PERSPECTIVE

Tacit Knowledge and Knowledge Conversion: Controversy and Advancement in Organizational Knowledge Creation Theory

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Nonaka's paper [1994. A dynamic theory of organizational knowledge creation. *Organ. Sci.* **5**(1) 14–37] contributed to the concepts of "tacit knowledge" and "knowledge conversion" in organization science. We present work that shaped the development of organizational knowledge creation theory and identify two premises upon which more than 15 years of extensive academic work has been conducted: (1) tacit and explicit knowledge can be conceptually distinguished along a continuum; (2) knowledge conversion explains, theoretically and empirically, the interaction between tacit and explicit knowledge. Recently, scholars have raised several issues regarding the understanding of tacit knowledge as well as the interaction between tacit and explicit knowledge in the theory. The purpose of this article is to introduce and comment on the debate about organizational knowledge creation theory. We aim to help scholars make sense of this debate by synthesizing six fundamental questions on organizational knowledge creation theory. Next, we seek to elaborate and advance the theory by responding to questions and incorporating new research. Finally, we discuss implications of our endeavor for organization science.

Key words: organizational knowledge; organizational knowledge creation; knowledge-based view of the firm; organization theory; social practice; innovation
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1. Introduction
Organizational knowledge creation is the process of making available and amplifying knowledge created by individuals as well as crystallizing and connecting it to an organization's knowledge system. The article by Nonaka (1994) in *Organization Science* developed organizational knowledge creation theory to explain this process. The concept of "tacit knowledge" is a cornerstone in organizational knowledge creation theory and covers knowledge that is unarticulated and tied to the senses, movement skills, physical experiences, intuition, or implicit rules of thumb. Knowledge of wine tasting, crafting a violin, or interpreting a complex seismic printout of an oil reservoir are well-known examples of tacit knowledge. Tacit knowledge differs from "explicit knowledge" that is uttered and captured in drawings and writing. For example, knowledge of a solution to a differential equation is explicit knowledge. The concept of "knowledge conversion" explains how tacit and explicit knowledge interact along a continuum.

While academic work has made significant progress in developing, testing, and extending organizational knowledge creation theory, important scholarly contributions have also raised issues with the theory and proposed alternative approaches to understand knowledge (in particular, tacit knowledge) in organizations. Our goals in this article are to systematically and comparatively analyze the debate on organizational knowledge creation theory and suggest how the controversies surrounding it might be resolved. In our analysis, we incorporate recent research. This article is organized as follows: the

next section presents core concepts of and questions concerning organizational knowledge creation theory. The remainder of this article elaborates and advances the theory by responding to the questions, with §3 clarifying the concept of knowledge in the theory, including the distinction between "tacit" and "explicit" knowledge, and §4 clarifying "knowledge conversion." Finally, we conclude the article and discuss the implications for scholars in organization science.

2. Organizational Knowledge Creation Theory: Core Concepts and Issues

Since the seminal work by Teece (1981, 1982) and Nelson and Winter (1982), knowledge has assumed an increasingly legitimate and important role in organization science. Breaking with established theories of the firm in neoclassical economics, knowledge was increasingly seen as a factor to explain the idiosyncrasies of firms. The resource-based theory of the firm showed the importance of knowledge alongside other costly-to-imitate resources for competitive advantage (Barney 1991, Reed and DeFillippi 1990, Conner and Prahalad 1996). In 1987, Winter published a chapter arguing that tacit knowledge is a source of competitive advantage for firms (Winter 1987). This work triggered subsequent research on knowledge in organizations, including a milestone work by Kogut and Zander (1992) that distinguished between codified and tacit knowledge. Winter's (1987) and Kogut and Zander's (1992) work initiated a line of inquiry in strategic management often referred to as the "knowledge-based view of the firm" (e.g., von Krogh et al. 1994, Spender and Grant 1996, Tsoukas 1996, Spender 1996, Szulanski 1996, Gupta and Govindarajan 2000; see also Foss 1996). The knowledge-based view included strategies for managing knowledge assets (e.g., Boisot 1998; Chou and He 2004; Nonaka et al. 2000, 2005b; Teece 1998, 2000; Bowonder and Miyake 2000; Chen and Edgington 2005). Authors empirically tested the implications of these strategies for firm performance (e.g., Bierly and Chakrabarti 1996, De Carolis and Deeds 1999, Dröge et al. 2003, Poppo and Zenger 1998, Sabherwal and Sabherwal 2005, Choi and Lee 2002) and provided empirical support for Winter's (1987) original conjecture. In parallel to this development, Teece et al. (1997) created a theory of firms' dynamic capabilities. In contrast to the resource-based theory of the firm, this framework highlighted the importance of dynamic processes. The competitive advantage of firms rests on processes of coordinating and combining assets, shaped by the firms' knowledge asset positions, as well as path dependencies in asset acquisition and development.

Organizational knowledge creation theory aimed not only to explain the nature of knowledge assets and strategies for managing them, but also to complement the knowledge-based view of the firm and the theory of dynamic capabilities by explaining the dynamic processes of organizational knowledge creation (Nonaka 1987, 1991, 1994; Nonaka et al. 2006). Two premises were important in this effort: tacit and explicit knowledge can be conceptually distinguished along a continuum, and knowledge conversion explains the interaction between tacit and explicit knowledge.[1] These premises received important scholarly analysis. In the following section, we present the central concepts and premises, and synthesize the debate into six questions on organizational knowledge creation theory.

2.1. Conceptual Distinction Between Tacit and Explicit Knowledge

In the early 1990s, a growing group of scholars (e.g., Kilduff 1993, von Krogh et al. 1994; for review, see also Dodgson 1993, Weick and Westley 1996, Vera and Crossan 2003) criticized the preoccupation with the notion of pregiven universal "information" that characterized mainstream organization theory from the 1950s through to the 1980s (e.g., March and Simon 1958) and the tendency to equate information with knowledge (see Newell and Simon 1972). Organizational knowledge creation theory aimed at developing a comprehensive view of knowledge that could shed light on organizational creativity, learning, innovation, and change (Nonaka 1987, 1988, 1991). As Argote et al. (2003, p. 573) suggested, knowledge creation became one of the important outcomes of knowledge management in organizations. Organizational knowledge creation theory defined knowledge in three parts, indicating that it has complementary properties. First, knowledge is justified true belief. Individuals justify the truthfulness of their beliefs based on their interactions with the world (Nonaka 1994, Nonaka et al. 2006). Second, knowledge is (i) the actuality of skillful action (we recognize that someone has knowledge through their performance of a task) and/or (ii) the potentiality of defining a situation so as to permit (skillful) action (Stehr 1992, 1994). Knowledge allows humans to define, prepare, shape, and learn to solve a task or problem (von Krogh et al. 2000). Third, knowledge is *explicit and tacit along a continuum* (Nonaka 1991, 1994). Knowledge that is uttered, formulated in sentences, and captured in drawings and writing is explicit. Explicit knowledge has a *universal* character, supporting the capacity to act across contexts. Explicit knowledge is accessible through consciousness. Knowledge tied to the senses, tactile experiences, movement skills, intuition, unarticulated mental models, or implicit rules of thumb is "tacit." Tacit knowledge is rooted in action, procedures, routines, commitment, ideals, values, and emotions (Nonaka et al. 1996, 2000a, b). Tacit knowledge can be accessible through consciousness if it leans towards the explicit side of the continuum. However, most of the details about individual skills, due to

their embodiment, are inaccessible through consciousness (Anderson 1983, Ambrosini and Bowman 2001, Sun 1997). Tacit knowledge was discussed by Polanyi (1966), and based on his work, one can state that tacit knowledge often "indwells" in a comprehensive cognizance of the human mind and body. The notion of "continuum" refers to knowledge ranging from tacit to explicit and vice versa. By incorporating "tacit knowledge," organizational knowledge creation theory overcame mainstream theory's tendency to equate knowledge with information.

