Collective Intelligence in the Organization of Science

Anita Williams Woolley
Tepper School of Business, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213, awoolley@cmu.edu

Erica Fuchs
Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213, erhf@andrew.cmu.edu

Whereas some suggest that consensus is the desirable end goal in fields of science, this paper suggests that the existing literature on collective intelligence offers key alternative insights into the evolution of knowledge in scientific communities. Drawing on the papers in this special issue, we find that the papers fall across a spectrum of convergent, divergent, and reflective activities. In addition, we find there to be a set of ongoing theoretical tensions common across the papers. We suggest that this diversity of activities and ongoing theoretical tensions—both signs of collective intelligence—may be a far more appropriate measure than consensus of the health of a scientific community.

Key words: collective intelligence; scientific communities; academic paradigms; organization science

History: Published online in Articles in Advance April 29, 2011.

Introduction
This special issue of Organization Science provides a broad sampling of the field of organizational research from the points of view of active scholars in respective domains. Although each article treats a very different topic area, as a collection they provide an opportunity to reflect on the progress of the field. Organization science is a relatively young field and one that resides at the intersection of other areas of social science (Augier et al. 2005). As a consequence, some writers have concluded that organization science lacks a high level of consensus on theories or paradigms (Pfeffer 1993, Simonton 2006). Kuhn (1996) defined fields lacking consensus as “preparadigmatic,” thereby implying that complete paradigmatic consensus is a desirable state for a field. And yet, we know that in collectives, high levels of consensus often result from as well as lead to dysfunctional group processes in which dissenting opinion is submerged because of pressures toward conformity (Asch 1955, McCauley 1989, Postmes et al. 2001). For example, Pfeffer (1993) explains that fields that operate with a higher level of consensus are often dominated by a small core of elite scholars who dictate the accepted paradigms. Furthermore, the explanatory power of a paradigm is only weakly related to its likelihood of success (Sterman and Wittenberg 1999). Indeed, scholars have warned that measures of success in elite-led paradigms can often give “short shrift” to matters of value, creativity, scope, innovation, and paradigm change (Van Maanen 1995, p. 689) and that premature convergence can stymie further intellectual development (Daft and Lewin 1990).

Whereas one interpretation of diversity of opinion might be that a collective exists at an earlier or lesser stage of development, another interpretation is that this diversity is characteristic of a highly functioning collective. Speaking of individuals, F. Scott Fitzgerald once noted, “The test of a first-rate intelligence is the ability to hold two opposing ideas in mind at the same time and still retain the ability to function” (Lester and Piore 2004, p. xi). Over the past 30 years, the term “collective intelligence” has held a host of meanings, ranging from the behavior of a “complex adaptive system” (where that system can range from bacteria to ants to humans; see, e.g., Bloom 2000) to the distributed knowledge or capability in human systems in which the whole is greater than the sum of the parts (Atlee and Pör 2000, Woolley et al. 2010). Such collective intelligence emerges from the collaboration and competition of many individual entities. Research on collective intelligence has argued that central to collec-
tively intelligent systems is the capability to engage in both convergent and divergent modes of thought, as well as to leverage the insights from reflection into course-correcting changes (Bloom 2000, Woolley et al. 2010). Each of these different modes of collective thought require particular social interaction processes to occur successfully in collectives (Larson 2009, McGrath 1984, March 1991), whether those collectives are small groups (Woolley et al. 2010) or organizations. Indeed, studies of ambidexterity in organizations encourage organizations to develop “skunk works” to support and protect the pursuit of divergent modes of thought (O’Reilly and Tushman 2008) and argue that engaging in only exploitation (evolutionary change involving decision making and thus convergence) or exploration (revolutionary change requiring divergence from existing ideas and business practices) may be imbalanced or unhealthy (Raisch et al. 2009, Andriopoulos and Lewis 2009; see also Rosenkopf and McGrath 2011).

