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Organizational Learning: From Experience to Knowledge

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Organizational learning has been an important topic for the journal *Organization Science* and for the field. We provide a theoretical framework for analyzing organizational learning. According to the framework, organizational experience interacts with the context to create knowledge. The context is conceived as having both a latent component and an active component through which learning occurs. We also discuss current and emerging research themes related to components of our framework. Promising future research directions are identified. We hope that our perspective will stimulate future work on organizational learning and knowledge.

Key words: organizational learning; learning curves; organizational memory; knowledge transfer; innovation; creativity
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Introduction

Since the publication of the special issue of *Organization Science* on organizational learning in 1991, the topic of organizational learning has been central to the journal and to the field. Cohen and Sproull (1991) edited the special issue, which included papers in honor of and by James G. March. Subsequent to the publication of the special issue, the interest in organizational learning broadened to include interest in the outcome of learning—knowledge. *Organization Science* also provided leadership in this area with the publication of a special issue on knowledge, knowing, and organizations, edited by Grandori and Kogut (2002).

Organization Science is well positioned to publish research on organizational learning. Organizational learning is inherently an interdisciplinary topic. Organizational learning research draws on and contributes to developments in a variety of fields, including organizational behavior and theory, cognitive and social psychology, sociology, economics, information systems, strategic management, and engineering. This interdisciplinary orientation makes the topic of organizational learning an excellent fit for *Organization Science*, which aims to advance knowledge about organizations by bridging disciplines.

In addition to special issues on organizational learning and knowledge that appeared in *Organization Science*, special issues appeared in other leading journals. Numerous articles were written. They include the very influential pieces by March (1991) on exploration versus exploitation, by Huber (1991) on processes contributing to organizational learning, by Kogut and Zander (1992) on knowledge and the firm, and by Nonaka (1994) on knowledge creation. Many books were prepared (e.g., Argote 1999, Argyris 1990, Davenport and Prusak 1998, Garvin 2000, Gherardi 2006, Greve 2003, Lipshitz et al. 2007, Nonaka and Takeuchi 1995, Senge 1990); several handbooks were developed (e.g., see Easterby-Smith and Lyles 2003, Starbuck and Holloway 2008, Dierkis et al. 2001).

The increased interest in organizational learning and knowledge was stimulated by both practical concerns and research developments. At a practical level, the ability to learn and adapt is critical to the performance and long-term success of organizations. Understanding why some organizations are better at learning than others has been an active research area (e.g., see Adler and Clark 1991, Argote and Epple 1990, Pisano et al. 2001). Furthermore, as organizations anticipate the retirement of many employees, issues of knowledge retention loom large in organizations. Knowledge transfer is also very important in organizations due to distributed work arrangements, globalization, the multiunit organizational form, and interorganizational relationships such as mergers, acquisitions, and alliances.

In addition to these practical concerns, theoretical and methodological advances also contributed to the increased research activity. Because organizational learning occurs over time, studying organizational learning requires time-series or longitudinal data. Furthermore, because organizational learning can covary with other factors, techniques for ruling out alternative explanations to learning, such as selection, are needed. Methodological developments facilitated the analysis of longitudinal data collected from the field to study organizational learning (Miner and Mezias 1996). In addition,

researchers developed experimental platforms for investigating organizational learning (Cohen and Bacdayan 1994) and knowledge transfer (Kane et al. 2005) in the laboratory. The field studies and experiments complement the simulations and case studies, which were historically used to study organizational learning. This richer set of methods enables the field to arrive at a robust understanding of organizational learning.

Although the promises of those who advocated creating "learning organizations" have not been fully realized, research on organizational learning has flourished. Significant progress has been made in our understanding of organizational learning. A goal of this essay is to point out where progress has been made and where more research is needed to further our understanding of organizational learning.

This perspective essay provides a theoretical framework for analyzing organizational learning and its subprocesses of creating, retaining, and transferring knowledge. Approaches to defining and measuring organizational learning are described. Current and emerging themes in research are identified. These themes include characterizing experience at a fine-grained level; understanding the role of the context in which learning occurs; characterizing organizational learning processes; and analyzing knowledge creation, retention, and transfer. Each of these themes is discussed in turn.

Organizational Learning: Definitions

Although researchers have defined organizational learning in different ways, the core of most definitions is that organizational learning is a change in the organization that occurs as the organization acquires experience. The question then becomes, changes in what? Although researchers have debated whether organizational learning should be defined as a change in cognitions or behavior, that debate has waned (Easterby-Smith et al. 2000). Most researchers would agree with defining organizational learning as a change in the organization's knowledge that occurs as a function of experience (e.g., Fiol and Lyles 1985). This knowledge can manifest itself in changes in cognitions or behavior and include both explicit and tacit or difficult-to-articulate components. The knowledge could be embedded in a variety of repositories, including individuals, routines, and transactive memory systems. Although we use the term knowledge, our intent is to include both knowledge in the sense of a stock and knowing in the sense of a process (Cook and Brown 1999, Orlikowski 2002).