Each property of knowledge makes up for that which is lacking in the other properties, and therefore allow us to theorize about and research various characteristics of action and cognition. For example, individuals may hold tacit beliefs about objects, events, and relationships. Such beliefs may sometimes hinder the capacity of individuals to act and impede groups from effectively coordinating individual action (Edmonson 1999). When making knowledge increasingly explicit along the continuum, the individual justify their beliefs based on their observation of objects, events, and relationships (Nonaka et al. 1996). Over time, these beliefs may become true if they can be justified and are useful to them and/or their group in coordinating individual action. However, because individuals may not be able to articulate all their beliefs and justify them (tacit knowledge), it seems not all knowledge is justified true belief.[2]

Scholars discussed the first and the third part of the definition of knowledge. First, Gourlay and Nurse (2005) as well as Hildreth and Kimble (2002) pointed to notions of "truth." The authors argued that "knowledge creation," because of the way the theory defines knowledge, is a "process of seeking true belief," which implies that truth resides outside human endeavor. This is problematic because organizational knowledge creation theory targeted the notion of information and criticized the so-called "correspondence doctrine," which characterized mainstream organization theory (von Krogh and Roos 1995). The correspondence doctrine assumes that an objective and pregiven reality for the organization exists, for example, an industry or market environment. This reality is represented internally in the organization through information. When decision makers gather and process information about the organization's environment, they can achieve more accurate or "true" representations and make better decisions. For example, March and Olsen (1975) proposed an early framework of organizational learning where individuals hold representations of an objective, pregiven reality. They improve these representations by processing information about this reality. Based on improved representations, individuals act and participate in decision situations. Individual actions shape organizational actions that, in turn, lead to environmental responses. The learning cycle would be complete when these environmental responses alter individual representations and lead to improved individual and organizational action. The March and Olsen (1975) framework is based on a view of human cognition as holding abstract and universal representations about problems and processing information to resolve them (see also March and Simon 1958, Cyert and March 1963). From the viewpoint of organizational knowledge creation theory, a controversy with this model is that, although accounting for the organization's adaptation to a pregiven reality such as a market or an industry, it cannot effectively explain how organizations foster creativity, create opportunities, change, and enable innovation. However, including "truth" in the definition of knowledge leads to a reappropriation of the "correspondence doctrine" that organizational knowledge creation theory sought to overcome (Hildreth and Kimble 2002). If the theory assumes that knowledge creation is the search for true belief, it may be limited to explaining how a pregiven reality is represented in the organization, while providing limited insight on topics such as innovation (see Gourlay and Nurse 2005). This discussion can be distilled in the following question:

QUESTION 1. *What is the status of "truth" in the definition of knowledge?*

Second, several scholars discussed the third part of the definition (Cook and Brown 1999, Brown and Duguid 2001, Hildreth and Kimble 2002). Tsoukas (1996, 2003) and Hildreth and Kimble (2002) noted that by using the concepts of tacit and explicit knowledge, organizational knowledge creation theory departed from the original work of Polanyi (1966, 1969). Polanyi, in his efforts to counter positivism in science, resisted the notion of "purely" explicit knowledge devoid of any tacit dimensions. Explicit knowledge is always grounded in tacit knowledge. Polanyi (1969) remarked that even a formal science such as mathematics relies on the nonexact judgment of individuals. For example, knowledge of differential equations requires the presence of a "knower" who understands the equation and its purpose, chooses variables, holds explicit knowledge of solutions, and interprets the results. Tacit and explicit knowledge are not two separate types but inherently inseparable (see Adler 1995, Hildreth and Kimble 2002). Therefore, "rules" of performance, such as those incorporated in "technical knowledge," are different if tacitly acquired from learning on the job or if acquired through manuals and tools (Tsoukas 2003).[3] This is a result of cognitive necessity: a person cannot simultaneously be aware of the task and the tool. Either my focus is on the hammer with which I want to drive the nail into the wall or on the task of driving the nail into the wall. Distinguishing between "focal" and "subsidiary" awareness, Polanyi remarked that action is disrupted if a person shifts their focal attention to the particulars of which they were previously

aware in a subsidiary manner. Due to the shift in attention, tacit knowledge cannot be *represented* in language, writing, or tools (Hildreth and Kimble 2002). Thus, one may argue that the distinction between tacit and explicit knowledge in organizational knowledge creation theory is conceptually flawed. Furthermore, because of this flaw, its value to organization science may also be debated (Tsoukas 2003). This line of argument raises two questions:

QUESTION 2. *Do tacit and explicit knowledge fall along a continuum?*

QUESTION 3. *Is the tacit/explicit knowledge distinction along the continuum valuable for organization science?*

2.2. Knowledge Conversion Explains the Interaction Between Tacit and Explicit Knowledge

Organizational knowledge creation theory aimed at complementing the somewhat static view of "knowledge assets" in the knowledge-based view (e.g., Grant 1996, De Carolis and Deeds 1999) and the theory of dynamic capabilities (e.g., Teece et al. 1997, Helfat 1997) by explaining how tacit and explicit forms of knowledge interact to create new knowledge. In the theory, tacit and explicit knowledge are not separate but "mutually complementary" in that they dynamically *interact* with each other in creative activities by individuals and groups (Nonaka 1994, Nonaka et al. 1996a, Alavi and Leidner 2001). For example, to speak a sentence that captures explicit knowledge, we need tacit knowledge to utter it (to pause, shape sounds, find and use rhythm, and so on). Along the continuum, knowledge can momentarily take on different forms. Human creativity affords these alternating forms for the purpose of effectively interacting, discovering "truth," justifying observations, defining problems, and solving them. In the theory, "knowledge conversion" captures the interaction between tacit and explicit knowledge along the continuum and refers to two elements (Nonaka 1994): first, personal subjective knowledge can be socially justified and brought together with other's knowledge so that knowledge keeps expanding (Massey and Montoya-Weiss 2006). The individual brings to bear their tacit and explicit knowledge and the process forces their interaction (e.g., Nonaka 1994, Nonaka and Takeuchi 1995). Consider a marketer of a clothing company who, seeking ideas for new trends, interacts with a group of young fashion trend setters. She observes language, clothing colors and styles, rituals, and the use of technology, and she feels this group can give important cues to future fashion. She also reflects on her own practice of observing and interacting with this group (Schön 1983). In justifying investments in further working with this group to her colleagues in fashion design and marketing, she uses her tacit knowledge from

interacting, her reflections on her own work, and explicit knowledge and artifacts in the form of memos, charts, analysis, video shots, interview statements, and samples of clothing. In the process, other people's knowledge of the trend-setter group grows, too.

Second, knowledge adopts alternating forms so as to mutually enhance tacit and explicit elements. Because knowledge is the capacity to act based on explicit and tacit elements, enhancing this capacity means making use of existing and new tacit and explicit knowledge. Knowledge alternates between tacit knowledge that may give rise to new explicit knowledge and vice versa. The alternation occurs in four processes: socialization, externalization, combination, and internalization (often referred to as the SECI model). In these processes, tacit and explicit knowledge mutually enhance each other towards increasing the capacity to act[4] (Nonaka 1991, 1994; Nonaka and Takeuchi 1995).