The relevance of these three modes of thought and their role in enhancing collective intelligence need not stop at the small group or organizational level. Research on collective intelligence began with studies of mass behavior and combined theories of parallel signal processing, group selection, and the superorganism to produce theory of how complex adaptive systems operate (Bloom 2000). More recently, research has been particularly focused on how networked information and communication technologies are enabling large groups of individuals in a community to enhance their community’s knowledge pool (Faraj et al. 2011), such as through health-focused online communities (Johnson and Ambrose 2006); on the potential advantages of leveraging community knowledge for problem solving, such as through crowdsourcing (Gulley and Lakhani 2010, Malone et al. 2010); and on how mass problem solving may be able to achieve significantly faster or improved solutions than any one individual could achieve alone (Jeppesen and Lakhani 2010; Gulley and Lakhani 2010). In contrast to the research on small groups and organizations, the number of individuals in these larger collectively intelligent system ranges from hundreds to millions or even billions. Furthermore, the intelligence of such collectives is directly dependent on the diversity of resources and perspectives they bring, along with a mechanism for simultaneously fostering a variety of solutions and applying those that best suit the situation at hand (Malone et al. 2010). Although some of these past studies have focused explicitly on collective intelligence within systems of individuals, one could likewise imagine such themes being relevant to systems of systems, such as systems of firms, as discussed in the organizational ecology literature. Past research has extensively explored the tensions (Casadesus-Masanell and Yoffie 2005), the consequences of divergent modes of thought (Iansiti and Levien 2004), and the leadership processes that can orient convergence within such firm systems (Gawer and Cusumano 2002). Indeed, Larsson et al. (1998) identify five learning strategies—collaboration, competition, compromise, accommodation, and avoidance—common in interorganizational alliances and suggest that the pairing of these strategies is key to understanding success in collective knowledge development (Larsson et al. 1998).

An interesting link lies between the work on collective intelligence and the evolution of new theories and paradigms within scientific communities (Crane 1972, Pór 1995, Price 1963). Research on scientific communities has shown how education and training, such as being in common graduate programs or joint military training, can build scientific communities and long-lasting networks (Breznitz 2005). This research has explored the existence and boundaries of “invisible colleges” within scientific communities and how research directions within these communities are influenced by experts (Crane 1972, Price 1963). Within these communities, conferences can act as important venues for existing communities to contest and form agreement around the viability of competing directions (Garud 2008), and special issues in journals can accelerate knowledge development and convergence (Olk and Griffith 2004). Research has also shown how an external agent, such as the government, can support the development of new scientific communities, facilitate convergence, and influence overall directions (Fuchs 2010). Past research on the evolution of thought within scientific communities has not, however, focused explicitly on the processes of collective intelligence—i.e., the self-organizing dynamics and opposing tensions that drive the complex adaptive system of such scientific communities. Nor has past research gone so far as to suggest that a balance across certain modes of behavior—such as convergence, divergence, and the capability to engage in reflection and course-corrective action—might be necessary not only for “healthy” complex adaptive systems but also for fields of science.

We leverage the diversity of papers in this issue to characterize the nature of collective intelligence within the field of organization science. In looking across the papers, we see five different types of collective activities: defining, bounding, opening, bridging, and grounding. We also find common fieldwide tensions that cut across the papers. We argue that these five collective activities represent divergence, convergence, and reflection activities occurring in different subareas of organizational research. We see the first four of these activities as spanning a continuum (see Figure 1). At the far left of this continuum are those papers that focus on convergence within the existing literature. At the far right are those that focus on divergence from the existing mindset. The activities of defining, bounding, opening, and bridging span from left to right on this continuum, from
convergence to divergence. Throughout these first four activities is the recurring theme of reflection, i.e., questioning existing theories and creating new ones through continual comparison against existing practice and contexts in the real world. We thus see the fifth activity—grounding—as supporting the full spectrum of the previous four activities and in particular as stimulating reflection in organization science. We conclude our paper by discussing the potential implications of our findings for the application of collective intelligence concepts to the evolution of scientific communities.

Convergence
Convergent thought generally occurs in collectives during judgment and decision-making processes. Larson (2009) describes collective decision making as a cognitive activity in which it is often very difficult, if not impossible, for members to demonstrate conclusively to one another that a proposed response is, in fact, correct. Given these challenges, specific techniques are often needed to accomplish convergence of thought across different perspectives. Two approaches to facilitating convergence are evident across the papers in this special issue. The first approach centers on defining terms, including new “subtypes” for a concept or construct to enable scholars to reconcile what may seem like disparate findings and highlight issues for further exploration. The second approach involves bounding an area of scholarship to clarify the contexts, theories, and variables that are and are not applicable.