Knowledge is a challenging concept to define and measure, especially at the organizational level of analysis (Hargadon and Fanelli 2002). Some researchers measure organizational knowledge by measuring cognitions of organizational members (e.g., see Huff and Jenkins 2002, McGrath 2001). Other researchers focus on knowledge embedded in practices or routines and view changes in them as reflective of changes in knowledge, and therefore indicative that organizational learning occurred (Levitt and March 1988, Gherardi 2006, Miner and Haunschild 1995). Another approach is to measure changes in characteristics of performance, such as its accuracy or speed, as indicative that knowledge was acquired and organizational learning occurred (Dutton and Thomas 1984, Argote and Epple 1990). Acknowledging that an organization can acquire knowledge without a corresponding change in behavior, certain researchers define organizational learning as a change in the range of potential behaviors (Huber 1991). Researchers have also measured knowledge by assessing characteristics of an organization's products or services (Helfat and Raubitschek 2000) or its patent stock (Alcácer and Gittleman 2006).

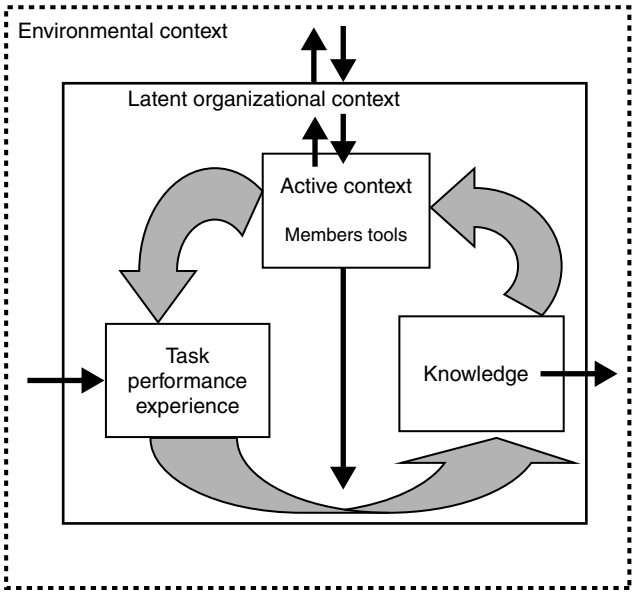
Approaches to assessing knowledge by measuring changes in practices or performance have the advantage of capturing tacit as well as explicit knowledge. By contrast, current approaches to measuring knowledge by assessing changes in cognitions through questionnaires and verbal protocols are not able to capture tacit or difficult-to-articulate knowledge (Hodgkinson and Sparrow 2002). Perhaps because of this difficulty, cognitive approaches, which were very popular in the 1990s, are increasingly being complemented by practice- or performance-based approaches.

A Theoretical Framework

A framework for analyzing organizational learning is shown in Figure 1. The framework aims to parse organizational learning to make it more tractable analytically. Organizational learning is a process that occurs over time. Thus, the figure aims to depict an ongoing cycle through which task performance experience is converted into knowledge that in turn changes the organization's context and affects future experience. Organizational learning occurs in a context (Glynn et al. 1994) that includes the organization and the environment in which the organization is embedded.

Experience is what transpires in the organization as it performs its task. Experience can be measured in terms of the cumulative number of task performances. For example, in a medical device assembly plant, experience would be measured by the cumulative number of devices produced. In a hospital surgical team, experience would be measured by the cumulative number of surgical procedures performed. In a design firm, experience would be measured as the cumulative number of products or services designed. Experience can vary along many dimensions, which are discussed in a later section. Experience interacts with the context to create knowledge.

Figure 1 A Theoretical Framework for Analyzing Organizational Learning



The environmental context includes elements outside the boundaries of the organization such as competitors, clients, institutions, and regulators. It can vary along many dimensions, such as volatility, uncertainty, interconnectedness, and munificence. The environmental context affects the experience the organization acquires. For example, orders for products or requests for services enter the organization from the environment. The organizational context includes characteristics of the organization, such as its structure, culture, technology, identity, memory, goals, incentives, and strategy. The context also includes relationships with other organizations through alliances, joint ventures, and memberships in associations.

The context interacts with experience to create knowledge. Conceptually, we propose differentiating the organizational context into an active context through which learning occurs and a latent context that influences the active context. The active context includes the basic elements of organizations, members and tools, that interact with the organization's task. The latent context affects which individuals are members of the organizations, what tools they have, and which tasks they perform. Here, tasks are subtasks members perform to accomplish the overall task of the organization. The difference between the active and the latent contexts is their capability for action. Members and tools perform tasks: they do things. By contrast, the latent context is not capable of action.