The concept of "knowledge conversion" triggered academic debates that can be grouped into three streams: the conceptual basis, the relationship of knowledge conversion to social practice, and the outcome of knowledge conversion. The first stream argued based on an interpretation of the original text of Polanyi (1966, 1969; see also 1958). Hildreth and Kimble (2002, p. 6) point out that "if we accept Polanyi's view of tacit (implicit) knowledge as being inexpressible, it cannot be converted into explicit knowledge because it can never be externalized and written down in an explicit form." This point was also underscored by D'Eredita and Barretto (2006), Gourlay (2006), and Ribeiro and Collins (2007). The authors analyzed in depth the case of the development of Matshushita's bread-baking machine presented in Nonaka and Takeuchi (1995; see also Nonaka 1991). Initially, a product development group at the company failed to engineer a product that could produce good-tasting bread. Their main problem was technical: the dough could not be mechanically manipulated in a way that brought sufficient air, lightness, and mix to the dough. The case shows that a young engineer, Tanaka, acquired tacit knowledge from jointly working with the master baker at a nearby luxury hotel. Upon returning to the company and the group, Tanaka made her knowledge increasingly explicit by, for example, proposing a concept of "twisting stretch." This concept was considered important by Tanaka in her illustration and explanation to the product development group how the master baker handled and kneaded the dough. Equipped with this concept, the group engineered a machine that emulated the movement of "twisting stretch." Ribeiro and Collins (2007, p. 1418) comment that "...there is no 'conversion' from tacit to explicit knowledge in bread-baking machines.... At the end, the master baker's tacit knowledge has been neither explicated nor incorporated into the machine." Thus, the notion of "conversion" could be a conceptual flaw (Gourlay 2006, Ribeiro

and Collins 2007). This line of argument leads to the following question:

QUESTION 4. *What is the conceptual basis of knowledge conversion*?

The second stream argued that knowledge conversion is impossible because tacit knowledge is chiefly acquired through the social practice of solving tasks and, thus, resides in that practice (Cook and Brown 1999, Hildreth and Kimble 2002, Tsoukas 2003, Ribeiro and Collins 2007). As Tsoukas (2003, p. 424) suggests, "we learn to engage in practical activities through our participation in social practices, under the guidance of people who are more experienced than us." Hildreth and Kimble (2002) emphasize the importance of a mentor in the organization who has a lot of tacit knowledge and who guides the newcomer in learning this tacit knowledge through a practice. In these authors' view, action requires tacit knowledge, which is acquired in the social practice of which the individual is a member. An alternative to knowledge conversion is a process of shifting between "focal" and "subsidiary" awareness. The individual shifts awareness between the task and the tools, reflects on their own experiences, uses language to remind themselves of what they already know, thematizes certain circumstances, and discusses them with others (Tsoukas 2003). In this view of knowledge as social practice, Cook and Brown (1999) point out that new knowledge and novel ways of knowing are generated through the interplay between reflection, thematization, and experience within situated interaction. Thus, the following question can be formulated:

QUESTION 5. *Given the relationship between tacit knowledge and social practices, how can the concept of knowledge conversion be upheld*?

In the third stream, Gourlay and Nurse (2005) provided a detailed analysis of the process of knowledge conversion. The authors concluded that the process outcome is not well specified in the theory. Tacit and explicit knowledge interact along the continuum. Yet, Nonaka (1994) refers to the encompassing "knowledge created through the process," and does not specify more concrete outcomes. The lack of precision regarding outcomes complicates empirical observation and measurements. This may undermine the predictive power of the theory, because researchers will not be entirely clear about what phenomena to examine in the organization. This line of argument leads to the following question:

QUESTION 6. *What is the outcome of knowledge conversion*?

In the following section, we respond to the six important questions synthesized above and thereby seek to advance the theory. We start by clarifying the tacit/explicit knowledge distinction along the continuum and then proceed to the concept of knowledge conversion.

3. Clarifying the Tacit/Explicit Distinction

In the following section, we respond to the questions regarding the definition of knowledge in organizational knowledge creation theory. We also argue why we think the tacit/explicit distinction along the continuum is of value to organization science.

3.1. Question 1: Status of "Truth"

The definition of knowledge entails "justified true belief." In Nonaka (1994), very limited space was devoted to the discussion of justification, truth, and belief. Nonaka and Takeuchi (1995, p. 58) clarified further:

> We adopt a traditional definition of knowledge as "justified true belief." It should be noted, however, that while traditional Western epistemology has focused on "truthfulness" as the essential attribute of knowledge, we highlight the nature of knowledge as "justified belief.... While traditional epistemology emphasizes the absolute, static, and non-human nature of knowledge, typically expressed in propositions and formal logic, we consider knowledge as a dynamic human process of justifying personal belief toward the "*truth.*"

Three observations can be made regarding the status of "truth" in this definition. First, the theory of organizational knowledge creation clearly separates itself from epistemology built on the correspondence doctrine prevalent in mainstream organization theory. This doctrine taught that information processing creates "true" representations of an individual or organizational reality. Reality, thus, serves as a point of reference against which the truthfulness of representations can be gauged. Conversely, in organizational knowledge creation theory, the status of truth is that it directs justification of belief towards experience. In other words, beliefs are true to the extent that they can be justified by the individual organizational member at certain moments and using various mental models.

Second, the emphasis on justified belief in the definition of knowledge corresponds to an epistemology of pragmatism developed by authors such as Charles Peirce, William James, and John Dewey. Early pragmatism took the view that if an idea works, it is "true" for a person. However, to avoid the many fallacies associated with excessive relativism (each person has their own truth), later pragmatists adopted various solutions to explain how "reality" interacts with an individual's knowledge. For example, following Putnam (1981), pragmatists could claim that individuals and "reality" interactively shape truth. The individual employs mental models, such as a way of arguing about the "truthfulness" of an observation, that allows them to distinguish between "reality" and the appearance of an object, event, or relationship (Toulmin 1958). The definition of knowledge implies that, over time, beliefs become true if they can be justified and are useful to the individual or group

in question, and enable this individual to act, the group to coordinate individual action, and shape "reality."

Third, organizational knowledge creation theory also includes a social definition of knowledge creation that holds consequences for the status of "truth." According to Nonaka (1994), Nonaka and Takeuchi (1995), Nonaka and Konno (1998), and von Krogh et al. (2000), knowledge is created through the interaction between individuals with different biographies. Different biographies imply that individuals bring different knowledge and interests to the process, and these represent a specific challenge. Early work proposed that knowledge creation in organizations is influenced by factors such as organizational culture, leadership, organizational structures, and incentives systems, which provide a social context for, enable, or constrain the process where people with different knowledge and interests interact (Nonaka and Konno 1998; Hedlund 1986, 1994; Hedlund and Nonaka 1993; von Krogh 1998; Nonaka et al. 2000a). A large array of empirical work confirmed that organizational knowledge creation is very sensitive to social context, such as the organization of processes (Dyk et al. 2005), timing of activities (Massey and Montoya-Weiss 2006), physical proximity of people (McFadyen and Canella 2005), and people's use of technology (Chou and He 2004).

People's justification of their beliefs is a process embedded in a social context. The definition of "truth" resulting from this process may be contested. People's past investments in learning and knowledge shape their current and future interests. For example, an engineer might have invested years in learning how to build exact physical models and product prototypes to be tested in a laboratory. Consider the case where the cost of new product development processes can be reduced by introducing a technology that simulates products in virtual reality, rather than doing physical experiments on prototypes. On the one hand, top management may embrace this idea, suggest implementing the new technology, and in the process, undermine the future need for the engineer's expertise. On the other hand, the engineer may resist the introduction of the new technology. The engineer's version of "truth" may be that computer-generated models fail to reveal all the technical parameters of prototype testing. This example underscores an important insight about organizational knowledge creation: The process is "fragile" and fraught with uncertainty, conflicts of interest, and differences in mindset (see Zárraga and Bonache 2005, Swan et al. 1999, Goodall and Roberts 2003, Beech et al. 2002).

To conclude, knowledge as "justified true belief" should not be considered a relapse into the correspondence doctrine that characterized mainstream organization theory articulated in the 1950s–1970s. Rather, the status of "truth" in the theory is that it relates to justified beliefs, corresponds to pragmatist epistemology, and results from processes where people individually and collectively justify beliefs in the organization. The status of truth is important because it allows the theory to adopt a broader definition of knowledge (rather than just individual or organizational representations of a pregiven reality) that includes both tacit and explicit forms along a continuum of knowledge. We turn to this next.

