually accommodating relationship with the social activity of organizing. Change necessarily involves a decoupling and then a recoupling between these cognitive and social activities. The authors believe that a variety of forces can decouple an interpretive scheme from a coherent relationship with a firm's organizing practices (i.e., environmental discontinuities, as well as strategic and structural shifts that might be traced to CEO changes or political processes). These ideas are reinforced in Lyles and Schwenk's (1992) formalized theory of organizational knowledge structures, wherein the locus of knowledge structure change is identified as challenges posed by a firm's environment, sociopolitical processes within the firm, and changes in key decision makers' values and assumptions. Hopfl's (1992) discussion of charismatic leadership speaks to this focus on the key decision maker by arguing that one of the main functions of such a leader is to manufacture and maintain meaning in an organization. Research testifying to the veracity of these propositions is slim but available.

Case study evidence supports Greenwood and Hinings' (1988) view of the relationship between organizational structure and interpretive schemes. Specifically, Bartunek (1984) and Bartunek and Franzak (1988) showed how the shared interpretive schemes of a religious order changed with an organizational restructuring. Poole et al. (1990) took a completely different methodological approach in their attempt to understand the social origins of organizational script development. While their use of a business simulation game may have limited external validity, they were able to use it profitably to help us understand that social interaction is a necessary condition for the development of organizational scripts.

Industry-level Representation. Huff (1982, p. 120) posed four important questions: How do people in different organizations come to perceive opportunity in such similar ways? How do they come to adopt similar paths to opportunity achievement? Does countering the competition completely account for similar timing on strategic decisions? What accounts for shared mistakes in anticipating environmental change? She answers these questions by arguing that common perceptions and actions can be traced to the operation of a strategic frame in an industry. Huff (1982) noted that she was well aware of Spender's unpublished work on industry recipes (he later pulled these ideas together in an important book (1989)). The basic idea behind the notion of a strategic frame or an industry recipe is that there exists a "shared knowledge-base that those socialized in an industry take as familiar professional common sense" (Spender 1989, p. 69). This shared common sense is hypothesized to be responsible for the similarity of competitors' perceptions and actions that piqued Huff's curiosity. More recently, Porac and Thomas (1990) and Abrahamson and Fombrun (1994) formalized this kind of thinking in their theories of competitive cognitive taxonomies and interorganizational macro-cultures.

Two studies demonstrated that perceived industry structure might differ from an outsider's view. Gripsrud and Grönhaug (1985) studied the perceived competitive structure in the minds of the 51 grocery store managers in a small Norwegian town. They found that the average manager recognized only 3.2 of these

stores as their competitors. Similarly, Baum and Lant (1995) queried 43 Manhattan hotel managers and discovered that the average manager identified only 15 competitors among the 167 hotels in Manhattan.

Some investigators attempted to document the shared mental representations of an industry. Porac et al. (1989) revealed the cognitive taxonomies underlying the Scottish knitwear industry, Spender (1989) interviewed managers from the United Kingdom's iron, dairy, and forklift truck rental industries to identify their industry recipes, and Calori et al. (1992) found industry effects in their French and British managers' frames of reference about their competitive environments. In the United States, Reger (1990), Reger and Huff (1993), and Walton (1986) all documented the shared perceptual structures among executives in various niches of the financial services industry, while Stubbart and Ramaprasad (1988) uncovered the similarities in the cognitive maps of the CEOs of two very different steel companies (U.S. Steel and Nucor).

Finally, Grönhaug and Falkenberg (1989) provide evidence that industry-level perceptions may not be widely shared. Grönhaug and Falkenberg studied self and competitor strategy perceptions in four wood products firms. They found that in most cases, competitors' perceptions of a firm's strategy did not match the firm's perceptions of its own strategy. While this study does not represent a direct investigation of industry recipes per se, it does remind us to anticipate variance in our investigations of industry-level cognition.

All of the work cited suggests the validity of industry-level knowledge representations. The key point to keep in mind, however, is that this work has validity at the industry-level of analysis only if the research focus is on the dynamics of knowledge representation among an industry's competitors. Some of the work cited focuses on managers' representations of industry competition. While such research clearly informs our understanding of industry cognitive structure, it represents an individual- or group-level building block in our understanding of industry knowledge representation.

Industry-level Use. The general idea here is that corporate strategy is formulated only to compete against a "cognitively tractable number of other organizations" (Porac and Thomas 1990, p. 233). Fiegenbaum et al. (1995) argue that this reduced set of competitors acts as a benchmark or reference point for a firm that is establishing its competitive strategy. Experience with this cognitively constrained picture of an industry provides the repertoire of strategic ideas that enables the firms to compete with each other (Huff 1982). As Spender (1989, p. 192) put it, "The recipe suggests a pattern of appropriate resources as well as a way of looking at the world." Abrahamson and Fombrun (1994) worry that such macro-cultural homogeneity can prompt strategic similarity and inertia among competitors, as well as a tendency to cling to traditional technologies. In the end, industry-level cognitive representations are thought to both define the competitive playing field and supply the rules of the game. This line of reasoning is consistent with contemporary thinking in institution theory (Powell and DiMaggio 1991).

So far, the empirical work in this area largely supports these ideas. Spender's (1989) grounded theoretic work is largely responsible for the development of this school of thought, and his case accounts provide supporting evidence. Yates' (1983) discussion of the "Detroit Mind" and its role in U.S. automakers' tardy response to the Japanese challenge is also consistent with these ideas. Moreover, Gripsrud and Grönhaug's (1985) preliminary study of the link between strategy making and cognitive industry structure is supportive. They found that the choice of strategy was predicted by whether or not the store manager felt the store's most important competitor was nearby. Feigenbaum and Thomas' (1995) study of the U.S. insurance industry provides evidence supporting the idea that strategic groups act as a cognitive benchmark in the development of corporate strategy. Perhaps the best account of the impact of industry recipes on corporate strategy making was given by Porac et al. (1989). They showed how the Scottish knitwear industry's self-definition as a producer of "high quality fully-fashioned classic knitwear" served to build and routinize a myriad of transactional relationships among competitors, as well as suppliers, retailers, and even customers. This study is important because it begins to shed light on how cognition can play a role in each step of the value chain. It also provides a bridge to researchers working in the economic paradigm who are seeking to understand the role of perception in the formation of strategic groups (Fombrun and Zajac 1987).

Industry-level Development. Theorists have paid little attention to the issues of industry-level knowledge structure change and development. Porac and Thomas (1990) devoted one paragraph to the topic, while Huff (1982) dedicated a section of her paper to it and Spender (1989) used only three of his 215 pages on the topic. Nevertheless, there seems to be a consensus that the source of change can be either exogenous or endogenous. In the broadest sense, Spender (1989, p. 196) writes that "recipes must adapt or be replaced

as industry's total social, technological, economic and cultural context develops." Paying particular attention to the economic context, Abrahamson and Fombrun (1994) ask us to examine the structure of a firm's value-added network of relationships (i.e., vertical, horizontal, and diagonal interdependences). One consistent theme in all of this work is that the stimulus for change could be endogenous innovation by a single firm in the industry.

