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THE EFFECTS OF REPEAT COLLABORATION ON CREATIVE ABRASION

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Building on research that suggests a negative relationship between repeat collaboration and team creativity, we propose that team mental models developed in earlier projects are likely to interfere with the processes that constitute creative abrasion: idea generation, disclosure/advocacy, and convergence. Suppression of these processes leads to less creative outcomes. We conclude by proposing that these negative effects can be mitigated by process and project charter interventions and by outsider entry into the project team.

There is a growing body of evidence that repeat collaboration in creative projects, like those found in scientific research and the entertainment industries, frequently produces outputs that underperform. Guimerà, Uzzi, Spiro, and Nunes Amaral (2005) report that research teams in the social and natural sciences that have high levels of repeat collaboration produce publications that receive fewer citations. Porac and colleagues (2004) argue that preexisting relational ties diminish creativity in science projects by limiting search and reducing conflict. Reagans, Zuckerman, and McEvily (2004) report on a consulting practice in which repeat collaboration is the norm, where performance suffers when consultants work together repeatedly. Similar negative relationships between repeat collaboration and creative performance have been reported in entertainment industry projects (Delmestri, Montanari, & Usai, 2005; Guimerà et al., 2005; Perretti & Negro, 2007; Uzzi & Spiro, 2005). While the number of studies reporting a negative relationship between repeat collaboration and creative performance is growing, none of these studies has proposed a unifying theory. Considering the importance of creative project teams for innovation (Wuchty, Jones, & Uzzi, 2007), the importance of creative industries in the global economy (Caves, 2000), and the fact that many creative professionals work together repeatedly, the question of how repeat collaboration influences creative outcomes is important for scholars and managers alike.

This question is also important because it introduces a temporal dimension into the study of creativity, something scholars of creativity in organizations have sought for more than a decade (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Drazin, Glynn, & Kazanjian, 1999; Ford, 1996; Woodman, Sawyer, & Griffin, 1993). Many scholars of project work have asked whether the benefits of lessons learned in one project can be carried forward or transferred to subsequent projects (Ancona & Caldwell, 1992; Gersick & Hackman, 1990; Liang, Moreland, & Argote, 1995; Nonaka, 1994; Purser, Pasmore, & Tenkasi, 1992), but because the assumption has been that projects are discrete temporary entities, few scholars have studied the effects of retaining a more or less intact core of personnel along a stream of disparate projects (Meyers & Wilemon, 1989; Skilton, 2003). Creativity research, like project and work team research, has tended to emphasize the effects of processes within diverse teams and between concurrent subteams (Atkinson, Batchelor, & Parsons, 1998; Drazin et al., 1999; Standifer & Bluedorn, 2006), rather than the effects of shared experience over time. There have been studies of the motivations for repeat collaboration (Perretti & Negro, 2007; Podolny, 2005; Schwab & Miner, 2008), studies of the relationship between creative abrasion and creativity (Ford & Sullivan, 2004; Leonard & Swap, 1999; Nonaka, 1994), and studies of the effects of familiarity on the execution of team work (Ancona & Caldwell, 1992; Gersick & Hackman, 1990; Lambert & Shaw, 2002), but no studies of the

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repeat collaboration–creative abrasion relationship.

The key insight of this paper is that many creative projects are not insulated from the baggage of participants' shared history. We combine creativity research, social cognition research, and work team research into a theory of how repeat collaboration influences creative abrasion, a sequence of processes key to creative project performance (Leonard & Swap, 1999). To achieve this we define repeat collaboration in terms of teams' distributed cognitive structures, and we develop propositions about the ways that these structures constrain creative abrasion. Although we assume that repeat collaborators generally intend to be creative, mental models developed in earlier collaborations may blind them to sources of information that could lead to innovative, creative ideas (Cohen & Levinthal, 1990; Katz, 1982; Lambert & Shaw, 2002; Lewis, Belliveau, Herndon, & Keller, 2007). These structures may encourage team members not to develop or disclose ideas that would disturb the status quo or, if such ideas are disclosed, discourage the inevitable conflict that comes with the advocacy of competing positions.

Given the potential for repeat collaboration to suppress creative abrasion processes, we also discuss antecedents and interventions. Although there are numerous possible antecedents, we focus on three factors that describe how strong team mental models will be at the start of the creative abrasion process: the degree of insider participation, the similarity between project objectives, and switching costs associated with changing team mental models. We also identify three ways in which these risks can be mitigated: outsider entry, interventions into the project charter, and interventions into the creative abrasion process.