Defining: Clarifying Definitions and Identifying New Subtypes
One activity that facilitates the progress of convergence in intellectual fields of inquiry is the clarifying of definitions and identification of subtypes of a construct to account for what otherwise appear to be disparate or conflicting findings. These new metaconcepts or subtypes then become tools for organizing the different voices and perspectives on a topic in a manner that allow them to coexist and contribute to a deeper, well-rounded understanding of a unifying construct. For example, Ocasio (2011) resolves discrepancies in existing research on attention by identifying three subtypes or processes—attentional perspective, attentional engagement, and attentional selection. Facing similarly disparate findings, McEvily (2011), in contrast, merges existing concepts of calculative and relational trust to enable more coordinated research progress on the issue. Finally, Ashforth et al. (2011), in reviewing research on identity, note that identity research is often conducted at only the individual, group, or organizational level of analysis while neglecting between-level dynamics. In response to this problem, they argue that cross-level research on identity is necessary and, in particular, future research on nested identities and the processes through which identities become linked across levels.

Bounding: Clarifying the Applicability of Existing Theories
Advice for writers of good theory often underscores the importance of bounding or otherwise delimiting the context within which a theory is applicable (Sutton and Staw 1995). When a topic becomes very popular, scholars and practitioners alike can start to see a phenomenon as a universal explanation. As ideas and evidence accumulate, it can become critical to articulate what future research in a particular area must address as well as concepts or issues that lie outside of the relevant conceptual domain. A few papers in this special issue take this approach. One example of such bounding is Lewis and Herndon’s (2011) examination of the range of tasks for which a transactive memory system (TMS) is beneficial, as well as the task domains in which TMS is at best unhelpful or potentially even inhibiting of performance. Another example is Argote and Miron-Spektor’s (2011) theoretical framework for analyzing organizational learning. Here, the authors position learning as the mediating process that occurs between experience and knowledge, resulting from the interaction of experience and context. Building on this framework, they delineate the boundaries around the future questions that will be most fruitful for advancing our collective understanding of organizational learning.

Divergence
Divergence consists of pushing an existing area of discourse to consider new paths and different perspectives. Although some might view such divergence as signs of an immature field, a collective intelligence perspective on scientific field development would suggest that ongoing signs of divergence are critical to the vitality and progress of research in a field. As history shows, divergent modes of thought can for long periods be shut out by the established community (e.g. Galileo’s theory of the solar system). However, mechanisms can also be developed to facilitate and incorporate these divergent modes of thought within the broader discourse. For example, in the rapidly changing field of computer science, there is a tradition of funding annual “hot...
topics” workshops to stimulate discussion on emerging themes, as well as of top conferences selecting submissions for an “Outrageous Opinions” session, where researchers present both radical technological ideas as well as humorous commentaries on the field. Similarly, the workshop that led to this special issue brought together leaders in the field of organization science to debate and brainstorm emerging themes. Two different approaches to facilitating divergence are evident across the papers in this special issue: opening up new paths or areas of research within an existing area of inquiry and bridging two perspectives that are each the dominant focus of a different area or tradition of scholarship.

Opening: Creating New Paths Within Existing Areas of Inquiry

One form of divergent activity in scientific fields is the bringing of new concepts into existing paradigms. The introduction of these new concepts to the field can redefine and overturn existing paradigms, and in doing so open up entire new paths of inquiry. In this special issue, several papers go about the work of “opening” by bringing in concepts from other areas of inquiry to help explain disparate findings in the existing literature. For example, Rosenkopf and McGrath (2011) review the burgeoning area of research related to exploration and exploitation in organizations and raise the need to bring in the concept of novelty to reframe the existing debate, thereby opening new research paths. Bunderson and Reagans (2011) embrace similar goals in their writing about the role of power and status in influencing learning processes and outcomes. They submit that much of the existing work on learning assumes a rational systems model but that processes maintaining the social hierarchy in an organization may serve to undermine, or at least radically change, learning processes and outcomes. However, when high-ranking actors use power and status in more “socialized” ways, they can stimulate collective learning behavior. Thus Bunderson and Reagans (2011) implore researchers to bring concepts of power and status into existing research on learning in groups and organizations.