What changes in the industry recipe and how it changes is even less clear. Spender (1989) made the case that either the content emphasis in the recipe can change (i.e., a shift away from an efficiency focus to a new product orientation) or the elements of the recipe itself can change (i.e., abandonment of one recipe and adoption of another). Porac and Thomas (1990) concurred that one category representation might supplant another. They also added some nuance to the theory by arguing that developmental shifts may involve changes in abstraction (i.e., bank managers redefining their businesses as financial service firms) or content shifts at the same level of abstraction (i.e., a specialty food store owner reconceptualizing the business as a supermarket). Unfortunately, none of these ideas have been the focus of empirical inquiry to date. Only Gripsrud and Grönhaug (1985) and Baum and Lant (1995) provided data about developmental processes. They investigated a slightly different question about developmental origins, however. Gripsrud and Grönhaug found that firm size and propinquity predicted perceived industry definition. The Norwegian grocery store managers they studied tended to view only the largest stores or their nearest stores as their competitors. Baum and Lant's study of the Manhattan hotel industry revealed similar results. Location, price, and size were used as discriminating cues by the hotel managers as they defined the competitors they monitored regularly.

Table 2 tells us that the issues of representation, development, and use of knowledge structure content at each of four levels of analysis have been given considerable theoretical and empirical attention in the past few years. This is not to say, however, that we have asked all the right questions, nor that we have complete answers to the questions we have asked. Moreover, before we can develop a continuing research agenda, we must consider the status of the more limited body of research on the structure of knowledge structures.

Investigations of the Structure of Knowledge Structures

Table 3 organizes the extant work on the structure of knowledge structures. It is similar to Table 2 in the organizing heuristic (representation, development, and use at different levels of analysis), but includes fewer researchers because relatively little work has been done in this area. We therefore just broadly review the work at three levels of analysis.

Individual Level. In his early and influential study of cognitive maps in rats, Tolman (1948) speculated about cognitive maps in humans. He offered what he called a "brief, cavalier, and dogmatic" (p. 207) discussion of the perils of narrow cognitive maps. He traced problems with regression, fixation, and the displacement of aggression to cognitive maps that are not comprehensive enough to cope with reality. Just a few years later, Ashby's (1956) "law of requisite variety" provided a theoretical framework both to explain Tolman's intuition and to build a research agenda for the structure of knowledge structures. He argued that if a self-regulating system is to survive, its internal diversity must match the diversity of its environment. This is what Tolman (1948, p. 208) probably meant when he invoked Freud to argue that comprehensive maps enable one "to live according to the reality principle rather than according to the too narrow and too immediate pleasure principle."

Bartunek et al. (1983) extended this kind of reasoning to the management domain. Noting the complexity and complicatedness that often mark a manager's information environment, they concurred with Weick's (1979, p. 261) advice to managers: "Complicate yourself!" Following Ashby's (1956) logic , they argued that in complex information environments "a narrow framework for understanding often results in ineffective managerial behavior" (1983, p. 273). Similarly, in a discussion of managerial world views, Miller (1993, p. 131) reasoned that "simplicity over long periods of time will eventually lead to lower organizational performance." Kiesler and Sproull (1982) would likely agree. They noted a piece of "conventional wisdom" that has sparked a number of empirical investigations: "If managers receive a wider range of information, they are potentially able to spot problems they would miss if their vision were narrower" (1982, p. 551). When Bartunek and his coauthors refer to a "narrow framework" and Kiesler and Sproull refer to a "narrow vision," they are implying the structural attributes of a knowledge structure that is employed in a theory-driven fashion. Several investigators have attempted to assess the use and development of such structural attributes.

The two most commonly studied structural attributes are differentiation (the number of dimensions within a knowledge structure) and integration (the degree of

Table 3 Theoretical and Empirical Discussions of the Structure of Knowledge Structures at Multiple Levels of Analysis

	Knowledge Structure Attributes		
	Representation	Development	Use
LEVEL OF ANALYSIS			
INDIVIDUAL			
Theoretical Work	Axelrod (1976) Lodge and McGraw (1991) Read (1987)	Bougon and Komocar (1990)	Ashby (1956) Bartunek et al. (1983) Kiesler and Sproull (1982) Miller (1993) Tolman (1948) Weick (1979)
Empirical Work		Day and Lord (1992) Goodman (1968) Hodgkinson and Johnson (1994) Levi and Tetlock (1980) Lurigio and Carroll (1985) Neimeyer and Metzler (1987) Rentsch et al. (1994) Sujan et al. (1988) Tetlock (1981) Tetlock and Boettger (1989) Tetlock et al. (1984)	Jolly et al. (1988) Stabell (1978) Sujan et al. (1988) Tetlock (1984)
GROUP			
Theoretical Work			Ashby (1956)
Empirical Work	Bougon et al. (1977) Krackhardt (1987)		Walsh et al. (1988)
ORGANIZATION			
Theoretical Work	Lyles and Schwenk (1992) Walsh and Ungson (1991)	Lyles and Schwenk (1992)	Ashby (1956) Brunnson (1982) Lyles and Schwenk (1992)
Empirical Work	Nelson and Mathews (1991)		
INDUSTRY			
Theoretical Work			
Empirical Work			

interconnectedness among the knowledge structure's dimensions). Researchers have investigated the origins of these structural properties. Goodman (1968) found that three personality variables (level of aspiration, job involvement, and cognitive complexity), as well as an individual's position in the organization's hierarchy, were positively related to the differentiation of an individual's cognitive map. Consistent with Goodman's personality focus was Neimeyer and Metzler's (1987) examination of the extent of differentiation and integration within vocational schemas. Those authors found that both schema differentiation and integration varied positively with one's identity development in Erikson's (1968) terms. Many more researchers have picked up on Goodman's (1968) intuition that a person's organizational experiences are key to understanding knowledge structure development processes.

Focusing on work experience, Day and Lord (1992) found that experts (CEOs) could categorize ill-structured problems much more quickly than novices (MBA

students). They attributed this difference to the experts' "well-developed knowledge structures" (p. 43). Other researchers have tried to quantify these developmental differences. Lurigio and Carroll (1985) discovered that both the number of schema categories and the number of information units within each category varied with experience. Specifically, novices had more schema categories, but fewer informational units within each category, than experts. Similarly, Rentsch, Heffner, and Duffy (1994) found that novices had more categories in their schemes than experts. In an elegant cross-sectional and longitudinal study of knowledge structure development among salespeople, Sujan et al. (1988) partially corroborated these results. While they did not discover any relationship between work experience and the number of categories in the knowledge structure per se, they did find that experienced (and more effective) salespeople had more descriptors per category than their inexperienced peers. Hodgkinson and Johnson (1994), however, found that both the number of levels in a manager's cognitive taxonomy of a business environment (vertical complexity) and the number of exemplars within each level (horizontal complexity) varied with the scope of the manager's job. Head office managers' cognitive structures were more complex in each instance than those of their colleagues working in the field. The authors attributed these structural differences to differences in the managers' work experiences. In particular, they argued that the head office managers' job roles required "deeper insights into the structure of the competitive environment" (p. 19). These studies suggest that work experience changes the qualitative nature of a person's category system. The results reviewed here, however, do not present a coherent and compelling set of findings. Consequently, this work must be seen as preliminary and suggestive.