This conceptualization of the active context builds on a theoretical framework developed by McGrath and colleagues (Arrow et al. 2000, McGrath and Argote 2001). According to their framework, the basic elements of organizations are members, tools, and tasks. The basic elements combine to form networks. The member–member network is the organization's social network. The task–task and the tool–tool networks specify the interrelationships within tasks and tools, respectively. The member–task network, the division of labor, assigns members to tasks. The member–tool network maps members to tools. The task–tool network identifies which tools are used to perform which tasks. Finally, the member–task–tool network specifies which members perform which tasks with which tools.

These elements of members, tools, and tasks and their networks are the primary mechanisms in organizations through which organizational learning occurs and knowledge is created, retained, and transferred. Members are the media through which learning generally occurs in organizations. Individual members also serve as knowledge repositories in organizations (Walsh and Ungson 1991). Moving members from one organizational unit to another is also a mechanism for transferring knowledge (Kane et al. 2005). Similarly, knowledge can be embedded in tools, and moving tools from one unit to another is a mechanism for transferring that knowledge. Tools can aid learning, for example, by helping to identify patterns in data. Task sequences or routines can also be knowledge repositories and serve as knowledge transfer mechanisms (Darr et al. 1995).

The latent context affects the active context through which learning occurs. For example, a context where members share a superordinate identity has been found to lead to greater knowledge transfer (Kane et al. 2005). Similarly, contexts where members trust each other (Levin and Cross 2004) or feel psychologically safe (Edmondson 1999) have been found to promote organizational learning.

Knowledge acquired by learning is embedded in the organization's context and thereby changes the context. Knowledge can be embedded in the active context of members, tools, and tasks and their networks. Knowledge can also be embedded in aspects of the organization's latent context such as its culture (Weber and Camerer 2003). Thus, knowledge acquired through learning is embedded in the context and affects future learning.

Some of the organization's knowledge is embedded in its products or services, which flow out of the organization into the environment (Mansfield 1985). For example, a patient might receive a new treatment from which the medical staff of other hospitals could learn. Or a medical devices firm might introduce a new product that other firms are able to "reverse engineer" and imitate.

Knowledge can be characterized along many dimensions. For example, knowledge can vary from explicit knowledge that can be articulated to tacit knowledge that is difficult to articulate (Polanyi 1962, Kogut and Zander 1992, Nonaka and von Krogh 2009). A related dimension of knowledge is whether it is declarative or

procedural (Singley and Anderson 1989). Declarative knowledge is knowledge about facts—what researchers have termed "know-what" (Edmondson et al. 2003, Lapré et al. 2000, Tucker 2007). Procedural knowledge is knowledge of procedures, or "know-how."

Knowledge can also vary in its "causal ambiguity," or extent to which cause–effect relationships are understood (Szulanski 1996). In addition, knowledge can vary in its "demonstrability," or ease of showing its correctness and appropriateness (Kane 2010, Laughlin and Ellis 1986). Furthermore, knowledge can be codified or not (Vaast and Levina 2006, Zander and Kogut 1995, Zollo and Winter 2002).

The learning cycle shown in Figure 1 occurs at different levels of analysis in organizations (Crossan et al. 1999)—individual, group (for reviews, see Argote et al. 2001, Argote and Ophir 2002, Edmondson et al. 2007, Wilson et al. 2007), organizational (for a review, see Schulz 2002), and interorganizational (for a review, see Ingram 2002). For example, Reagans et al. (2005) provided empirical evidence of learning at different levels of analysis in a hospital. Individual experience, team experience, and organizational experience all contributed to the improved performance of surgical teams. Furthermore, the relative importance of different types of experience can vary across levels of analysis. Research in software development has shown that specialized experience in a system improved individual productivity, whereas diverse experience in related systems improved group and organizational productivity (Boh et al. 2007).

Although individual learning is necessary for group and organizational learning, individual learning is not sufficient for group or organizational learning. For learning to occur at these higher levels of analysis, the knowledge the individual acquired would have to be embedded in a supraindividual repository so that others can access it. For example, the knowledge the individual acquired could be embedded in a routine or transactive memory system.

We turn now to a discussion of current and emerging themes in research on organizational learning. These themes are organized according to the elements of the framework for analyzing organizational learning shown in Figure 1. We discuss current themes related to organizational experience, the context, organizational learning processes, and organizational knowledge. The discussion of organization knowledge is organized according to the subprocesses of creating, retaining, and transferring knowledge.

Organizational Experience

Learning begins with experience. The first current and emerging theme in organizational learning is characterizing experience at a fine-grained level along various dimensions (Argote et al. 2003). Argote and Todorova (2007) proposed dimensions of experience, including organizational, content, spatial, and temporal ones. The most fundamental dimension of experience is whether it is acquired directly by the focal organizational unit or indirectly from other units (Levitt and March 1988). Learning from the latter type of experience is referred to as vicarious learning (Bandura 1977), or knowledge transfer (Argote and Ingram 2000). The dimension of direct versus indirect experience can be crossed with other dimensions (Argote 2011).