Other work engages in the process of opening by specifying alternative models that explain phenomena better than the dominant model. For example, Borgatti and Halgin (2011) clarify fundamental concepts related to network theory and argue that much of existing network theory shares an underlying theoretical model, called the “network flow model.” Pushing against the existing paradigm, Borgatti and Halgin propose an alternative model, which they call the “bond model,” and which appears to fit phenomena that are not well accounted for by the flow model but can be explored using traditional social network research methods.

Bridging: Creating New Paths byConnecting Disconnected Fields

Whereas in some cases divergence can take the form of bringing in new concepts to reframe and overturn assumptions within the existing paradigm, divergence can also involve the creation of entirely new fields. One well-documented place for the emergence of new fields is at the boundary of existing ones (Hargadon and Sutton 1997, Burt 2004, Ritvala and Granqvist 2006). A number of papers in this issue recommend paving new directions in organization science by creating a new field of inquiry at the boundaries between two existing fields. Particularly prominent among these papers are those focused on bridging between more established fields and the nascent field of entrepreneurship. Three papers take this approach. Sørensen and Fassiottto (2011) suggest that we need to bring the existing literature on organizations to entrepreneurship research. Here, they call for the need to explore how an entrepreneur’s past history within organizations affects the characteristics of the organization he subsequently founds. Tolbert et al. (2011), on the other hand, suggest bringing the study of institutions to entrepreneurship. In doing so, they suggest that the contribution would be in two main areas: understanding how institutions affect entrepreneurship choices, including the founding, design, and external relationship management of new organizations; and understanding how entrepreneurship is related to institutional change—in particular, how social movements lead to entrepreneurship and how entrepreneurship leverages social movements to found new organizations. Finally, Dacin et al. (2011) argue that the nascent field of social entrepreneurship intersects a number of domains (i.e., entrepreneurial studies, social innovation, and nonprofit management) and recommend bringing in insights from multiple existing research streams to advance the study of social entrepreneurship.

The call for creating a new field of inquiry at the boundaries between two existing fields also can be found outside entrepreneurship. In the area of strategy, Argyres (2011) also argues for bridging, suggesting the need to bring organizational economics back to the field of strategy to understand capability development—i.e., the way firms can and do develop the kinds of capabilities on which competitive advantage is built. Similarly, v. Werder (2011) calls for an expanded view of corporate governance, one that goes beyond the treatments offered by economics and finance or law, to one that incorporates perspectives from strategy and organization theory. He argues that we need to expand beyond our view of management opportunism to consider how all stakeholders can and will behave opportunistically. Finally, new fields of inquiry can also emerge through bridging in the methodological domain. For example, Burton and Obel (2011) convincingly argue that better and more integrated progress in the field can come from using
computational modeling in organization science research to describe what is, what might be, and what should be. Burton and Obel (2011) illustrate the potential for computational methods to open up a whole new field of inquiry in organization science through examples of how early leaders in using these methods in organizational research have already uncovered unforeseen insights.

**Reflection**

The ability for self-reflection has been identified as a hallmark of higher-order development that differentiates man from beast (Amsterdam 1972, Kagan 1981, Povinelli and Preuss 1995). Furthermore, collective reflection has been shown to differentiate higher-functioning from lower-functioning collectives (Schippers et al. 2003, 2007). Reflection in a collectively intelligent community can be thought of as drawing back and taking a big picture perspective on the whole system: Are we heading in the right direction? Are the problems framed correctly? Are our basic assumptions valid? In scientific fields, this reflection results in a call for checking existing theories against, and creating new theories from, experiences in the real world or questioning the methods used to explore phenomena. Such reflection can, for example, be seen in the social sciences in the long-standing history of grounded theory building, in which new theories are developed through an iterative back-and-forth between theory and real-world data (Glaser and Strauss 1967, Eisenhardt 1989, Davis et al. 2007). Such reflection can also involve questioning what theory is and is not, as well as its appropriate role in the development of scientific ideas (Sutton and Staw 1995, Weick 1995). In this special issue, papers calling for the “grounding” of existing and emerging organizational theories in the specifics of real-world contexts take two forms—papers that argue that organizational theory needs, in general, to be better grounded in an understanding of daily actions and practice and papers that identify “special” contexts whose unique natures offer insights into particularly pressing or unresolved issues in existing organization theory and, thus, the development of new theory. This special issue likewise contains research that questions the very meaning of theory itself.