An interesting set of applied studies suggests that politicians become more integratively complex after they assume office. This finding holds for elections to the Presidency (Tetlock 1981) and Senate (Tetlock et al. 1984) in the United States, as well as for the change of power in the Soviet Union (Tetlock and Boettger 1989). Perhaps accountability prompts people to think in a more complex fashion.

In an important study, Levi and Tetlock (1980) examined the differentiation and integration of the cognitive maps of Japan's prime ministers, foreign ministers, and army and navy chiefs of staff in the months prior to the outbreak of World War II. They found only weak evidence for the hypothesis that crisis-produced stress leads to simplified cognitive processing by policy makers. Only the navy chief of staff showed evidence of increasing simplification in his cognitive map (perhaps because he knew a war with the United States would severely tax his branch of the armed forces). Levi and Tetlock are the only researchers to date who have tried to link environmental conditions (i.e., a crisis) to the structural attributes of an individual's knowledge structure. A few researchers, however, have examined the consequences of the use of such knowledge structures.

The hypothesized deleterious consequences of holding firmly to a "narrow vision" have been flagged by Weick (1979), Kiesler and Sproull (1982), and Bartunek et al. (1983). A "narrow vision" in colloquial terms may translate to a "less differentiated knowledge structure" in cognitive terms. By Ashby's (1956) logic, greater structural differentiation (and perhaps integration) may be associated with optimal information processing in ill-structured situations. Schroder et al.'s (1967) theory would support this line of reasoning. In addition to Sujan and his coworkers, other researchers have attempted to assess the possible consequences associated with various structural attributes. First, Stabell (1978) examined the information-processing consequences following the use of knowledge structures with varying degrees of integrative complexity. Employing Kelly's (1955) repertory grid technique, he was able to derive a global measure of integrative complexity. He found a modest positive relationship between an individual's integrative complexity and the volume and breadth of information considered in an ill-structured problem situation. Second, Tetlock (1984) computed an integrative complexity score in an attempt to uncover the relationship between cognitive structure and the extremity of ideological beliefs among members of the British House of Commons. He found that extreme socialists and conservatives were less integratively complex than their more moderate colleagues. Relatedly, low integrative complexity scores also predict conservative voting records on the U.S. Supreme Court (Tetlock et al. 1985). While there may be other explanations for these results, one possibility is that "one's cognitive style may shape the value content of one's ideology" (Tetlock 1984, p. 373). Tetlock went on to speculate that less integratively complex individuals "may be more attracted to monistic than pluralistic ideologies. Such individuals are likely to grow impatient with the difficult trade-offs that pluralistic ideologies require" (p. 373). Third, Jolly et al. (1988) combined a variation of a repertory grid technique and a laddering procedure (Reynolds and Gutman 1984) to assess the level of abstraction in a knowledge structure and its effects

on performance appraisal judgments. A personal value concept (at the third level of abstraction) was found to explain significant variance in the performance ratings.

Much work remains to be done in this area. Several articulated theoretical ideas are still awaiting investigation. In the area of development, for example, Bougon and Komocar (1990, p. 148) identified possible ways to change the structure of a cognitive map: a) changing the direction of influence in a loop; b) adding, removing, or replacing a node in a loop; c) changing the sign of the links in a loop; and d) changing the number of parallel links in a loop. They provided illustrative examples for each of these change tactics, but the efficacy of these various approaches has not been tested systematically.

Finally, we might both sharpen our focus on the differentiation and integration of these knowledge structures and then move beyond that focus. We need to know more about how differentiation and integration relate to each other. The literature tends to assume that these two constructs are perfectly correlated. It may be, however, that there are instances of high (low) differentiation and low (high) integration. We need to understand both the ontology and utility of these different structural configurations. Moreover, several scholars have suggested that we study additional structural attributes. Axelrod (1976), for example, critiqued his own work and generated new, unexamined structural properties of cognitive maps, including the magnitude, emphasis, and confidence of a particular means-end linkage. He also argued that other types of means-end causation (besides simple causation) should be investigated (i.e., conditional or interactive causation, nonreversible causation, and nonmonotonic causation, pp. 260–261). Lodge and McGraw (1991) stated that we should examine the strength of association among the categories of a schema and then asked us to consider the place of affect in those cognitive structures. Read (1987) suggested that we examine the distinction between causes and enablements. An enablement sets the stage for a behavior, but does not actually cause it. A knowledge structure may play an enablement role in shaping behavior. Finally, we might take Rosch's (1978) ideas about nested levels of abstraction more seriously. We should be able to build on all of these ideas to develop a typology of the structure of knowledge structures in the future.

Group Level. While Ashby (1956) offers a theoretical logic about the utility of knowledge structures at this or any level of analysis, ideas about the representation of the structure of knowledge structures at the group level of analysis are method bound. That is, ideas about structure are largely derivative from cause mapping (Bougon et al. 1977), network analysis (Krackhardt 1987), or multidimensional scaling (MDS) techniques (Walsh et al. 1988). Eden et al. (1992) recently identified a variety of analytic choices that confront researchers who study the emergent features of cause maps. Three studies illustrate how theory and method commingle in this area.

First, Bougon et al. (1977) demonstrated how it is possible to combine each group member's cause map into an etiograph, or a collective cause map. While using the content of the map to establish causal direction, they derived structural properties (e.g., indegrees and outdegrees) that afforded a cybernetic understanding of individuals' causal means and ends in an information environment, as well as their sense of perceived influence over those variables. Second, Krackhardt (1987) introduced the idea of "cognitive social structure" in his work, but did not fully develop its construct validity. Rather, he used his time with the executives of a high-tech machinery company to illustrate how various structural properties of this cognitive social structure might be derived from a network analytic measurement approach (e.g., slices, locally aggregated structures, and consensus structures). He acknowledged that this was a preliminary step, a step that would enable "the cognitive side of this research (to) be formalized and pursued" (p. 128). Finally, Walsh et al. (1988) attempted to test Ashby's (1956) logic directly in their investigation of the decision consequences associated with the use of various structural configurations of a group-level knowledge structure. In an examination of Walsh and Fahey's (1986) idea of the negotiated belief structure, they used MDS to assess the dimensions of each group member's belief structure, aggregated them to form a group-level construct after accounting for power and influence in the group decision process, and correlated these variables with simulated company performance in an ill-structured decision environment. In seeming contrast to the requisite variety logic, they found that a group's shared agreement around a narrow set of belief structure dimensions (high realized consensus and low realized coverage, in their terms) was associated with several indices of superior firm performance.

Organization Level. We are just beginning to see work on the structural aspects of an organization-level knowledge structure construct. We have already examined Walsh and Ungson's (1991) distributed view of organizational memory. Their theory about the six hypothesized organizational retention facilities and the

retrieval processes associated with each of them begins to articulate a view of the structural substrate of what might be considered an organization knowledge structure.