3.2. Question 2: Upholding the Tacit/Explicit Distinction Along the Continuum

Question 2 asks about the basis for upholding the tacit/explicit distinction along the continuum of knowledge. According to Polanyi's work, tacit knowledge/knowing is impossible to communicate to others through articulation and it ranges from knowledge for inherent physical functioning to the insights or inspiration needed for an act of creativity. Explicit knowledge is articulated, and therefore it can be communicated to others. Let us consider the example of science. Polanyi's argument against positivism was that scientific progress could not be explained by the accumulation of articulated, universal, and formal scientific knowledge. While upholding the distinction between tacit knowledge/knowing and explicit knowledge, he considered the primacy of tacit knowledge/knowing for all other knowledge: Tacit knowledge is required to understand explicit knowledge. Yet, he also admitted that foreknowledge of a true or partly true conception of the nature of things was needed for scientific discovery and inquiry (Polanyi 1964). Scientific knowledge, by definition, can be shared amongst scientists. To make a scientific advance, the scientist must have acquired tacit knowledge in setting up and calibrating her equipment, orchestrating the laboratory, documenting experimental steps, choosing materials, using senses to interpret results, and so forth. However, scientific advance also assumes the scientist is aware of explicit knowledge, such as conjectures, theories, research design, analysis, and conclusions. Ultimately, scientific knowledge with its flaws in "representing" reality also shapes the individual scientist's quest for new knowledge through tacit understanding which, in turn, feeds into the social process of doing science. As a social process, science provides scientific knowledge that is passed on to peers who accept it as such, and who are exposed to the "same indeterminate reality" and, therefore, can test this knowledge (Jha 2002).

We share Polanyi's (1966) conjecture that knowledge for people and groups can be rooted in tacit knowledge and have tacit elements. This is so because the second part of the definition of knowledge relates to the capacity to act, define, and solve problems. The arguments leading to Question 2 do not account for this point of agreement by suggesting the theory treats explicit and tacit knowledge as *separate entities*. In organizational knowledge creation theory, tacit and explicit knowledge should not be seen as separate entities but rather mutually complementary and based on the same continuum. This is

not an entirely new idea. Baldwin and Baldwin (1978), for example, suggested that "knowing" and "knowledge" are two ends of a continuum.[5] Yet, this part of the definition in Nonaka (1994) created confusion and needs to be elaborated.

An explicit form of knowledge is objective, rational, and created in the "then and there," whereas a tacit form is actionable, subjective, experiential, and created in the "here and now" (Leonard and Sensiper 1998; see also Rämö 2004). Tacit knowledge is acquired with little or no direct instruction, it is procedural, and above all, practically useful (Sternberg et al. 1995). Even if we try hard, it cannot be *fully* articulated because much of it is embodied (Maturana and Varela 1987) and, therefore, intuitive, tied to the senses, and escaping any formal analysis through self-introspection. At one extreme end of the continuum, tacit knowledge is not accessible through consciousness (Anderson 1983, Sun 1997, Ambrosini and Bowman 2001).[6]

In principle, one could take the view that all tacit knowledge remains embodied, forever locked away in people's neural networks. Yet, by logical extension of how people express their thoughts, viewpoints, and interests, some tacit knowledge must also be the basis for explicit knowledge (Day 2005). For example, some tacit knowledge of scientists must be the basis for scientific knowledge, such as experiences with discovery processes, the results of scientists' successful improvisations with instruments in the laboratory, and errors to avoid when replicating the experiment. Thus, some knowledge must move along the continuum from tacit towards scientific knowledge that eventually becomes knowledge independent of the scientist who created it in the first place. This process of "moving along the continuum" is more fluid than a discrete shift from subsidiary to focal awareness. We will return to this point in the next section.

To conclude, the arguments leading to Question 2 did not fully account for points of agreement between organizational knowledge creation theory and the work by Polanyi. The clarification of the tacit/explicit knowledge distinction along the continuum shows that it can be upheld in the theory. Next, we turn to the value of the distinction for organization science.

3.3. Question 3: Value of the Tacit/Explicit Distinction for Organization Science

Question 3 asks if the tacit/explicit knowledge distinction along a continuum is valuable for organization science. We contend that the continuum is valuable if it can generate questions and specific results of interest to our field for two reasons. First, because researchers can unveil and distinguish knowledge assets for organizational action that are immediately visible (e.g., technology, procedures) from knowledge in organizations that require several levels of "thick" interpretation to

be understood (e.g., expertise or organizational culture), the continuum is valuable. Researchers can analyze the interaction between tacit and explicit knowledge or direct their attention to one end of the continuum. For example, research can discern statistical relationships between intellectual property (explicit knowledge) and firm performance or reveal the tacit knowledge and creative processes of engineers as they develop new patentable technologies (see also Ambrosini and Bowman 2001, Arnulf 2005).

The focus on empirical research and the need for new theorizing was an important rationale for Winter (1987) and Kogut and Zander (1992) to distinguish between tacit knowledge and explicit knowledge assets in the knowledge-based view of the firm. For example, by focusing on explicit or "codified" knowledge and the replication of technology, Kogut and Zander (1992) could examine whether organizational growth and international expansion destroy the source of competitive advantages for the firm. It would be cumbersome if researchers who examine technical knowledge under all circumstances had to consider tacit knowledge in measuring technical progress and innovation. Moreover, a prerogative use of "organizational knowledge" could demand researchers to always consider its origin in the tacit knowledge of people, groups, and organizations. To advance the knowledge-based view of the firm, history has shown that scholars need the choice of what end of the knowledge continuum to focus on.

Second, one purpose of scholarship in organization science is to provide knowledge for management practice. This requires that scholars not only develop and test theory, but also that they extract knowledge that can be used as input to solve practical problems in organizations (Eisenhardt 1989). The tacit/explicit distinction along the continuum of knowledge allows us to examine the tacit knowledge people use to solve tasks and also to raise questions on how people in organizations sometimes substitute tacit knowledge for "simple" explicit knowledge, e.g., in a given context, elementary but effective rules for problem definition and solving. Such elementary rules are also an important target for empirical research in organization science. They are valuable to management practice, not as accurately "representing" problems and solutions across organizations,[7] but as a source of inspiration for how to do things differently and deal with new situations (see Crowston 1997). For example, Flanagan et al. (2007) conducted a case study of a diesel engine manufacturer, and their results showed that senior designers often had "tacit overview knowledge" of complex product designs with modules and interconnections, as well as the project organization (with roles and expertise) that mapped onto these designs. Thus, senior designers played an important role in supporting teamwork by coordinating activities and facilitating communication across large project

teams. When these designers moved on and novices and contractors were hired, processes broke down and costly oversights became more frequent, as did the need for additional management overhead. The authors introduced and demonstrated the utility of a simple rule they called "design confidence," a metric that reflects designers' belief in the maturity of a design parameter at a given time in the design process. Design confidence does not represent the technology, but is rather an element of explicit knowledge about task completion. Such knowledge provides designers with an overview of how their work impacts on the work of other project members and provides experienced and novice designers with a "language" to discuss technical designs.

To conclude, we find that the tacit/explicit distinction along the continuum is valuable for our field because it allows the examination of knowledge that serves specific purposes in organization science, and because the distinction may aid management practice. Having clarified the definition of knowledge in organizational knowledge creation theory, we now turn to the questions concerning knowledge conversion.

4. Clarifying Knowledge Conversion

Based on the tacit/explicit distinction along a continuum of knowledge, organizational knowledge creation theory sought to explain how new knowledge is created in an organization through the process of knowledge conversion. In the following section, we discuss the conceptual basis for knowledge conversion, how knowledge conversion relates to social practice and, finally, alternative perspectives on the process outcome.

4.1. Question 4: Conceptual Basis for Knowledge Conversion

Question 4 asks about the conceptual basis for knowledge conversion. There are four reasons why we propose that the concept can be upheld. First, if the distinction between tacit and explicit forms of knowledge along the continuum is maintained as argued above, then knowledge conversion becomes imperative for organizational knowledge creation. Knowledge loses some of its "tacitness" through the process of externalization. As it moves along the continuum to become more explicit, knowledge becomes a basis for reflection and conscious action, and, as Grant (1996) remarks, it becomes less costly to share with others. Thus, knowledge conversion from tacit to explicit is important for expanding knowledge beyond what a single individual might know.