Concerning the content dimension of experience, experience can be acquired about tasks or about organization members (Kim 1997, Taylor and Greve 2006). Experience can include successful or unsuccessful units of task performance (Denrell and March 2001, Kim et al. 2009, Sitkin 1992). Experience can be acquired on novel tasks or on tasks that have been performed repeatedly in the past (Katila and Ahuja 2002, March 1991, Rosenkopf and McGrath 2011). Experience can range from ambiguous (Bohn 1995, Repenning and Sterman 2002) to easily interpretable. Concerning the spatial dimension of experience, an organization's experience can be geographically concentrated or geographically dispersed (Cummings 2004, Gibson and Gibbs 2006).

Concerning the temporal dimension of experience, experience can vary in its frequency and its pace (Herriott et al. 1985, Levinthal and March 1981) and be acquired before (Carillo and Gaimon 2000, Pisano 1994), during, or after task performance. Learning through "after-action" reviews would be an example of learning acquired after task performance (Ellis and Davidi 2005). Similarly, learning though counterfactual thinking (Morris and Moore 2000, Roese and Olson 1995), which involves reconstruction of past events and consideration of alternatives that might have occurred, typically occurs after doing. To these dimensions, we add the dimension of whether the experience is naturally occurring or simulated through computational methods or experiments.

A dimension of experience that has attracted much attention recently is its rarity. A special issue of *Organization Science* focused on learning from rare events (Lampel et al. 2009). Because rare events by definition occur infrequently, they pose challenges for interpretation. Because these rare events often have major consequences, such as the *Challenger* or *Columbia* accidents or recent financial disasters, interest in learning from them is high. There is also interest in learning from events that occur infrequently though more frequently than rare disasters. For example, learning from alliances (Lavie and Miller 2008, Zollo and Reuer 2010), learning from acquisition experience (Haleblian and Finkelsktein 1999, Hayward 2002), and learning from contracting experience (Mayer and Argyres 2004, Vanneste and Puranam 2011) have received considerable attention.

Understanding the effects of experience on learning at a fine-grained level contributes to organizational learning

theory in several ways. First, because experience with different properties can have different effects on learning outcomes, analyzing experience at a fine-grained level advances theory. For example, heterogeneous experience has been found to increase learning outcomes more than homogeneous experience (Haunschild and Sullivan 2002, Schilling et al. 2003). Recent experience has been found to be more valuable for organizational learning than experience acquired further in the past (Argote et al. 1990, Baum and Ingram 1998, Benkard 2000).

Another advantage of the more fine-grained characterization of experience is that it permits examining relationships among different types of experience. For example, some researchers have found that direct experience and indirect experience are negatively related (Wong 2004, Haas and Hansen 2004, Schwab 2007); that is, one form of experience seems to substitute for the other. By contrast, other researchers have found that direct and indirect experience relate positively to each other in a complementary fashion (Bresman 2010). Understanding when different types of experience are complements or substitutes for one other is an important topic for future research.

A third advantage of a more fine-grained analysis of experience is that it moves forward the specification of when experience has positive or negative effects on learning outcomes. Thus, the analysis enables us to determine when experience is a good "teacher" and when it is not (March 2010). On the one hand, there is considerable evidence from the learning curve literature that performance improves with experience (Dutton and Thomas 1984). On the other hand, experience can be difficult to interpret (March 2010, March et al. 1991) and may have little or even a negative effect on learning outcomes. Organizations can draw inappropriate inferences from experience and learn the wrong thing (Zollo and Reuer 2010, Tripsas and Gavetti 2000). Levitt and March (1988) developed the concept of "superstitious learning" to describe the inappropriate lessons organizations learn. Analyzing experience at a fine-grained level enables us to specify when experience has a positive or negative effect on learning outcomes. For example, certain types of experience, such as rare or ambiguous experience, may be harder to draw appropriate inferences from than experience that is frequent and less ambiguous. Organizations with rare or ambiguous experience may benefit from different learning processes. Thus, a more fine-grained characterization of experience enables us to specify when experience is a good teacher and moves us toward a more unified theory of organizational learning.

A final advantage of a more fine-grained characterization of experience is that it facilitates designing experience to promote organizational learning; that is, as we determine the kinds of experience that are most valuable in organizations and the contextual conditions that support the realization of the experience's value, we can offer prescriptions about how to design organizations to promote organizational learning.