More recently, Lyles and Schwenk (1992) used this same terminology to develop a more abstract theory about such a construct. They argued that an organizational knowledge structure consists of core and peripheral aspects that roughly relate to a set of shared ideas about the organization's goals (core) and means to achieve those goals (periphery). Consistent with previous work on differentiation and integration, they argued that these knowledge structures may vary in terms of complexity ("the number of elements within a knowledge structure," p. 163) and relatedness ("the linkages between elements," p. 163). As mentioned in our discussion of the development of knowledge structure content, their theory begins to account for change in these structures. Moreover, they offered hypotheses about the consequences of using such knowledge structures. Their logic is very similar to Ashby's (1956) logic. That is, firms having complex and loosely coupled knowledge structures are thought to be more flexible and adaptable than those having simple and tightly coupled ones (i.e., Propositions 8 and 9 in their theory). Brunson (1982) provided a perhaps important amendment to this kind of thinking. He distinguished between choice and action processes in organizations, arguing that a narrow organizational ideology (in his terms) was helpful to choice but not to action. This contingent view of the functional utility of differentiation may spark a reconsideration of Lyles and Schwenk's ideas, if not Ashby's ideas as well.

Empirical work in this area is practically nonexistent. Nelson and Mathews (1991), however, devised what might be a promising empirical approach. They began by identifying the collective cause map about the conduct of business in a land title company. Next, they identified various structural properties of this map (i.e., indegrees and outdegrees, as well as deviation amplifying and limiting loops). Finally, they used network analysis to examine patterns of interdependence in the firm and how they related to the structural attributes. While they did not claim to have represented an organizational knowledge structure in this research, their work establishes an important precedent for examining the relationship between cognitive and social processes at the organization level of analysis.

The most surprising aspect of the findings to date in this broad area of inquiry is the lack of support for many of the research hypotheses derived from Ashby's (1956) logic. Lurigio and Carroll (1985), for example, found that expert parole officers' schemas were less differentiated than those of their novice colleagues. Walsh et al. (1988) discovered that groups acting on a smaller number of belief structure dimensions outperformed groups acting on more differentiated negotiated belief structures. Levi and Tetlock (1980) found very little support for the hypothesis that a decision maker's cognitive map becomes less differentiated in crisis situations. Finally, Stabell (1978) found only marginal support for his direct test of the Schroder et al. (1967) thesis. Integrative complexity was not strongly associated with increased information usage. These sometimes inconclusive and sometimes surprising results, however, should not dampen our enthusiasm for conducting research in this area. On the contrary, these challenging and puzzling findings should spark our curiosity and prompt us to develop even better theory. The sparseness of Table 3 indicates that we are only just beginning to understand these issues. The remainder of this article articulates the most important unanswered questions about managerial and organizational cognition as a basis for identifying a research agenda for the field.

Discovering a Research Agenda in a Critical Reading of the Managerial and Organizational Cognition Literature

The preceding section brings together the diverse body of applied cognitive research that has been conducted in the management community, appreciatively chronicling what has been reported in the investigations. The organizing framework enables the reader to quickly identify under-researched areas, and the descriptions of extant work should provide a ready basis for extending and elaborating the ideas and results.

By a more critical reading of this literature, we can question the assumptions of the work and identify issues that have been wholly ignored or finessed. The point is to question our accumulated wisdom and push ourselves to build an even more rigorous and relevant program (Kuklinski et al. 1991 provided a similar service to the political science profession with their critical consideration of the political cognition literature). To this end, this section articulates a continuing set of research challenges in the broad areas of knowledge structure representation, use, and development in organizations. We also briefly note some methodological issues in measurement and research design. While it is beyond the scope of this article to provide a systematic

critique of the methodological challenges posed by this kind of work, we hope to alert researchers to some key challenges they may confront in the future.

Representation

At least four broad issues should be addressed in this area. We need to reconsider the utility of descriptive studies of knowledge structure content, reexamine assumptions about veridicality, consider the relationship between knowledge structure content and structure, and probe the limitation of the human mind as a prime repository of organizational memory.

Content Portraits. Most basically, it may be time to call a moratorium on research whose only aim is to describe the content of a particular knowledge structure. Our review identifies more than 25 studies of this sort. They seem to be offered as a first step toward establishing a cognitive research program, almost as a way of creating some legitimacy for such inquiry. The articles usually close with a call for effects research. Without questioning the quality of these investigations, we hope that researchers will now embrace more ambitious research questions right from the start. We have the impression that researchers who are trying to bring a knowledge structure perspective to an established area of study feel that they must build a justification for that research area (e.g., Pinkley's 1990 work on negotiation behavior). We know that individuals hold knowledge structures for various information domains. Moreover, we have some idea about how to measure them. Investigators should build on the body of work reported here and move directly to test the theoretical relationships that most intrigue them.

Veridicality. We need a better understanding of the relationship between knowledge structures and the information environments they represent. An interest in problem recognition (Cowan 1986, 1990) and problem definition (Smith 1989) has kindled work on how problems and opportunities (Fredrickson 1985) and opportunities and threats (Jackson and Dutton 1988) are perceived. For many years, we thought that the accuracy (or veridicality (Hogarth 1980)) with which a knowledge structure represented an information environment determined its usefulness. Starbuck and Milliken (1988, p. 40), however, brought some subtlety to this perspective when they stated that "one thing an intelligent executive does not need is totally accurate perception." They argued that an executive needs a perceptual filter that amplifies the relevant information and attenuates the irrelevant information. Indeed, the theoretical logic behind schematic information processing is that individuals create knowledge structures to simplify complex worlds and screen out the irrelevant in those worlds. Luria's (1968) account of the problems engendered by a mnemonist's nearly complete recall ability may be read as testimony to this kind of argument. Relatedly, Salancik and Porac (1986) made the point that decision makers need to distill some basic, abstract sense out of a large number of revealed bivariate causal assessments. Their notion of a "distilled ideology" captured the conclusions reached from such bivariate assessments. It represents a holistic environmental assessment. At issue, then, is just how accurate a knowledge structure must be in order to be useful to the person(s) employing it.

If a knowledge structure is a simplified representation of an information domain by definition, administrative scientists need to discover the nature of useful simplicity. That is, we need to discover how simple this representation can be become before it loses its functional utility. This discovery process will be difficult for two reasons. First, it is improbable that we could ever determine the usefulness or "relevance" of decision information prior to making a decision. In this light, Starbuck and Milliken's (1988) words are of little comfort to an executive. Post-decision assessments, however, can begin to shed light on these predecision relevance considerations. Perhaps the second reason is even more problematic. That is, any assessment of simplicity must be based on some kind of objective reality that can serve as a comparison benchmark. Establishing such a benchmark is an impossible task if our worlds are subjectively defined (Berger and Luckmann 1966). Two options are available to us. First, we can employ consensually defined environments to serve as a comparison benchmark. Krackhardt's (1990) work on accuracy is an example of this approach. Similarly, we might compare subjective and more consensually defined "objective" measures of environments. For examples, Duncan's (1972) subjective measures of perceived environmental uncertainty can be profitably contrasted with Dess and Beard's (1984) more objective indices of a task environment to assess the accuracy of managers' perceptions of it (Sutcliffe 1994). As a second option, we might take a lesson from the work of Smith et al. (1991) and be very disciplined and specific about defining what aspect of the information environment interests us. Their work on reactions to specific competitors' actions is noteworthy because they clearly defined a specific environment in their research.