Bechky (2011) and Feldman and Orlikowski (2011) argue that to push on our current theories of organizations, we must bring in an understanding of daily, real-world actions or practice. Bechky (2011) argues that current organizational theory is not sufficiently grounded in the real world and therefore lacks relevance. She then argues, in part in response to this problem with current theory, for the need to bring in individual’s occupations to our study of organizations. Similarly, Feldman and Orlikowski (2011) argue for the importance of bringing practice theory—or the theoretical relationships between the (empirically observed) recurrent, everyday actions of people and the structural outcomes of those actions—into organizational research. They argue that such a focus on practice can have particularly large implications for organizational theories on strategy in practice (the relationship between the pronouncements of top-level management and the emergent strategy of an organization), knowledge, the creation and effects of institutions, and the processes involved in structural change.

Reflection is also evident in a second set of papers that highlight the potential for “special” contexts to shed insight into unresolved issues in organizational research: the paper by Faraj et al. (2011) on knowledge creation in online communities (OCs), Northcraft and Tenbrunsel’s (2011) paper on volunteer dilemmas in the academic review process, and the Dacin et al. (2011) paper on social entrepreneurship. In each of these special contexts, some aspect of the “prototypical organization” is enhanced, removed, or recombined in a nonconventional way. Faraj et al. (2011) argue that online communities—with their volunteerism, social ambiguity, and lack of formal governance structures—offer unique insights into worker fluidity and knowledge cocreation, an opportunity that has not yet been exploited in the existing OC literature. According to Faraj et al. (2011), worker fluidity in OCs leads to dynamic changes that create tensions in an OC during knowledge creation. The responses generated by OCs to overcome these tensions offer insights into how to manage such fluid environments and bring into question existing small group theories and theories of knowledge creation and change in organization science. In the papers by Northcraft and Tenbrunsel (2011) and Dacin et al. (2011), a clearly defined physical or monetary award is missing from the “prototypical” scenario. Drawing on past research, they present frameworks from which to approach such problems. In both cases, the authors revisit literature from a host of existing fields and point out the need to develop new theory.

A different form of reflection is evident in papers that question the appropriate definition and role of theory itself. For example, Burton and Obel (2011) argue that theory should not only describe what was and what is, but also—as can be achieved with computational models—what might be and what should be. Shapira (2011) addresses the ongoing debate about the appropriate role of theory in empirical work. He points out discrepancies in how the term “theory” is used in the literature and argues that, in reality, research formulation in the organizational sciences has not one but three modes— theories, models, and conceptual frameworks. He argues that mathematics, a language of precision, is best suited in sorting out the best theories once knowledge has already been accumulated based on data, whereas narrative approaches, which provide great empirical richness, are best suited to scientific development in more nascent stages of inquiry.
Cross-Cutting Tensions

In the evolution of a complex adaptive system, it can be critical for certain tensions to remain unresolved in that system (Andriopoulos and Lewis 2009, Smith and Tushman 2005). On the one hand, time-bounded periods of unresolved tensions may be critical to leaving enough time for the correct answer or direction to be found. On the other hand, a certain amount of continuing tension may be critical to the ongoing questioning and thus healthy functioning of the system. A number of theoretical tensions emerge as common across the papers, regardless of their category or approach. These common themes highlight broad-reaching challenges facing scholars in the study of organization science. They include (1) the explanatory power of varying units of analysis, (2) the tension between context specificity versus common themes, (3) the clarifying power versus limitations of definitions, (4) the embeddedness versus agency of actors, and (5) the tension between static versus dynamic analyses.