Scholarly work indicated that organizational knowledge creation theory construes explicit knowledge as the *representation* of the tacit knowledge on which it is based (e.g., Tsoukas 2003, 2005; Hildreth and Kimble 2002). For example, Ribeiro and Collins (2007) suggest that Nonaka and Takeuchi (1995) claim that knowledge conversion in the home-bakery case ensures that

the master baker's tacit knowledge is explicated and "represented" as explicit knowledge. However, in organizational knowledge creation theory, a premise is that tacit knowledge, at one extreme end of the continuum, is embodied knowledge, hardwired into our cognition and biological functioning as individuals (Maturana and Varela 1987, Varela et al. 1991). At the extreme of embodied knowledge, tacit knowledge is tied to our physiology and sensory and motor functioning, but also to our history of physical movement in the world (Varela 1992). What we refer to as "embodied" knowledge for the individual involves processes that are automatic, nondirected, and nonintentional (Reber 1993). There is no possibility to "represent" this embodied knowledge in language, drawings, models, manuals, etc.[8] Thus, the theory should not reduce all tacit knowledge to that which can be potentially articulated.

Knowledge is transformed and also enriched when it gradually assumes an explicit form, for example, through utterances. Embodied knowledge enables us to make these utterances in the first place, but as we articulate, we experiment with words, concepts, and linguistic relationships that enable us to convey meaning to ourselves and others.[9] This process of moving towards the explicit knowledge side of the continuum allows us to express certain aspects of our tacit knowledge. For example, the creative aspect of articulation appears in Italo Calvino's (1990) reflections on his authorship. Calvino's struggle to render his emotional state involves a fundamental search for words, concepts, and phrases until he finds those that fulfill his expectations *towards* his emotions. Authorship is a craft of narrating ideas, feelings, or memories not so as to *represent* them accurately from memory, but to use or create words and sentences that best convey knowledge to others (see von Krogh and Roos 1995).

In contrast to the extreme of embodied knowledge, increasingly explicit knowledge involves cognitive processes that are flexible, controlled, and intentional (Reber 1993). A critical reader might comment that it is "wrong" to call increasingly externalized elements "explicit knowledge." Yet, we think that the term "knowledge" should apply if it results from the justification of belief and if it enhances the capacity to act, define, and solve problems (see also Sun et al. 2001, Dienes and Perner 1999, Pothos 2007). At one extreme of the continuum, some simple explicit knowledge can even enable machines to solve very specific, constrained, and well-defined problems. As Dreyfus and Dreyfus (1986) convincingly argue, expert knowledge can never be fully captured in computer software due to the tacit and embodied elements. Yet, expert knowledge is a basis for increasingly explicit knowledge on which to create automated processes.

Second, in considering the conversion from explicit to tacit along the continuum of knowledge, we first note that

the second part of the definition, namely that "knowledge is the capacity to act," is important to understanding the functioning of knowledge conversion. Explicit knowledge can be shared at low cost amongst individuals and loses some of its "explicitness" through internalization, where people move to act on the knowledge (Nonaka 1994). "Movement" here implies that individuals acquire tacit knowledge through action, practice, and reflection. Tacit knowledge, therefore, contains elements of explicit knowledge as well as rich "situated" elements, that is, elements unique to action and practice. Whereas the context of action and practice may be social, internalization is an individual, psychological process. The impersonal aspects of explicit knowledge return to personal participation in the search for and acceptance of the object to be known (also suggested by Polanyi and Grene 1969). From this perspective, as underscored by Jha (2002, pp. 226–228), tacit and explicit knowledge are not "competing," but rather are two forms knowledge assumes on a continuum, "oscillating" to mutually enhance each other.

Third, empirical studies lend support to the concept of knowledge conversion. For example, in an early attempt, Nonaka et al. (1994) used confirmatory factor analysis to test to what extent organizational knowledge creation can be explained by the SECI model. The study was based on survey data from 105 managers in Japanese firms. The authors operationalized socialization, externalization, combination, and internalization in 38 items, and the survey identified the time the respondents spent on the different activities of the four processes. All four processes explain variance in the knowledge creation construct, although contrary to what Nonaka (1994) proposed, the study did not find that managers' use of "dialogue" and "metaphor" were important in externalization.[10] Later, Becerra-Fernandez and Sabherwal (2001) investigated the relationship between context, such as the task orientation and domain, and knowledge conversion, using both quantitative and qualitative methods. The data were collected at the Kennedy Space Center and consisted of interviews and survey data from 159 individuals. The authors found evidence supporting knowledge conversion as operationalized in 19 items, adjusted to various knowledge management tools and processes available in the case organization. However, they also found that the four SECI processes, mediated by context, have a different impact on people's satisfaction with knowledge management (measured by 11 items). Chou and He (2004) developed a survey instrument to capture both knowledge conversion and knowledge assets in firms. The authors collected data from 204 organizations in a variety of industries. The knowledge conversion (SECI model) was operationalized in 15 items, and four types of knowledge assets were operationalized in 43 items. The data show that the knowledge creation construct is reliably measured by processes of knowledge conversion

(Chronbach's α: 0.838–0.947). Moreover, the authors show that knowledge conversion correlates with various types of knowledge assets in organizations. This finding also underscores the need to understand how to effectively build and use knowledge assets, as advocated in the knowledge-based view of the firm.

Fourth, psychological research on knowledge acquisition, learning, and cognition has progressed rapidly over the last years, and recent work provides insights on the conjecture of an individual's knowledge conversion (externalization and internalization).[11] For example, Stanley et al. (1989) showed that when learning a new task, people's tacit knowledge of how to solve the task often precedes their explicit knowledge observed in the verbalization of their learning. Based on a review of studies on learning, Sun (1997; see also Sun et al. 2001, 2007) proposed that, due to the fact that explicit knowledge lags behind but improves along with tacit knowledge, explicit knowledge is extracted from tacit knowledge (Sun 1997, p. 1323). Moreover, Koch (2004) presents work showing that people have the cognitive capacity to reflect and use explicit knowledge to detect errors already made unconsciously, based on their tacit knowledge. Explicit knowledge starts as slow and consciously modifiable cognition but, with a certain repetition, gradually becomes tacit knowledge. Ashby et al. (1998) tentatively proposed that in learning a new task, a person's conscious awareness and verbal systems allow them to acquire explicit knowledge. With time, however, tacit knowledge becomes more important for solving the task, provided that such knowledge is more efficient in task solutions.

The acquisition of tacit and explicit knowledge is an important topic in studies of artificial grammar learning (AGL). Here, subjects are asked to learn an unknown but finite set of continuation relations between symbols, including beginning and end states, so that a "correct" sequence of symbols can be constructed and distinguished from a "false" sequence (Reber 1989). Pothos (2007) has reviewed research on AGL since the 1950s and concluded that tacit knowledge should be understood as knowledge that is not consciously activated at the time of a cognitive operation. Furthermore, explicit knowledge "starts as slow and consciously modifiable, but with repetition, it gradually becomes automated" (Pothos 2007, p. 230). As tacit knowledge gradually forms, people are increasingly able to work with very complex stimuli in terms of symbols and their relations.

The literature in cognitive psychology does not use the term "knowledge conversion," but theories and research in this field may shed light on the interaction between tacit and explicit forms of knowledge along the continuum. Recent research aims at understanding individual cognition and often does not presuppose that a person operates in a social context. In organizational knowledge

creation theory, knowledge conversion is not only individual but also a social process (Nonaka and Takeuchi 1995, p. 61). We turn to this point in the next section.

To conclude, the tacit/explicit distinction along a knowledge continuum allows the conceptual basis for knowledge conversion to be more fully understood. We clarified the concept and showed that it receives empirical support in organization science. In addition, new theorizing and empirical research in cognitive psychology provide novel insight into the concept.