We should recognize, however, that as social scientists necessarily pursue novel routes around seemingly intractable problems, managers continue to act on the

basis on their knowledge structures (whether accurate or not). The key to resolving our conundrum, then, may be found in understanding the relationships between cognition and action in a dynamic sense. While Starbuck and Milliken's (1988) view of inaccuracy may send chills down managers' spines, Weick's (1990) ideas may be a source of solace and even strength. He pointed out that the utility of a cognitive map lies most directly in its capacity to invoke action. Only by taking action (even based on an imperfect view of the world) can a manager hope to understand this world and to accomplish something. Understanding follows learning that is prompted by seeing discrepancies between the map and the world encountered by using it (parenthetically, this view of learning is consistent with the treatment of learning in two leading artificial intelligence architectures, ACT* (Anderson 1983) and Soar (Newell 1990). Of course, one needs a map, any map, to see a discrepancy. As Weick (1990, pp. 6–7) concluded, "Accuracy is nice, but not necessary, and the reason is that organizations generate action which creates its own substitutes for accuracy and learning... The truth of a map lies in the action and in the conditions of use."

While we are tempted to suggest that accuracy may be more important when dealing with physical rather than social environments (the former may be less subject to enactment processes), we suspect that the utility of a knowledge structure is always situationally dependent. Basso's (1972) work on the Fort Norman Slave Indians' conceptions of ice illustrates the point. The Indians developed a functionally useful view of ice through what we can only assume to be a process of trial and error learning. This view of ice is no doubt more complex than the view developed by the Cherokee Indians living in the southeastern United States in years past. The point is that neither view should be seen as more objectively accurate than the other. The assessment of veridicality ultimately lies in an assessment of the functional utility of the knowledge representation. As a result, future research should examine the relationship between cognitions, actions, amended cognitions, and redirected action. Some actions always prove to be better than others. We need to understand the role cognition plays in prompting and supporting what prove to be either effective or ineffective organizational actions. Only then might we begin to understand the utility of veridicality.

Content and Structure. As mentioned previously, there is disagreement in the literature about whether we should study content or structure. While no one has argued against the study of the structure of knowledge structures, we have heard arguments calling for a cessation of content research. Interestingly, the body of work in content dwarfs the work on structure. We need to study both content and structure because they are conceptually entwined. Tables 2 and 3 may contribute to the reification of a distinction. However, these two tables effectively organize the literature because they reflect the way the research in this area has been conducted to date. Tetlock (1984) attempted to combine work on content and structure. Other researchers should follow his important lead. We need to know more about how content is supported or compromised by structure and vice versa.

Beyond Individual Minds. The debate on the conceptual status of Durkheim and his students' ideas about thought collectives and collective memories is challenging and provocative, but many people may see it as referendum on the validity of the supra-individual knowledge structure construct. In truth, the debate only touches on the question of the integrity of this idea. The organization-level representation and retention of knowledge involves much more than the minds of individuals within the organization (whether connected in some intersubjective way or not). The work of Sandelands and Stablein (1987) and Weick and Roberts (1993) should do much to stimulate inquiry about the role of social process in the organizational representation of information. Moreover, Walsh and Ungson (1991) ask us to reconsider our understanding of technology, organizational structure, and workplace ecology to see them all as repositories of knowledge about information environments. Recasting our understanding of these traditional research topics as components in the working of an organization mind simultaneously breathes new life into old constructs and moves forward an exhausting debate about collective thought. Seen in this light, work on organizational cognition is in its infancy. The key is to view organizational cognition as much more than some kind of aggregation or even congregation of individual cognitive processes.

Use

Three broad issues warrant our theoretical and empirical attention in the area of knowledge structure use. One issue is unique to supra-individual knowledge structures and the other two are more general in scope. We flag a construct validity issue and then raise a number of considerations about when knowledge structures are used and how they affect the management of organizations.

The Fallacy of the Wrong Level? Many researchers have accepted the idea that knowledge structures can

be considered at the supra-individual level of analysis. With this idea comes the expectation that groups, organizations, and maybe even industries are engaged in parochial thinking, gap filling, and the like. In turn, these processes may contribute to mindless behavior at each level of analysis considered here (mindless behavior can sometimes be seen as problematic behavior guided by automatic information processing (Langer et al. 1978)). Lyles and Schwenk's (1992) discussion of the organizational knowledge structure is the most recent example of this kind of thinking. We are skeptical that mindless behavior at these levels of analysis is largely rooted in cognitive processes. We need to beware of the fallacy of the wrong level when we embrace this kind of analogical reasoning.

The retrieval of information from a supra-individual knowledge structure is not a purely cognitive act. Rather, retrieval at that level of analysis involves behavior, and hence follows a mutual cueing process (Halbwachs 1950). This social cueing process triggers controlled, not automatic, information processing. Indeed, this fact contributes largely to the success of Eden's (1988) interventionist work. The promise of such group decision making is that it may lead to controlled information processing and what can be seen as a form of dialectical inquiry. Still, we do see evidence of seemingly mindless behavior in groups and organizations. Cognition may certainly contribute to such mindlessness, but we need to be fully aware of how cognition and social processes commingle at such times. In fact, the study of supra-individual knowledge structures requires us to examine social cognition (or sociocognition) in a way that work at the individual level may not.

As an example, let us consider three ways in which cognitive and social processes might conspire to produce the kinds of strategic decision-making blunders and failures that so intrigue applied cognitive researchers. First, a top management team might act on the basis of one person's limited and automatic reasoning process because political forces effectively silence people with competing views (see Janis' (1972) discussion of mindguards). Here, the decision failure may be rooted in social process limitations. Second, social processes may enable the cognitive endowment of a decision-making group to be fully explored, yet the group can still blunder. Neustadt and May's (1986) cautions about the captivating and dangerous use of past analogies might explain such decision catastrophes. Here, the failure may be rooted in cognitive limitations. Finally, even though a strategic decision group decides to embark boldly in a new direction, the firm may never reach its destination because these decision makers fail to consider how past decision premises are encoded in the firm's culture, transformations, structure, and ecology. As Walsh and Ungson (1991) pointed out, the automatic retrieval of past decisions from these repositories of organizational memory must be addressed if any bold strategic redirection is to be successful. In this case, cognitive and social factors outside the decision-making group may explain a decision failure. In all, theory about supra-individual knowledge structures must address both the social and cognitive features of this construct. We must resist the temptation to wholly apply individual-level cognitive theory to supra-individual levels of analysis and, in so doing, overlook the interactions between our social and cognitive worlds.