Context

Movement toward a more unified theory of organizational learning is also enhanced by the second research theme, the importance of the context. The strong form of this argument is the "situated cognition" research tradition, which argues that cognition can only be understood in context (Brown and Dugid 1991, Hutchins 1991, Lave and Wenger 1991). A weaker form of this argument is that context is a contingency that affects learning processes and moderates the relationship between experience and outcomes. For example, specialist organizations have been found to learn more from experience than generalist organizations (Ingram and Baum 1997, Haunschild and Sullivan 2002). A "learning" orientation has been shown to facilitate group learning up to a point (Bunderson and Sutcliffe 2003). A culture of psychological safety (Edmondson 1999) that lacks defensive routines (Argyris and Schön 1978) has been found to facilitate learning. The effect of alliance experience on acquisition performance has been found to be more beneficial when acquisitions are handled autonomously with high relational quality (Zollo and Reuer 2010).

Dimensions of the context that are receiving increasing attention and are ripe for further research include properties of the organization's structure (Bunderson and Boumgarden 2010, Fang et al. 2010) and its social network (Hansen 2002, Reagans and McEvily 2003), the extent to which organizational units share an identity (Kane et al. 2005, Kogut and Zander 1996), power differences within organizations (Contu and Willmott 2003, Bunderson and Reagans 2011), and whether members are colocated or interact virtually (Cummings 2004). The feedback members receive (Greve 2003, Denrell et al. 2004, Van der Vegt et al. 2010), their emotions (Davis 2009), and their motivations (Higgins 1997) are also ripe for future research.

Future research on how the context affects organizational learning would benefit from theoretical developments in characterizing the context. We have proposed a new conception of the organizational context that includes active and latent components. This conception depicts how macroconcepts such as culture can affect the microactivities of organization members. This conception is consistent with calls for research on "inhabited institutions" (Bechky 2011). Further research is needed to determine the fruitfulness of this conception of the organizational context as consisting of active and latent components. Future research may also benefit from adopting a combinational approach (George 2007, Fiss 2007) to examine how different contextual conditions interact with each other and with experience to affect organizational learning.

Organizational Learning Processes

The third theme in research on organizational learning centers on organizational learning processes. The learning processes are represented by the curved arrows in Figure 1, which depicts a learning cycle. When knowledge is created from a unit's own direct experience, we term the learning subprocess as knowledge creation. When knowledge is developed from the experience of another unit, we term the learning subprocess as knowledge transfer. Thus, the curved arrow at the bottom of the figure depicts either the knowledge creation or knowledge transfer subprocess. A third subprocess, knowledge retention, is depicted by the curved arrow in the upper right quadrant of Figure 1 that flows from knowledge to the active context. It is through this process that knowledge is retained in the organization. Thus, we conceive of organizational learning processes as having three subprocesses: creating, retaining, and transferring knowledge. These subprocesses are related. For example, new knowledge can be created through its transfer (Miller et al. 2007).

Several researchers have conceived of search (e.g., see Knudsen and Levinthal 2007) as another organizational learning subprocess (Huber 1991). In our framework, search is represented by the curved arrow in the upper left quadrant of Figure 1. The arrow shows that the active context of members and tools affects task performance experience. This effect can occur through several processes, including search. For example, members can choose to search in local or distant areas and search for novel or known experience (Katila and Ahuja 2002, Rosenkopf and Almedia 2003, Sidhu et al. 2007). It is debatable whether search processes are best conceived as part of organizational learning processes or antecedent to those processes. Reviewing the large literature on search is beyond the scope of this essay (for reviews, see Gupta et al. 2006, Raisch et al. 2009).

The subprocesses can be characterized along several dimensions. The dimension of learning processes that has received the most attention is their "mindfulness." Learning processes can vary from mindful or attentive (Weick and Sutcliffe 2006) to less mindful or routine (Levinthal and Rerup 2006). The former are what psychologists have termed controlled processes, whereas the latter are more automatic (Shiffrin and Schneider 1977). Mindful processes include dialogic practices (Tsoukas 2009) and analogical reasoning, which involves the comparison of cases and the abstraction of common principles (Gick and Holyoak 1983, Gentner 1983). Less mindful processes include stimulus–response learning in which responses that are reinforced increase in frequency. Levinthal and Rerup (2006) described how mindful and less mindful processes can complement each other, with mindful processes enabling the organization to shift between more automatic routines and routines embedding past experience and conserving cognitive capacity for greater mindfulness.

Most discussions of mindful processes have explicitly or implicitly focused on the learning subprocess of creating knowledge. The subprocess of retaining knowledge can also vary in the extent of mindfulness. For example, Zollo and Winter (2002) studied deliberate approaches to codifying knowledge, which would be examples of mindful retention processes. Similarly, the subprocess of transferring knowledge can also vary in mindfulness. "Copy exactly" approaches or replications without understanding the underlying causal processes would be examples of less mindful transfer processes, whereas knowledge transfer attempts that adapt the knowledge to the new context (Williams 2007) would be examples of more mindful approaches.