The papers in this special issue explore a variety of units of analysis through which to better understand the field of organization science. These units of analysis include individuals, groups, teams, organizations, communities, occupations, networks, and organizational ecologies, to name only a few. In presenting these units of analysis, several common tensions emerge. First, several papers suggest that to push forward the field of organization science, we must look at units of analysis other than the organization itself (i.e., Bechky 2011, Dougherty and Dunne 2011, Sørensen and Fassiotto 2011). Second, several papers question how applicable theories developed based on a particular unit of analysis are to theories focused on other analysis units, and how activities at one level of analysis influence those at another. For example, Ocasio (2011) leverages insights on attention from neuroscience and applies those themes to the past research on attention in organization science and, in doing so, asks explicitly what the relationship is between individual- and organization-level attention. Similarly, McEvily (2011) asks what the link may be between individual and organizational levels of trust. Finally, Ashforth et al. (2011) express interest in the processes by which identities become linked across levels (i.e., individual, group, and organization).

A second tension that emerges across the papers concerns the benefits of focusing on context specificity versus common themes. This tension emerges in the debates on appropriate methods and the extent to which relevance can be lost without empirical grounding (i.e., Bechky 2011, Feldman and Orlikowski 2011), the applicability of “special contexts” to broader theory (Dacin et al. 2011, Faraj et al. 2011, Northcraft and Tenbrunsel 2011), and the relevance of contextually derived definitions. In Bechky’s (2011) and Feldman and Orlikowski’s (2011) papers, empirical grounding is seen as both a starting place for new theories and a “reality check” on existing ones. Relately, Rosenkopf and McGrath (2011) argue that we need to incorporate additional contextual nuance to further distinguish degrees of novelty. On the other hand, Faraj et al. (2011) point out the opportunity provided by the special context of online communities to strengthen existing theory, specifically by leveraging the aspects of typical organizations that online communities may be lacking. Finally, many of the papers focus on concept definitions, questioning the extent to which the context in which a definition is developed taints its relevance to a broader set of situations (i.e., McEvily 2011).

A third tension, which runs throughout these papers, is the clarifying power versus limiting nature of definitions. Although some papers focus explicitly on the definition of a particular word, theme, field, or category, most papers in this issue take some portion of their text to clarify definitions. Among those papers that focus explicitly on definitions, some argue that the existing definitions are defined too broadly or imprecisely, whereas others argue that the existing definitions are not defined broadly enough. Yet others argue that definitions need to be merged. For example, McEvily (2011) argues that a failure to talk across disciplines has led to parallel research on trust in economics and organizational theory that fail to interact. In response to this challenge, he argues that there needs to be a new “hybrid” form of trust that merges the insights from both of these fields. Finally, in search of the appropriate extent and boundaries of definitions, the tension between context specificity and generality discussed in the previous paragraph is preeminent. Invariably, the choice of definition, whatever that choice may be, will highlight the pursuit of particular research questions while leaving others less obvious or all together left out.

A fourth tension across the papers is agency versus embeddedness, i.e., the extent to which actors’ actions are a function of their environment versus distinct from or even altering the environment in which they act. Underscoring that actor’s actions are, in part, determined by their environment, Sørensen and Fassiotto (2011) present the idea that entrepreneurs’ original organization(s) influence the structure of the new organization the entrepreneur subsequently creates. Relatedly, in their paper on online communities, Faraj et al. (2011) present how technical structure can simultaneously constrain and create new opportunities for actions and interaction that would not have been possible in an alternative environment. In contrast, Tolbert et al. (2011) and Dacin et al. (2011) focus on how individuals and organizations not only are affected by but also can change the external environment within which they act.

Finally, a fifth tension across the papers is the extent to which research should focus on a deep understanding of a phenomenon within a given moment versus the need
for greater research on temporal dynamics and organizational change, where research outputs can be slower and data sources more limited. As highlighted in the previous paragraph, many of the papers in this special issue focus on the embeddedness versus agency of individuals and organizations with respect to organizational and environmental change. Other papers highlight the importance of further research on dynamics and change itself (i.e., Argyres 2011, Ashforth et al. 2011, Faraj et al. 2011, Sørensen and Fassiotto 2011). Each of these papers highlights the tension between past research that has provided a powerful understanding of the current moment and understanding how past and future moments may change the current observations over time.