When Are Knowledge Structures Used? Skeptics might digest all of the research on managerial and organizational cognition and wonder whether there are boundary conditions to the use of knowledge structures. That is, when are knowledge structures not employed in decision making? The literature offers us three decision models as a response to this kind of question. Simply put, research suggests that we can be mindful, mindless, or out of our minds when taking action in organizations. A knowledge structure is thought to undergird mindless action. The mindful/mindless distinction reflects the classic top-down/bottom-up (Abelson and Black 1986) or theory-driven/data-driven (Nisbett and Ross 1980) distinction found in the psychology literature. By similar reasoning, the organization science literature makes a mindful/mindless distinction (Ashforth and Fried, 1988) and a distinction denoting differences between habits of mind and active thinking (Louis and Sutton 1991). Louis and Sutton (1991) argued that novelty, discrepancies, or deliberate initiative distinguish between the two processes. We would add social facilitation to this list. Our discussion about mutual cueing in a group setting illustrates a facilitated shift from mindless to mindful information processing. One need only walk the streets of London, England to find another example of social facilitation. The messages painted on the curbs at intersections exhorting people to look to their right are designed to keep tourists from mindlessly walking into the path of a speeding vehicle!

We know much less about what might be called "out-of-our-mind" behavior. Weick's famous dictum, "How do I know what I think until I see what I say?", reflects an act first-think later view of action taking. At the organization level, Starbuck's (1983) view of organizations as action generators is grounded in a similar logic. While we can imagine that time pressures may

prompt action before thought, we recognize that Starbuck and Weick are asking theorists to do much more than engage in contingency thinking. Consequently, our research needs to uncover the differences between mindless and out-of-our-mind behavior and then denote the circumstances when such information processing prevails over mindful thinking and action.

Linking Knowledge Structures to the Management of Organizations. If the use of knowledge structures is hypothesized to have an impact on organizations, we need to know much more about both the magnitude of this impact and how it unfolds. Many of us have had our curiosity piqued by the case study analyses of strategic decision-making blunders, but we really do not know whether or not these cognitive explanations represent a fundamental attribution error. That is, the observers of a troubled situation may have a tendency to make a person attribution (i.e., it was the CEO's or the top management team's fault) rather than a situational or contextual attribution for the organizational performance failure. Work should proceed on two fronts.

First, we need theory and data to establish when we can expect to see a link between knowledge structures and organizational effects. Theoretically, we need to posit the nomological nets that may capture these phenomena. We may see a closer linkage when we examine within-level, as opposed to cross-level, effects. For example, a CEO's knowledge structure may have more of an effect on the content of a subordinate's performance review than on the content of the firm's strategy. In the first case, there may be few competing forces shaping the review; in the second case, any number of exogenous factors may affect a firm's strategy. Notice that at this point we are in essence trying to establish the boundary conditions for the strategic choice paradigm (Astley and Van de Ven 1983). It is in this light that Hambrick and Finkelstein's (1987) work is so important to managerial cognition researchers. Their view of managerial discretion begins to articulate the conditions under which we might expect a CEO's cognitions to "matter" to a firm's performance. Empirically, we need more work like that of Ginsberg and Venkatraman (1992) and Thomas et al. (1993). We must establish the correlational relationships between cognition and action in a firm. Only then can we take the next step and begin to understand the process explanations that undergird these established effects.

As we move to investigate the process explanations, the study of within-level consequences at the individual level would be facilitated by blending the applied and basic approaches to this problem. Management researchers may want to join the psychologists in their efforts to understand the origins of the information processing consequences of holding a knowledge structure. Thus, Taylor and Crocker's (1981) call for a social psychological approach to solving real problems will be answered. Isenberg's (1986) work on executive problem solving represents a beginning in this area. Ford et al. (1989) provided an exhaustive review of the available methodological approaches for understanding decision-making processes. In essence, research efforts that bridge the information-processing and organizational decision-making paradigms will be welcomed.

As we begin to examine the cross-level consequences identified by the organization theory and strategy scholars, we will need to be acutely aware of the competing origins of firm behavior. Obviously, we will need to control for them. For example, a study of how industry recipes affect the deployment of a firm's resources must account for the more typically considered product market influences on such resource deployment decisions. In this way, we might begin to tease out the unique contribution that managerial and organizational cognition brings to our understanding of organizing.

Development

The general intuition in the field is that knowledge structures develop with increasing experience in an information domain. The research reviewed here on this experience-development relationship is worthwhile and gaining momentum, but three related issues appear to warrant our attention: the utility of change, the costs and benefits of forgetting, and social and emotional bases of change.

The Utility of Change. A paradox is identified in the discussion of veridicality. That is, while a knowledge structure is a simplified representation of an information world, it may be useful only to the extent that it accurately maps that world. The paradox is that in complex information environments, a useful knowledge structure (in mapping terms) may be one that is just too complex to handle (in terms of cognitive economy). The goal then is to somehow split the difference and discover "useful simplicity." Weick (1990) helped us to resolve this paradox by arguing that utility resides in a knowledge structure's capacity to prompt action and thus facilitate learning. We therefore need to investigate continuing changes in the knowledge structure and not search for some static assessment of a knowledge structure-information environment fit.

Our challenge is to develop a more dynamic view of information processing in organizations. We need to

consider how such attributes as the rate, magnitude, and locus of knowledge structure change may prove to be useful in different kinds of information environments (marked by their own complexity and changing nature). We should revisit the relationship between content and structure in this regard too. Our understanding of change must be grounded in a clear conceptualization of what is changing. The Barr et al. (1992) research is important because it is the first empirical study to call attention to this issue of the utility of knowledge structure change and its relationship to organizational learning.

This view of change suggests a need to reconsider the use of Ashby's (1956) law of requisite variety as the theoretical foundation for our work. This law seems to argue for a much more static conceptualization of knowledge structure utility than the dynamic, action learning view suggested here. Indeed, this observation may help explain why the empirical evidence in support of Ashby's reasoning is so slim.

The Costs and Benefits of Forgetting. Any dynamic consideration of knowledge structure change that is premised on the idea of learning must necessarily consider the nature of the unlearning or forgetting that accompanies this process. In this light, the forgetting associated with successive approximations toward veridicality can bring real benefits to the person, group, organization, or industry. The costs of forgetting may be less obvious, however. Differential rates of unlearning in an organization can be a powerful source of inertia and bring resistance to needed change.

Forgetting may also be associated with disuse, decay, and inefficient encoding. It may be that the set of exigencies in an information environment that present themselves for interpretation occur very infrequently. The interesting question here is how individuals and organizations maintain their perceptual readiness to interpret these low baserate phenomena appropriately. At the individual and group levels of analysis, simulations (Stumpf and Dunbar 1989–1990) and scenario planning exercises (Hampden-Turner 1990) can be used as a form of "cognitive exercise" to keep these knowledge structures from decaying. At the organization level, March and Sevon's (1984) discussion of the functional utility of gossip and Krackhardt and Stern's (1988) argument that an organizational network of friendship ties enhances cooperation and readies an organization to cope with a crisis suggest that some minimal level of social contact (about anything) in an organization may be necessary to maintain an alert organization mind. Finally, Carmona and Perez-Casanova (1993) ask us to examine how a firm's resource allocation decisions can contribute to organizational forgetting. Perhaps a firm cannot remember what it knows because it did not efficiently reinforce what it knew to begin with. Obviously, these ideas about cognitive exercise and alert and efficient organization minds are preliminary, but provocative. The point is that we should not lose sight of the intriguing issues about decay and forgetting in our quest to understand the functional utility of change and development.