A learning process dimension that is especially important in organizations is the extent to which the learning processes are distributed across organizational members. For example, organizations can develop a transactive memory or collective system for remembering, retrieving, and distributing information (Wegner 1986, Brandon and Hollingshead 2004). In organizations with well-developed transactive memory systems, members specialize in learning different pieces of information. Thus, learning processes would be distributed in organizations with well-developed transactive memory systems. Similarly, learning processes would be distributed in organizations that engage in "heedful interrelating" (Weick and Roberts 1993).

Another dimension is whether learning is bottom-up (based primarily on experience) or top-down (based on goals, task demands, and social interactions). This distinction, which builds on research on the psychology of attention, is similar to the comparison of forward- versus backward-looking search in organizational research (Chen 2008, Gavetti and Levinthal 2000).

Further research is needed on the organizational learning processes and their interrelationships. Our understanding of organizational learning processes is likely to be advanced by developments in attention (Ocasio 2011, 1997) as well as by cognitive developments in neuroscience and physiology (Senior et al. 2011). Ideally, a parsimonious yet complete set of dimensions to characterize organizational learning processes should be developed.

Analyzing Knowledge Creation, Retention, and Transfer

The fourth research theme centers on the subprocesses and outcomes of knowledge creation, retention, and transfer.

Knowledge Creation. Knowledge creation occurs when a unit generates knowledge that is new to it. Research on knowledge creation could benefit from connecting with the literature on creativity (for a review,

see Gupta et al. 2007). Research on the influence of experience on creativity is relevant for understanding the organizational learning subprocess of knowledge creation. There is increasing evidence that a large, deep, and diverse experience base contributes to creativity because it increases the number of potential paths one can search and the number of potential new combinations of knowledge (Amabile 1997, Rietzschel et al. 2007, Shane 2000). At the same time, prior experience can constrain creative thinking, because it can lead to drawing on familiar strategies and heuristics when solving a problem (Audia and Goncalo 2007, Benner and Tushman 2003).

Recent work is aimed at reconciling these seemingly inconsistent findings. Several studies have documented a nonlinear relationship between experience and creativity or innovation: increased experience contributes to creativity and innovation up to a certain point, with diminishing returns at high levels of experience (Katila and Ahuja 2002, Hirst et al. 2009). Other researchers distinguished between different types of experience such as direct or indirect (Gino et al. 2010), successful or unsuccessful (Audia and Goncalo 2007), heterogeneous or homogeneous (Weigelt and Sarkar 2009), and deep or diverse experience (Ahuja and Katila 2004). A more fine-grained analysis of the experience–creativity link will help reveal underlying mechanisms and boundary conditions that explain how, when, and why prior experience affects knowledge creation in organizations.

The study of routines and practices as a context in which creativity occurs has attracted considerable attention recently. Traditionally, routines and managerial practices were perceived as detrimental to creativity, because they reduce variation and flexibility and impede an organization's ability to innovate and adapt to change (Benner and Tushman 2003). More recently, researchers have argued that routines can be a resource for change (Feldman 2004) and distinguished between specific routines that were more or less favorable to creativity or innovation (Miron et al. 2004, Naveh and Erez 2004). Research stressed the importance of channeling the creative process and providing a structure that facilitates knowledge creation and implementation (Miron-Spektor et al. 2011, 2008). Another contextual characteristic that has received considerable research attention over the years is the degree of "slack" or excess resources (Cyert and March 1963, Nohria and Gulati 1996, Greve 2003). An exciting new line of research on the context and creativity examines knowledge creation in the context of online communities (Faraj et al. 2011).

Research has shown that personal characteristics of members affect team creativity (Baer et al. 2008, Miron-Spektor et al. 2011). Research on the role of emotions in creativity has also increased in recent years. Positive and negative moods have been shown to increase creativity through different mechanisms (Davis 2009, De Dreu et al. 2008, Grawitch et al. 2003). Emotional ambivalence or the co-occurrence of negative and positive emotions has also been shown to enhance knowledge creation (Amabile et al. 2005, George and Zhou 2007, Fong 2006). Yet despite this growing interest, research on team affective tone and creativity is rare, and the few studies on this topic have yielded inconsistent results (George and King 2007, Grawitch et al. 2003).

Research also examines how motivation affects creativity. Research has examined how aspiration levels affect search and innovation (Lant 1992, Bromiley 1991, Cyert and March 1963). Intrinsic rewards have long been considered to be essential for creativity (Amabile 1997). It was found, for example, that task-oriented teams that are intrinsically motivated to excel in their task are highly innovative (Hülsheger et al. 2009). Extrinsic rewards can also enhance creativity because they orient recipients toward the generation and selection of novel solutions (Eisenberger and Rhoades 2001). Researchers have also examined how regulatory focus (Higgins 1997) influences creativity. Motivation to attain rewards (i.e., promotion focus) has been found to enhance individual creativity, whereas motivation to avoid punishments (i.e., prevention focus) hindered it (Friedman and Forster 2001, Kark and Van Dijk 2007). Research is needed to determine whether these findings on motivational orientation and creativity at the individual level generalize to the group and organizational levels.