Collective Intelligence in Organization Science

This paper—itself a divergent “bridging” paper according to our categorization—explores the opportunity for new research in organization science at the intersection of existing research on collective intelligence and the evolution of knowledge within scientific communities. We use the papers in this emerging issue as a real-world sample of leading activities—or practice—in the field of organization science (Bechky 2011, Feldman and Orlikowski 2011). Using grounded theory-building techniques (Glaser and Strauss 1967), we categorize the papers into five different types of field-organizing activities—defining, bounding, opening, bridging, and grounding. We suggest that the first four activities are representative of a broad continuum (from left to right) of convergent and divergent modes of thought. These four activities are supported by and contribute to grounding activities, which are representative of the reflection that is necessary to advancing the field. In contrast to past research on scientific fields that has suggested convergence to be a desirable end (Kuhn 1996), we suggest that a spectrum of convergent, divergent, and reflective modes of thought may instead be a more appropriate indicator of collective intelligence and thus the healthy functioning of a scientific field.

Using grounded theory-building techniques, we also identify five tensions that are sustained throughout the papers in this special issue. These five tensions are the applicability of theory across units of analysis, the importance of context specificity versus common themes, the clarifying power versus limitations of definitions, embeddedness versus agency, and the accuracy of reporting current events versus the importance of accounting for temporal dynamics. According to the literature on collective intelligence, in the evolution of a complex adaptive system, it can be critical for certain tensions to remain unresolved in that system (Bloom 2000). Based on this research, we again suggest that such tensions may be important signs of the healthy functioning of a field of science.

In the same way that our paper itself fits within the five categories of field-organizing activities, we find the theoretical tensions common across the special issue’s papers to likewise be echoed in our own. Like Ashforth et al. (2011), our discussion of collective intelligence raises critical questions about the processes by which intelligence is linked across units of analysis (not only individuals to groups to larger communities and ecologies, but also systems of systems). Like Faraj et al. (2011), our setting of scientific communities is a particular context that may have both special insights and also limitations in understanding collective intelligence more globally. Like Ocasio (2011) and McEvily (2011), our discussion raises the question of whether the definition of collective intelligence and potential subtypes may need to be revisited depending on the context and the size of system. Last, research on collective intelligence itself sits at the heart of the tension between deeply understanding the current moment and the need for greater research on temporal dynamics and organizational change.

Collective intelligence is a potentially powerful concept through which to understand the collaboration, competition, and decision-making processes of complex, adaptive social systems. We hope that this paper, in scratching the surface of potential future research at the interface between the literature on collective intelligence and the evolution of knowledge in scientific communities, may act as an encouragement for scholars to begin more extensive work. Fruitful future areas of research will include developing a grounded understanding of the dynamic evolution of scientific communities, developing and refining metrics with which to measure the performance of such communities, and creating a deeper understanding of the predictive power of such metrics for the performance of scientific fields such as our own.

Endnote

1The study of organizations can be traced back to the earliest systematic human writings and extended going forward to include Smith, Marx, Weber, and beyond (Augier et al. 2005). This said, one could argue that the field of organization science began with the advent of scientific management in the 1890s (Taylor 1911) and that research in organization science in Anglophone North America began after World War II (Augier et al. 2005).

2An example of the former is the 13th Workshop on Hot Topics in Operating Systems (HotOS XIII); an example of the latter is the Outrageous Opinions session held at ACM SIGCOMM 2009.

References


**Anita Williams Woolley** is an assistant professor of organizational behavior and theory at the Tepper School of Business, Carnegie Mellon University. She received her Ph.D. in organizational behavior from Harvard University. Her research addresses team performance, collective intelligence, and managing multiple team memberships. Her work also appears in *Science*, the *Academy of Management Review*, *Social Neuroscience*, the *Journal of Organizational Behavior*, *Small Group Research*, and multiple edited volumes.

**Erica Fuchs** is an assistant professor in the Department of Engineering and Public Policy at Carnegie Mellon University. She received her Ph.D. in engineering systems from the Massachusetts Institute of Technology. Her research focuses on how globalization, and in particular national differences, is influencing the evolution of technology in our society. Her work also appears in *Composite Science and Technology*, *Journal of Lightwave Technology*, *Research Policy*, and *Management Science*.

---

**CORRECTION**

In this article, “Perspective—Collective Intelligence in the Organization of Science” by Anita Williams Woolley and Erica Fuchs (first published in *Articles in Advance* April 29, 2011, *Organization Science*, DOI: 10.1287/orsc.1110.0648), the reference to v. Werder was omitted and has now been included in the text and in the reference list.