The Social and Emotional Bases of Change. Consistent with our discussion of veridicality and the utility of change, the dominant intuition in the field has been that knowledge structures change as a function of some discontinuity in an information environment. It would be helpful to discover the relative effects of positive and negative environmental feedback on both the maintenance and change of a knowledge structure. Sitkin's (1992) discussion of the benefits and liabilities of success and failure might be a useful starting point for considering these ideas. Still, we need to know much more about the social bases for change.

We know that the content of knowledge structures varies by social interaction patterns (Rentsch 1990) and by a person's place in an organization's hierarchy (Hauenstein and Foti 1989, Ireland et al. 1987). We also know that direct influence seems to elicit a change (Poole et al. 1989) and that there are likely to be costs if one does not change in the face of such pressure (Bartunek and Ringuest 1989). The trouble is that we know very little about the change process itself. For example, what is the threshold level of influence needed to change knowledge structures of various content and structural profiles? We also know little about how the social and informational bases of change relate to each other. It would be interesting to know whether a socially induced change is more enduring than an informationally induced change and vice versa. Poole et al. (1989) offered one hint about the efficacy of socially induced change, concluding that "influence modes that generate strong emotional responses are more likely to induce schematic change" (p. 288). Studying emotion as it relates to cognition is one of the most important new research directions the field can take.

Our understanding of managerial and organizational cognition is limited because we have been held captive by the computer metaphor of information processing. If our research is to have strong external validity, we must consider the emotional basis of work and its relationship to the cognitive questions that we have been asking. Shrivastava et al. (1987) are virtually alone in their call for such work. They are emphatic in their

point that "organizational members are feeling, emotive, affective human beings. Their decisions are often based on an *emotional understanding of issues*" (italics theirs, p. 102). Their general point is well taken, but their idea about "emotional understanding" should not be accepted without careful thought. The psychological community is very unsure about whether thoughts precede feeling (Lazarus 1982), feelings precede thought (Zajonc 1980), or feelings and actions coexist, but separately from thinking (Sandelands 1988). In the absence of well-established research findings in this area, basic and applied research will evolve together.

Methodological Issues

The fundamental empirical task facing management researchers is to identify the content and structure of a knowledge structure at both the individual and supra-individual levels of analysis. Several measurement approaches have been used to assess knowledge structures in organizations. While we are beginning to see technical discussions of various approaches to the assessment of cognition in the literature (see Langfield-Smith and Wirth (1992), Laukkanen (1994), and Markóczy and Goldberg (1994) for a discussion of how to compare cognitive maps and Roehling (1993) for a discussion of the pitfalls of using a policy capturing procedure in the field), no one has cataloged the myriad approaches that have been employed. No single approach has emerged as a standard. The following discussion of these various approaches briefly considers the measurement choices facing a prospective cognition researcher in the organization sciences. A fundamental design dilemma that confronts many of us who choose to work in this area is noted.

Knowledge Structure Assessment. Runkel and McGrath (1972) argued that consumers of research should always question first who observed and recorded the behavior under investigation and second whether or not the subject was aware that his or her behavior was being recorded. They were concerned about threats to valid measurement. By questioning who observed and recorded the behavior under study (i.e., subject, researcher, or some other person in the past without a connection to the research project), readers might come to understand the role of the investigator in shaping the subject's behavior. Concern about the subject's reactivity (i.e., evaluation apprehension, hypothesis guessing, compensatory rivalry across treatment groups, and the like) prompted the authors to articulate their subject awareness dimension. A useful typology for arraying the various sources of empirical evidence emerges when we cross these two dimensions. This typology is helpful in sorting out the strengths and weaknesses of a wide variety of measurement techniques used in the assessment of knowledge structures at the individual and group levels of analysis.

The most fundamental challenge to researchers assessing a knowledge structure is to be certain they are measuring the subject's knowledge structure and not their own. It can be very difficult to disentangle a researcher from the assessment of a construct as personal as a knowledge structure. Available methods differ in their degree of researcher intrusion. In some circumstances, the subject has the primary responsibility for the observation and recording of behavior. In others, the researcher retains most of the control. In still other cases, the control appears to be shared equally between the subject and the researcher (this distinction represents a slight amendment to Runkel and McGrath's (1972) typology). Finally, the behavior may be recorded by some third party. By contrasting these four distinctions with a dimension that notes the subject's awareness of this behavioral assessment, we may consider many of the empirical approaches to the identification of knowledge structures in organizations. Table 4 portrays these measurement approaches.

While many assessment procedures are reported in the literature, we cannot yet say that any one approach is more valid than another. The standard measurement prescription applies: triangulate (Jick 1979). In practice, this will not be easy. Many approaches are time-consuming and laborious from a subject's point of view. Nevertheless, Brown (1992) and Lurigio and Carroll (1985) report some success with a multimethod approach. Lurigio and Carroll's work establishes a methodological standard for continued work in this area.

Lurigio and Carroll's use of multiple measures in their study of parole officers' schemas of criminal offenders is exemplary. Their intent was to understand something of the origins and consequences of those schemas. They began their study with a series of semistructured interviews to establish the content and structure of the knowledge structures. They discovered that parole officers' schemas identified ten distinct types of criminals (e.g., burglar, drug addict, career criminal, suburban kid, dumb hillbilly). A content analysis procedure was used to create a structural measure of schema richness as well. To validate these results, the authors found real cases involving each type of criminal and extracted seven descriptive attributes of each. A new group of parole officers and office clerks sorted these randomized attributes into different types of probationers. The office clerks were employed to

establish a nonequivalent control group—without relevant experience, they should not have had any kind of identifiable schemas. Sorting time was assessed. Lurigio and Carroll were then able to compare the semistructured interview results with their sorting results. Matching and cluster analysis procedures established the validity of the schemas. The content and structure were shown to vary by work experience (e.g., none, novice, and expert). Finally, a group of parole officers and a control group of office clerks were asked to evaluate actual criminal cases. A variety of attributes of information processing were assessed by questionnaire (e.g., distinctiveness of the cases, prognosis, decision confidence) and by traces (e.g., response time).