4.2. Question 5: Social Practice and Knowledge Conversion

Given the relationship between tacit knowledge and social practices, Question 5 asks how the notion of knowledge conversion can be upheld. In this section, we examine in more detail the concept of "social practice" and show that the questions posed to organizational knowledge creation theory emanate from a different research agenda than the one advancing the theory. Next, we discuss the relationship between explicit and tacit knowledge in social practices. We conclude that organizational knowledge creation theory has not adequately accounted for the role of social practices.

The questions concerning knowledge conversion in organizational knowledge creation theory illustrate the differences in research agendas pursued by researchers in organization science. Organizational knowledge creation theory, complementing both the knowledge-based view of the firm and dynamic capabilities theory, focuses on organizational creativity, change, and innovation, although much of the debate on the theory originated from a different research agenda. In what can be broadly referred to as the "social practice view" of organizational knowledge, based on what Schatzki et al. (2001) called the "practice turn" in the social sciences, researchers analyzed existing, tightly-knit groups operating in socially stable organizational contexts that allow individuals to acquire tacit knowledge through socialization in practice. Thus, since its introduction into organization science (e.g., Winter 1987; Nonaka 1991, 1994; Kogut and Zander 1992), "tacit knowledge" has come to serve two purposes: as a foundation of social practice *and* as a foundation for innovation.

Within the social practice view of organizational knowledge (e.g., Wenger 1998; Brown and Duguid 1991, 2001), Tsoukas (2003) suggests that we acquire tacit knowledge or learn to engage in practical activities through our participation in social practices under the guidance of people who are more experienced than us. In his seminal work advancing the concept of social practices, Tsoukas (2003) builds on the writings of MacIntyre (1984b), amongst others, who understands a social practice as any coherent, complex, coordinated form of human activity through which goods internal to that form of activity are realized and extended in the course

of trying to achieve standards of excellence (see also Knight 1998). Virtuous behavior is an internal good for a practice. For example, becoming a virtuous piano player is a good internal to, or in support of, the social practice of "piano playing." By being a member of a social practice, practitioners learn the "rules" of performance, skills, values, beliefs, and norms that constitute virtuous behavior and that shape their work. When gradually developing their expertise, practitioners become capable of participating effectively in a social practice constituted of a complex web of people, artifacts, and activities (see Gherardi 2006). Practitioners' tacit knowledge consists of a set of particulars, such as the keys on a piano, of which they are subsidiarily aware as they focus on something else, such as playing great music (see Tsoukas 2003).

Practitioners "intuitively" recognize when the "rules" of performance apply and which "rules" to follow. At best, practitioners "intuitively" recognize when the "rules" should be discarded or reformed in light of emergent circumstances (see Olin and Wickenberg 2001, Smith et al. 2003). Yet, it is difficult (if not impossible) for practitioners to reflect on the "rules" of performance while they are engaged in the practice, and thereby change or invent entirely new "rules" (Bourdieu 1990). The reason could be that social practices transmit conscious but also unconscious "rules" and, thus, help conserve tacit knowledge (Cook and Brown 1999; see also Day 2005).

The social practice's boundaries and member inclusion are part of defining a social identity. Practitioners tend to draw "boundaries" around their social practice, and they regulate "membership." Membership can only be attained if people behave according to overt or covert "rules" of performance in that practice (Wenger 1998). To conclude, tacit knowledge is constitutive of social practice.

Organizational knowledge creation theory aims at explaining organizational creativity, change, and innovation more than it aims at explaining how organizations conserve tacit knowledge through social practices. A number of empirical studies underscore this point. Dyk et al. (2005) gathered longitudinal data from a car manufacturer and confirmed the notion that organizational knowledge creation in new product development proceeds through an intertwined process of knowledge conversion. Their study extended organizational knowledge creation theory by comparing the relative amount of intraorganizational knowledge transfer occurring during periods of product redesign with the amount of knowledge transfer occurring during steady-state periods. Similar empirical work on product development can be found in Schulze and Hoegl (2006), Hoegl and Schulze (2005), and Flanagan et al. (2007). Massey and Montoya-Weiss (2006) show that knowledge conversion often implies considerable change in the way

organizations employ media to communicate knowledge. Other examples of how organizational knowledge creation relates to innovation include, but are not limited to, new venture creation (Tsai and Li 2007), information systems development (Patnayakuni et al. 2006), work in project teams (Fong 2003), and integration of customers in innovation processes (Su et al. 2007).

In organizational knowledge creation theory, practitioners enter into and socialize in existing and new practices that require them to reflect on their "rules" of performance (see Nonaka 1994). According to the theory, practitioner diversity is a source of innovation (Roberts 2006). By bringing together different biographies, practitioners gain "fresh" ideas, insights, and experiences that allow them to reflect on events and situations (von Krogh et al. 2000). Thus, organizational knowledge creation aims at expanding boundaries by including more practitioners with different knowledge and interests, who represent different social practices, and who come from diverse functions, departments, and groups. Practitioners' diverse tacit knowledge, that they partly acquired in their diverse social practices, is a source of creativity. Through knowledge conversion (e.g., externalization and combination), practitioners may discover new ways of defining problems and searching for solutions (Nonaka and Konno 1998, Leonard and Sensiper 1998). In contrast to the social practice view of organizational knowledge, in organizational knowledge creation theory social identity is not necessarily tied to one existing practice but emerges for those groups involved in the organizational knowledge creation and that cross social practices. As becomes apparent from this discussion, tacit knowledge (alongside other forms of knowledge) is also seen constitutive of innovation.

Equipped with an understanding of the different agendas of the social practice view of organizational knowledge and organizational knowledge creation theory, we can now return to the analysis by Ribeiro and Collins (2007) of knowledge conversion performed by Tanaka and the home-bakery product development group. The conversion of knowledge from a tacit towards an explicit form is inherently a creative act using metaphors, analogies, and images (Nonaka 1991). An example is the concept of "twisting stretch." Knowledge conversion in this case is not about Tanaka representing tacit knowledge of the master baker or the social practice of baking bread (that Tanaka became a member of) in the concept of "twisting stretch." In fact, this would have to presuppose a different understanding of "truth" than the one adopted in the definition of knowledge (see §3.1). Rather, knowledge conversion is about expanding the previous boundaries of the knowledge of the individuals (Tanaka learning to bake with the master baker) and the team (Tanaka developing the concept of "twisting stretch") for the

larger organization to be innovative. Venturing a description from a social practice perspective, this was possible because Tanaka temporarily left her "social practice of engineering and product development" in the company to join the "social practice of bread baking" by becoming an apprentice to the master baker.

The concept of knowledge conversion is fundamental to organizational knowledge creation theory and important to organization science, because it explains how new ideas come forth in innovation, not only how individuals tap into rich practices and acquire the tacit knowledge of these practices. Yet, authors who study tacit knowledge acquisition in social practices raise issues in the theory regarding the interaction between explicit knowledge (e.g., manuals, written instructions, rules) and tacit knowledge/knowing (see Cook and Brown 1999, Tsoukas 2003, Brown and Duguid 1991, 2001). Because explicit knowledge fails to represent the practical circumstances surrounding individual tacit knowledge acquisition, it is of limited value in guiding a social practice. Yet, examples underscore the importance of explicit, universal knowledge that spans individuals' efforts and social practices. Consider explicit knowledge that enhances the reliability of behavior and that remains the property of the organization beyond generations of employees. A current example is credit levels in relation to equity for banks regulated by the international standard of Basel II, which aims at protecting all stakeholders in the financial system. According to this standard, banks should have in place explicit, regulated knowledge in the form of procedures for decision making on credit levels. Bank employees are mandated to act on this knowledge beyond their particular interests. Part of this explicit knowledge is also the basis for automated systems that monitor credit risks in transactions and trading.