Another exciting research direction examines how social networks affect knowledge creation. Strong network ties can constrain creativity when they are formed with similar others, and they thus limit the exposure to new information (Perry-Smith and Shalley 2003, Perry-Smith 2006). Studying both network density and tie strength, McFayden et al. (2009) found, however, that members who maintain strong ties with members who comprise a sparse network have the greatest creativity. Ties that bridge "structural holes" or otherwise unconnected parts of a network have been found to increase creativity (Burt 2004). Furthermore, bridging ties that span structural holes are especially conducive to creativity when individuals who bridge boundaries share common third-party ties (Tortoriello and Krackhardt 2010).

Research on how tools affect knowledge creation and organizational learning is in its infancy. Boland et al. (1994) described an information system that facilitated idea exchange and thereby increased knowledge creation. Ashworth et al. (2004) found that the introduction of an information system in a bank increased organizational learning. Kane and Alavi (2007) used a simulation to examine the effect of knowledge management tools, such as electronic communities of practice or knowledge repositories, on organizational learning. The researchers found that the performance of electronic communities of practice was low initially but subsequently surpassed the performance of other tools. Further research is needed to understand the effect of tools on knowledge creation.

Knowledge Retention. Research on knowledge retention focuses on both the stock and flow of knowledge in the organization's memory. Research examines the effect of organizational memory on organizational performance (Moorman and Miner 1997) and how organizations "reuse" the knowledge in their memory (Majchrzak et al. 2004). Research also examines whether organizations "forget" the knowledge they learn (de Holan and Philips 2004); that is, research examines whether knowledge acquired through organizational learning persists through time or whether it decays or depreciates. Considerable evidence of knowledge decay or depreciation has been found (Argote et al. 1990, Darr et al. 1995, Benkard 2000, Thompson 2007). Organizations, however, vary in the extent to which their knowledge depreciates.

Current work is aimed at understanding factors that explain the variation in knowledge depreciation (Argote 1999). A promising direction is analyzing whether knowledge acquired from different types of experience decays at different rates (Madsen and Desai 2010) or whether knowledge embedded in different repositories decays at different rates. At a more macro level, current work on knowledge retention examines the implications of organizational learning and forgetting for industry structure (Besanko et al. 2010).

Research is also aimed at characterizing the organization's memory—the various reservoirs or repositories in which knowledge is embedded (Levitt and March 1988, Walsh and Ungson 1991). Building on the previously discussed theoretical framework of McGrath and colleagues (Arrow et al. 2000, McGarth and Argote 2001), Argote and Ingram (2000) conceived of organizational memory as being embedded in organizational members, tools, and tasks and the networks formed by crossing members, tools, and tasks. Research on three knowledge repositories or reservoirs is particularly active: members, routines (or the task–task network) and transactive memory systems (or the member–task network).

Research on the effect of member turnover on organizations provides information about the extent to which knowledge is embedded in individual members. A recent trend in this area is to examine how turnover interacts with characteristics of the organization. Network research has shown, for example, that the loss of employees with many redundant communication links in a network is less detrimental to organizational performance than the loss of employees who bridge structural holes (Burt 1992) or otherwise open communication links in the network (Shaw et al. 2005). Furthermore, turnover has a less deleterious effect in organizations that are hierarchical (Carley 1992) or highly structured (Rao and Argote 2006) and where members conform to organizational processes (Ton and Huckman 2008). Finally, the results of a simulation suggest that turnover affects the performance of electronic communities of practice more than it affects knowledge repositories (Kane and Alavi 2007). Knowledge embedded in organizational structures, tools, and processes can buffer the organizations from the negative effects of member turnover.

Research on routines aims to understand how recurring patterns of activities develop (Cohen and Bacdayan 1994) and change (Feldman and Pentland 2003). For example, Rerup and Feldman (2011) articulated how routines develop through trial-and-error learning. Routines can be explicit, such as the standard operating procedures of an organization. Routines can also be tacit, such as the ones that emerge implicitly through mutual adjustments members make (Birnholtz et al. 2007, Nelson and Winter 1982). Research also examines the consequences of embedding knowledge in routines for its retention and transfer.

The other knowledge reservoir that is receiving considerable attention is transactive memory. In organizations with well-developed transactive memory systems (Wegner 1986), members possess metaknowledge of who knows and does what. This metaknowledge improves task assignment because members are matched with the tasks they do best; it also enhances problem solving and coordination because members know whom to go to for advice. Research has shown that units with well-developed transactive memory systems perform better than units lacking such memory systems (Austin 2003, Hollingshead 1998, Liang et al. 1995).