Table 4 Approaches to the Study of Cognition in Organizations

	Subject Awareness of Behavior Assessment	
	Aware	Unaware
Primary Control of Behavior Observation and Recording		
	Self-reports	*Traces*
Subject	**Repertory Grid** • Folk Theories (Borman, 1987) • Frame of Reference (Dunn and Ginsberg, 1986) • Organizational Frame of Reference (Dutton et al. 1989) • Means-ends (Jolly et al. 1988) • Cognitive Groups (Reger and Huff, 1993) • Integrative Complexity (Stabell, 1978) • Cognitive Infrastructure of Organizations (Wacker, 1981) • Organizational Prototypes (Walton, 1986) **Means-ends Analyses** • Cause Map (Bougon et al. 1977) • Causes and Effects (Ford and Hegarty, 1984) • Cognition (Walker, 1985) **Pairwise Comparisons** • Perceptual Structures (Billing and Cornelius, 1980) • Cognition (Blackburn and Cummings, 1982) **Object Sorting** • Mental Models • Schemata (Lurigio and Carroll, 1985) • Conflict Frames (Pinkley, 1990) • Implicit Theories (Sternberg, 1985) • Belief Structures (Walsh, 1988) • Negotiated Belief Structures (Walsh et al. 1988) **Self-Q Technique** • Cause Map (Bougon, 1983) • Cognitive Maps (Bougon et al., 1990) **Policy Capturing Procedure** • Managers' Perceptions (Ireland et al. 1987)	

Table 4 Continued

	Aware	Unaware
Researcher and Subject	*Interactive Reports*	*Hidden Observers*
	Grounded Theory Ethnography • Interpretive Scheme (Gioia and Chittipeddi, 1991) **Strategic Assumption Surfacing Technique** • Assumptions (Mason and Mitroff, 1982) **Unstructured Interviews** • Industry Recipes (Spender, 1989) **Semistructured Interviews** • Frames of Reference (Isabella, 1990) • Schemata (Lurigio and Carroll, 1985) • Organizational Knowledge Structures (Lyles and Schwenk, 1992) • Frames of Reference (Shrivastava and Mitroff, 1983) **Questionnaires** • Tacit Knowledge (Wagner, 1987)	**Speech Act Analysis** • Scripts (Gioia et al. 1989) **Videotape Analysis** • Behavioral Scripts (Poole et al. 1990) **Linguistic Analysis** • Utility in Cognitive Maps (Simons, 1993)
Researcher	*Researcher Inference* **Imagery Analysis** • Shared Appreciative System (Sapienza, 1987)	*Key Informants*
Other	*Public Behavior* **Analysees of Written Statements** • Organizational Boundary Perceptions (Fiol, 1989) **Analysees of Verbal Statements** • Beliefs (Stubbart and Ramaprasad, 1988)	*Archives* **Archival Data Analysis** • Cognitive Maps (Axelrod, 1976) • Cognitive Maps (Barr et al., 1992) • Causal Maps (Fahey and Narayanan, 1989) • Argument Mapping (Fletcher and Huff, 1990) • Cognitive Maps (Levi and Tetlock, 1980) **Photograph Analysis** • Organizational Belief Systems (Dougherty and Kunda, 1990)

Lurigio and Carroll's careful use of questionnaires, semistructured interviews, object sorting, and even trace measurements with both an experimental and a control group of subjects should serve as a model for future research efforts in this area.

A Design Dilemma. We recognize that not everyone can hope to approach Lurigio and Carroll's standard of methodological rigor. They were able to use multiple methods because they could assess their dependent variable at roughly the same time that they were assessing their independent variable. Researchers intrigued by the case study evidence linking managerial and organizational cognition to strategic blunders and catastrophes of various sorts have no such luxury. Such blunders and catastrophes are relatively unpredictable and rare. For example, it is unrealistic to assume that many researchers will collect intricate measures of the knowledge structure of a firm's top management team in the hope that the firm might suffer a catastrophe of some sort while that team is in office. Strategy researchers interested in studying the effects of cognition on firm performance face a dilemma. They can collect elaborate measures of a knowledge structure and pray that a strategic action of some consequence occurs

(and even then be saddled with data from a single case) or they can sample on the consequential actions and then reconstruct the knowledge structure from historical documentation (using the methods at the bottom of Table 4). In this case, they will have an interesting dependent variable and an independent variable of questionable validity.

There appear to be two ways to resolve this dilemma. Research by Ginsberg and Venkatraman (1992) and Thomas et al. (1993) represents an attempt to use the first approach. Their longitudinal work is noteworthy because they identified a setting beforehand that was likely to elicit differences in behavior. They then assessed their cognitive constructs one and three years previously in an attempt to establish a causal relationship between cognition and expected actions. Barr et al. (1992) attempted to employ the second approach. They sampled on firm success and failure in a turbulent environment and then tried to understand the cognitive contribution to this outcome. Since sampling on a dependent variable enables a researcher to create a variety of interesting archival databases (of course, this practice ignores the baserate of the phenomenon), we need to know much more about the validity of the cognitive variables that we can assess historically by using cognitive mapping (Axelrod 1976), argument mapping (Fletcher and Huff 1990), semiotic analysis (Fiol 1990), and the like. A good first step would be to conduct a convergent validity study that analyzes a firm's letter to the shareholders in an annual report, using the textual procedures noted at the bottom of Table 4. The researchers would then sit down with the firm's CEO and top management team and employ a variety of the other experimental procedures listed at the top of the table. Obviously, if we discovered a convergence between the two approaches, we would be closer to resolving the dilemma that now confronts managerial cognition researchers.

Conclusion

Many of us in the organization sciences have taken a 10-year trip down Memory Lane. A broad purpose of this article is to collect what we have learned and assemble it in such a way that our continuing research challenges can be clearly identified. The early accumulation of research results may appear fragmented even to persons familiar with the work, especially when the investigators are in subdisciplines that have their own emerging research paradigms and publication outlets (e.g., industrial-organizational psychology, organizational behavior, organization theory, and strategic management). It is difficult for anyone to take stock of what is known and unknown about a topic when the research has not been productively synthesized. Researchers may not even be aware of each other's work. In the strategic management literature, for example, El Sawy and Pauchant (1988, p. 455) observed a few years ago that "there is little opertionalization of cognitive frames of reference and their shifts in a form amenable to direct translation into corporate practice," even though half of the measurement approaches compiled in Table 4 were published prior to 1988. Similarly, Löwstedt (1993, p. 503) recently observed that "there are relatively few empirical studies of human cognitions in real-life situations in organizations." The problem for El Sawy and Pauchant, Löwstedt, and others is that relevant work is scattered in the literature; it is difficult to know that its exists. The framework used here enables us to review the applied theoretical and empirical research on the representation, use, and development of the content and structure of knowledge structures at each of four levels of analysis. It should make the managerial and organizational cognition research tradition much more available and tractable to scholars.

As a basis for better understanding of the role of knowledge structures in the management of organizations, we identified 10 areas of needed research in the broad areas of knowledge structure representation (i.e., halt purely descriptive studies, push our assumptions about veridicality, blend our interests in content and structure, and move beyond individual minds in our considerations of supra-individual knowledge structures), use (i.e., beware the fallacy of the wrong level, understand the boundary conditions of use, and reconsider cross-level consequences), and development (i.e., reconsider the utility of change, examine the place of forgetting, and investigate the social and emotional bases of change). Moreover, we alerted researchers to the many measurement tools that are available to assess the construct at the individual and group levels, as well as to a basic design dilemma that may await them. Much work remains to be done. The researchers who take the next steps in the investigation of managerial and organizational cognition should now have a clear view of where we have been and where we need to go. Our research agenda is at once clear, challenging, and promising.

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