Although authors who examine social practices recognize the notion of explicit knowledge, one of their very important contributions to organization science is to suggest that tacit knowledge/knowing is a prerequisite for the application of explicit knowledge. Yet, in organizations, a social practice may constitute hidden "rules" of performance, procedures, problem understanding, problem solutions, and tasks that have the potential to be articulated. These elements provide a basis for the explicit knowledge end of the continuum. Eyerman and Jamison (1991; see also Tilly 1999) suggest that when individuals collectively act to change practice, they often create new, explicit knowledge in the process that inspires others to act too. For example, in an organization, people may first have a tacit sense of inequality, such as how decisions are being made or incentives used. Next, people may articulate knowledge, share it, and then act to change their situation for the better. These aspects of knowledge conversion also need to be included in organizational knowledge creation.

To conclude, based on Question 5 and the discussion above, knowledge conversion plays a critical role in explaining organizational knowledge creation. The debate that led to Question 5 also shows that the relationship between organizational knowledge creation theory and the social practice view of organizational knowledge is underdeveloped. This is a challenge for organizational knowledge creation theory. As Brown and Duguid's (1991) seminal work shows, innovation requires the interaction between people in a social practice who have been socialized into that practice. However, it also requires the interaction of people from diverse social practices who by their membership in these practices have acquired distinct tacit knowledge. In particular, the idea that externalization and combination of knowledge is valuable hinges on differences in social practices throughout the organization.[12] Thus, social practices may be necessary, but not sufficient, for understanding organizational knowledge creation.

4.3. Question 6: Outcome of Knowledge Conversion

We now proceed to Question 6, which asks about the outcome of knowledge conversion, which was not adequately developed in Nonaka (1994). Based on the discussion in §4.2, we propose there are two ways to understand the outcome of knowledge conversion, as "knowledge outcomes" and as "social practice outcomes." According to the definition of knowledge in the theory, the "knowledge outcome" could be threefold. First, the ultimate outcome of organizational knowledge creation is product and process innovations. Yet, on the way there, knowledge conversion could provide enhanced understanding or "justified true belief" (see Massey and Montoya-Weiss 2006). For example, the individual establishes stronger justification for beliefs about truth, and a team reaches agreement on and collective understanding of problems, solutions, tasks, and actions in the organization. Second, a knowledge outcome is an enhanced capacity to act (see Sabherwal and Becerra-Fernandez 2003, Wathne et al. 1996). For example, newly acquired individual knowledge enables improved or new definitions or problems and solutions and more effective task performance. For the team, shared knowledge allows for group decision making and problem solving (Grant 1996), drawing from shared insights, language, mental models, knowledge about expertise, problem-solving capabilities, and specialized tasks of individual organizational members. Third, the capacity to act, define, and solve problems can be explicit and/or tacit along the continuum (see Dyck et al. 2005). For the individual, the outcome of knowledge conversion can be the development of tacit and explicit forms of knowledge. At the level of the team, it can be shared knowledge also ranging from tacit to explicit.

Given the discussion in §4.2, we propose that the outcome of knowledge conversion can also be a new social practice. Organizational knowledge creation theory was formulated as an alternative to mainstream organization theory, based on the correspondence doctrine and the idea of the organization as an information-processing entity. In mainstream organization theory, for example, the work of March and Simon (1958), an organization overcomes the individual's bounded rationality and limits to information processing and decision making by specifying hierarchies, partitioning tasks, defining rules, and channeling information to clearly identified positions. As a system, the organization could strive to preserve rationality in the face of individual limitations. However, well-defined problems and explicit problem-solving procedures were necessary conditions for the system to work; they could be effectively represented by the individual who could make the best (optimizing or satisficing) decisions.

Whereas mainstream theory aimed at constraining problems and solutions, organizational knowledge creation aims at defining new problems and creating, exploring, and experimenting with new solutions. Individual limitations are obstacles to creativity and innovation rather than a constrained capacity to process available information. Individual limitations are not overcome by adherence to rational information processing suprastructures, but by intensifying interactions between organizational members who, thereby, can expand the boundaries of their knowledge. Here, there is common ground between the social practice view of organizational knowledge and organizational knowledge creation theory. As argued in §4.2, *interactions* constitute the fabric of social practices (e.g., Gherardi 2006). Likewise, in creating organizational knowledge, people come together from different areas of the organization that in themselves constitute diverse social practices. Although differences in people's biographies, including knowledge and interests, may adversely impact on organizational knowledge creation and make it fragile, diversity rooted in various social practices is key to a successful process. As shown convincingly by the debate on organizational knowledge creation theory (§4.2), a social practice brings routine and stability to behavior and processes. Thus, we propose that social practices may evolve around knowledge conversion, over time providing necessary conditions of stability. In a social practice of knowledge conversion, there may exist a coherent, complex, coordinated form of human activity in the shape of socialization, combination, externalization, and internalization. The goods internal to that form of activity should be considered the knowledge created and acquired by its practitioners. In trying to achieve standards of excellence in organizational knowledge creation, practitioners learn to identify and remove obstacles to knowledge conversion, such as a lack of

resources, time to engage in organizational knowledge creation, and lack of mutual trust amongst practitioners. However, there is currently limited understanding about how social practices emerge from knowledge conversion.

To conclude, knowledge conversion may have both a knowledge and a social practice outcome. More research is needed on the emergence of new social practices of knowledge conversion.

5. Discussion and Conclusion

Based on the article by Nonaka (1994) in *Organization Science*, two premises have influenced more than 15 years of theory building and research on organizational knowledge creation: tacit and explicit knowledge can be conceptually distinguished along a continuum, and knowledge conversion explains, theoretically and empirically, the interaction between tacit and explicit forms of knowledge. Recently, a number of issues were raised regarding these premises. This article introduced and commented upon the discussions on organizational knowledge creation theory with the aim of helping scholars to make sense of the issues and advance their own work. We propose that the two premises should be upheld in organizational knowledge creation theory. As shown, they serve theory building and empirical research on creativity, change, innovation, and learning in organization science. However, distilling and responding to six questions to organizational knowledge creation theory, we also found there are major research opportunities in the intersection between social practices and organizational knowledge creation. As we argued in §4.2, this is so because social practice may be seen as a necessary, but not sufficient, condition for organizational knowledge creation. Thus, what we have uncovered can be summarized in a new broad research question:

QUESTION 7. *What is the relationship between organizational knowledge creation and social practices in organizations?*

This is not a trivial question. Organizational knowledge creation theory proposes that leaders in organizations establish a social context (Japanese: "Ba") that positively influences the outcome of the process (Nonaka and Konno 1998; Nonaka et al. 2000a, b; Bryant 2005). When people commit to this context by joining innovation projects, meeting in small networks, or exchange information in online and offline communities, they may transcend their knowledge as well as the social practices in which they acquired much of their knowledge. However, as discussed in §3.1, people's diverse biographies introduce fragility in organizational knowledge creation. The social practice view of organizational knowledge allows us to theorize how tacit knowledge is acquired and biographies are shaped in the organization, and thus brings us closer to explaining how organizations succeed

or fail in innovation. For example, in the social practice view, tacit knowledge is acquired through socialization of organizational members into a group under the guidance of a mentor. As several writers point out (e.g., Nelson and Winter 1982, Winter 1987, Grant 1996), repetitive recognizable patterns of interdependent actions carried out by multiple actors or organizational routines emerge and are conserved through such knowledge acquisition. Criticizing the existing literature, Feldmann and Pentland (2003) argue that organizational routines can also evoke considerable change in organizations, because multiple actors who hold diverse goals, information, and interpretations need to interact to perform routines. In a similar vein, to enable innovation through organizational knowledge creation, organization members transcend boundaries on their existing knowledge and social practices. Interaction emerges between people from different social practices who pursue diverse interests, speak different languages, hold unique mental models and distinct preferences, access various social networks, etc.