Recent research is aimed at understanding the conditions under which transactive memory systems are most valuable (Ren et al. 2006). For example, research examines how changing membership (Lewis et al. 2005), changing tasks (Lewis et al. 2007), or disasters (Majchrzak et al. 2007) affect the usefulness of transactive memory systems. Further research on conditions under which transactive memory systems improve organizational performance is needed.

Current research is also aimed at understanding what leads to the development of transactive memory systems. Many studies have found that experience leads to the development of transactive memory systems (e.g., Liang et al. 1995, Hollingshead 1998). Communication (Kanawattanachai and Yoo 2007), task characteristics (Zhang et al. 2007), and stress (Pearsall et al. 2009) have also been shown to affect the development of transactive memory systems. More research is needed on factors predicting the development of transactive memory systems.

Knowledge Transfer. Theoretical work posited that organizations learn indirectly from the experience of other units as well as directly from their own experience (Levitt and March 1988). Learning indirectly from the experience of others, or vicarious learning (Bandura 1977), is also referred to as knowledge transfer (Argote and Ingram 2000). This transfer can

be "congenital" and occur at the organization's birth (Huber 1991) or after the organization has been established. Empirical work has provided evidence of knowledge transfer—both when an organization first beings operation (Argote et al. 1900) and on an ongoing basis after the organization has been established (Darr et al. 1995, Epple et al. 1991, Zander and Kogut 1995, Baum and Ingram 1998, Bresman 2010). Considerable variation has been observed, however, in the extent of transfer (Szulanski 1996).

A current theme in research on knowledge transfer is identifying factors that facilitate or inhibit knowledge transfer and thereby explain the variation observed in the extent of transfer. These factors include characteristics of the knowledge such as its causal ambiguity (Szulanski 1996); characteristics of the units involved in the transfer such as their absorptive capacity (Cohen and Levinthal 1990), expertise (Cross and Sproull 2004), similarity (Darr and Kurtzberg 2000), or location (Gittleman 2007, Jaffee et al. 1993); and characteristics of the relationships among the units such as the quality of their relationship (Szulanski 1996, Zollo and Reuer 2010). Although work on knowledge transfer in the 1990s emphasized cognitive and social factors, more recent work also emphasizes motivational (Quigley et al. 2007, Osterloh and Frey 2000) and emotional (Levin et al. 2010) factors as predictors of knowledge transfer.

Knowledge transfer typically occurs across a boundary. The boundary could be between occupational groups (Bechky 2003), between organizational units (Darr et al. 1995,) or between geographic areas (Tallman and Phene 2007). Understanding the translations that happen at the boundary is an important area of current research (Carlile and Rebentisch 2003, Carlile 2004, Tallman and Phene 2007). Another current theme in this area of knowledge transfer is aimed at understanding the effectiveness of various knowledge transfer mechanisms (Rosenkopf and Almeida 2003), such as personnel movement (Almedia and Kogut 1999, Song et al. 2003), technology (Kane and Alavi 2007), templates (Jensen and Szulanski 2007), social networks (Owen-Smith and Powell 2004, Reagans and McEvily 2003), routines (Darr et al. 1995, Knott 2001), and alliances (Gulati 1999).

An important research question in the area of knowledge transfer is how to manage the tension between facilitating the internal transfer of knowledge within organizations while preventing external leakage or spillover outside the organization (Kogut and Zander 1992). Organizations, especially for-profit firms, need to balance transferring knowledge internally with keeping the knowledge in a form that is hard for other organizations to imitate (Rivkin 2001). Argote and Ingram (2000) argued that embedding knowledge in the networks involving members was an effective strategy for managing this tension. Empirical research is needed to test hypotheses about how to balance the tension between facilitating knowledge transfer within organizations while impeding knowledge transfer to other organizations.

Another exciting research question pertains to the transfer of capabilities from existing to new ventures—either within an existing firm (Cattani 2005) or to new entrepreneurial firms (Carroll et al. 1996). For example, research examines how the experience of the founding team affects the performance of new entrepreneurial firms (Beckman and Burton 2008, Dencker et al. 2009). There is considerable evidence that spin-offs from existing firms, or de alio firms, perform better than new, or de novo, entrants to an industry (Klepper and Sleeper 2005). Research, however, has not established what is being transferred to the new firm from previous experience at the parent firm. Understanding what is being transferred from the parent firm that provides its offspring a competitive advantage is an important issue that would benefit from future research.

Conclusion

This paper provides a new theoretical framework for analyzing organizational learning and knowledge. We hope that the framework will stimulate future research on organizational learning. We have also identified current and emerging themes in research on organizational learning and knowledge. Further research on these themes will greatly enrich our understanding of organizational learning and knowledge creation, retention, and transfer. Because organizational learning is so central to organizations and their prosperity, a greater understanding of organizational learning promises both to advance organization theory and contribute to improved organizational practice.

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