The social practice view of organizational knowledge is imperative to investigating these and other sources of fragility in organizational knowledge creation, because it may provide a much needed political understanding of knowledge in organizations. In this paper, we categorized the social-practice view of organizational knowledge broadly. Future work should deliver a comparative analysis of the various theoretical assumptions and methodological orientations in the literature contributing to this view (for a starting point, see Cox 2005, Antonacopoulou 2008). In particular, more analysis is needed of the literature that sheds light on the political and conflicting natures of learning, knowledge, and social practice (e.g., Contu et al. 2003, Contu and Willmott 2003). Organization science will benefit from a realistic discussion of when social practices enable or stifle organizational knowledge creation and vice versa. This discussion should be informed by work attempting to answer the following question:

QUESTION 8. *When and why do social practices contribute to the conservation of existing tacit knowledge and existing routine rather than organizational knowledge creation and innovation?*

Theory building and research on Question 8 will inevitably connect organizational knowledge creation theory to the emerging discussion on organizational ambidexterity. The "organizational ambidexterity" hypothesis suggests that successful organizations achieve a balance between being efficient in running today's business, while being adaptive to changes in their environment ensuring that they also survive in the future (Tushman and O'Reilly 1996). A critically important research question is how leaders enable ambidexterity in organizations

(Gibson and Birkinshaw 2004). Organizational knowledge creation provides an organization with the ability to adapt to a changing environment (Nonaka et al. 2006). However, given that organizational knowledge creation entails personal risks, costs, and rewards, this research question can be interpreted as a problem of organizational members' motivations to transcend their social practices and the knowledge entailed in the efficient running of a business. Thus, future research on organizational knowledge creation and social practices should attempt to contribute to the following question:

Question 9. *How can leadership motivate and enable individuals to contribute to organizational knowledge creation by transcending social practices?*

To answer Questions 7–9 it will be useful to consider work teams as a unit of analysis. Innovation and organizational knowledge creation is often temporarily organized in project teams composed of people who represent various functions, units, groups, or organizations. There is a substantial literature available on team composition and how the diversity of team members impacts on innovation (for a review, see Jackson et al. 2003). For example, recently authors have argued that factors such as team members' prior experience of working together, team size, and diversity in knowledge domains impact the ability to innovate (Taylor and Greve 2006). Yet, forming work teams with diverse members is challenging. Research has uncovered that team performance and its members' feelings and behavior toward each other are influenced by factors such as diverse technical languages and perspectives, the need for power and status in the team, the urge to develop a feeling of cohesiveness, and managing relationships with groups beyond the team (Jackson 1996). Thus, future research on the relationship between organizational knowledge creation and social practice should account for team formation and factors that impact on team performance.

Finally, empirical research on Questions 7–9 should consider that knowledge takes different forms along the continuum. Thus, a multitude of research designs are needed that include participant observation, laboratory studies, surveys, biographical analysis, and interviews. Moreover, due to the intimate connection between knowledge and social practice giving organizational knowledge creation a "here and now" character, there is a need to conduct extensive research on knowledge conversion in the "concrete lived time" of practitioners (Chia 2002). The debate on organizational knowledge creation theory has an inevitable outcome: future empirical research should pursue more longitudinal designs in the field to clarify how social practice relating to organizational knowledge creation can best be observed. Research and theory building that aim to answer the set of research questions presented will greatly advance the understanding of organizational knowledge creation

as well as social practices in organization. As seen, the research opportunities are vast. We welcome your participation!

Endnotes

[1] A third important premise is that knowledge creation is context dependent and requires specific organizational leadership. The concept of leadership in organizational knowledge creation theory was discussed by Gourlay (2006) and Essers and Schreinemakers (1997). Lado and Wilson (1994) and Tsoukas (1996) provide seminal discussions of leadership in the knowledge-based view of the firm. Due to space constraints, we will not address this issue in the current paper.

[2] We are grateful to Linda Argote for pointing out that knowledge can manifest itself in justified true belief or in action. To capture these manifestations, it is imperative to include several complementary properties in the definition of knowledge §2.1.

[3] Polanyi's work appeared in the 1960s and should be understood in this historical context. His work was based on "Gestalt" psychology and stood for an alternative perspective to the mainstream theory of human cognition and knowledge emerging at the time. Toward the end of the 1950s, several attempts were made to integrate various scientific disciplines, ranging from psychology to computer science, in a common endeavor to develop a "science of the mind" (see, for example, Gardner 1985). Polanyi's work was so important because it analyzed the inherently personal, subjective, and process-oriented component of knowledge/knowing and, thus, provides an alternative view of the scientific enterprise. His work shares the intention of organizational knowledge creation theory, which attempts to create a compound view of knowledge, including tacit and explicit elements. However, a marked difference between Polanyi's work and Nonaka's (1994) is that the former author contributes to science studies, whereas the latter paper is a contribution to *organization science and reflects the pursuit of a research agenda in this field*. Although Polanyi's work inspired the concept of tacit knowledge, organizational knowledge creation theory needed to expand it to both capture social forces and recent contributions to the understanding of knowledge in management and organization theory. Therefore, the concept of tacit knowledge was inspired by but not restricted to Polanyi's work.

[4] Externalization is similar to Kogut and Zander's (1992) "codification." For an additional comparison and explanation of knowledge conversion, see Nonaka (1994).

[5] Another example of the continuum idea is found in Nicolini et al. (2003), who proposed that "knowing" precedes "knowledge."

[6] Varela (1992, p. 259) shows this view of (tacit) knowledge as embodied corresponds to work of pragmatist philosophers (see §2.1) (see Shook and Margolis 2007). It should also be noted here that recent work in cognitive psychology applies

new methods and research designs, including neuroimaging, that show the interplay between physical and mental operations. Such studies increasingly consider notions of implicit cognition, implicit learning, and embodied and tacit knowledge, and extend to social decision making and rewards (Reber 1993, Adolphs 2003). This work may shed new light on how people acquire tacit and explicit knowledge (e.g., Sun 1997, Pothos 2007, Shanks and St. John 1994, Shanks 2005). We return to this in §4.1.

[7]This would not be consistent with the theory. As Winch (1958) pointed out, understanding a rule for problem solving is coeval with the ability to apply it appropriately. Thus, because all contexts are unique, how to apply it cannot be deduced from the problem-solving rule itself.

[8]In a machine, one can at best speak of "embeddedness" (a better term than "embodiment," which was used by Nonaka and Takeuchi (1995)) of a design team's explicit knowledge in the form of overall designs, modules, interfaces, software, parameters, etc. From the viewpoint of a user, a machine may capture some aspects of knowledge in the sense that it consistently performs the same tasks for them at least at the same level of performance (see the definition of knowledge in §2.1.), as would another individual. This is not to say that an individual's tacit knowledge is represented in the machine.

[9]We are grateful to one reviewer for an example of how people communicate about color to illustrate this point. The explicit aspects of colors consist of words, such as "red," "blue," and "white." What matters for knowledge is not the words per se and whether they correspond to a reality, e.g., to light waves. What matters is whether the pattern among the set of words used in describing color is similar to the patterns that exist among the individual perceptions that people have. A word only makes explicit one aspect of the tacit knowledge people have about color, namely, the pattern of relationships that exists to describe their perceptions.

[10]Analysis of the empirical studies available on knowledge conversion has targeted case studies such as the one of the home bakery. An exception is Nurse (2001, also quoted and reiterated in Gourlay and Nurse 2005), who analyzed Nonaka et al. (1994) and observed that, apart from lack of transparency in the data introducing problems of reliability, this early statistical model did not adequately account for the social context of knowledge conversion. Other factors such as training, individual interest in knowledge, and the social context for knowledge exchange were not adequately captured.

[11]Some limitations should be observed. Much of this research can be traced back to the original work of Piaget (1976). A substantial share is based on the correspondence doctrine and deals with neural networks and the subsymbolic levels of cognition (von Krogh et al. 1994). Thus, knowledge is taken to be true representations of reality, such as a problem-solving rule or task specification. Information processing improves such representations. Whereas the correspondence doctrine might guide studies of human cognition in a laboratory setting where experimental conditions and the problem-solving environment are controllable and finite, organizations are open problem spaces, afford dynamic and complex tasks, and provide alternative "representations" and contested truths (Brinck 1999).

[12]See also Wenger's (1998) discussion of boundary-spanning activities that bridge knowledge across communities of practice.

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