CREATIVE ABRASION, TEAM CREATIVITY, AND CREATIVE PROJECT TEAMS

Before we discuss the processes that make up creative abrasion, it is useful to draw the limits of the theory we propose. We limit our theory development to processes in a specific organizational form—the creative project team. Creative project teams and team creativity matter for this study because they tell us where creative abrasion occurs and why it is important. Because of space constraints, we will not include either construct as a major element in our theory, which deals more with processes than final outcomes or the details of project team organization.

The theory we develop here is specific to creative project teams. We define creative project teams as temporary, self-managed organizations consisting of two or more individuals who engage in nonroutine tasks to produce creative outputs (Grabher, 2004; Whitley, 2006). Creative project teams have traditionally been contrasted with stable work teams because membership in them is temporary, because creative processes are different from the processes of routine production, and because of the one-off nature of creative project outputs. When we move the unit of analysis from a project to a project stream, however, teams of collaborators who work together repeatedly exhibit some of the same traits as stable work teams. If the mental models that guide collaborators' interactions persist from project to project, what makes creative project teams different are creative processes and outcomes. Creative processes and outcomes are put at risk when creative project teams become more like stable work teams.

In this study we adopt Ford's definition of creativity as "a domain-specific judgment of the novelty and value of an outcome of a particular action" (1996: 1115). This definition puts judgments about creativity in the hands of clients, audiences, users, and critics (Amabile, 1997; Amabile et al. 1996; Chen, 2006; Guimerà et al., 2005; Merton, 1968; Whitley, 2006). For Ford (1996) and Leonard and Swap (1999), the most important judgments are expressed by the extent to which the outcomes of projects are adopted by users. Because this definition is based on user judgments, the full range of projects, from radical innovations to incremental permutations of well-known themes, can achieve creative success. Because "commercial" and "artistic" success depend on user responses, the definition does not distinguish between them.

To produce novel outputs that users will adopt, creative teams must use processes that lead them toward novel problems and solutions that appeal to users in one or more markets, and they then must use processes that help them cast their solutions in a form that the team can

execute. This suggests that successful creative project teams enact a more or less regular set of processes. Many scholars have proposed that when creative projects begin, the task elements of the project (such as problem definitions, solutions, and goals) and the team elements of the project (such as roles, processes, and relationships) are highly ambiguous, offering team members little guidance about what to do or how to behave (Bettenhausen & Murnighan, 1991; Ford & Sullivan, 2004; Leonard & Swap, 1999; Nonaka, 1994; Pinto & Prescott, 1988; Star, 1989). These conditions are believed to stimulate creative teams to engage in high levels of idea generation, constructive conflict, and negotiation that eventually lead to convergence on a specific choice (Chen & Chang, 2005; Drazin et al., 1999; Ford & Sullivan, 2004; Gilson & Shalley, 2004; Jehn & Mannix, 2001; Nonaka 1994; Pinto & Prescott, 1988; Star, 1989; Weick, 1979). Building on work by Hirshberg (1993), Leonard and Swap (1999) labeled this set of early processes *creative abrasion*. In our review of the literature on team creativity, we concluded that three processes constitute creative abrasion.

First, creative teams need to generate a variety of ideas about the problem they face and how to solve it (Amabile et al., 1996; Drazin et al., 1999; Ford, 1996; Gilson & Shalley, 2004; Leonard & Swap, 1999; Nonaka, 1994; Woodman et al., 1993). Satisficing by limiting idea generation to the nearest, most obvious, or most precisely defined problems or solutions limits the plasticity of the problem-solving process and, with it, the likelihood that the team will invent or discover a better course of action. Most creative project teams are designed to be pluralistic, in the hope of generating a variety of ideas from team members' divergent expectations, methods, and understandings of problems and solutions (Leonard & Swap, 1999; Nonaka, 1994).

Idea generation is active. Whether it involves Pixar digital effects supervisors joining collective sketching groups during lunch time in search of story ideas (Dunn, 2004), industrial designers collecting random objects to inspire off-the-wall connections (Hargadon & Sutton, 2000; Schilling, 2008), a bread machine designer working as helper to a master baker (Nonaka, 1994), or contractors responding to Frank Gehry's use of 3-D representations to create previously unimaginable designs (Boland, Lyytinen, & Yoo, 2007), effective idea generation involves responsive interaction with the world and coparticipants that produces many options. The ideas that result may be poorly defined, inconsistent, or apparently inappropriate.

Second, the ideas individuals generate must be disclosed and advocated for even if they are underdeveloped. It does little good to staff a team with creative individuals if they self-censor their ideas (Leonard & Swap, 1999; Star, 1989). Disclosure and advocacy processes require participants to make their ideas explicit and to build cases for them. Nascent project teams have to make a case for opinions about a screenplay or characters to develop, which design principles should guide development of a new product line, or which technology should be deployed as a new platform. This process can lead to the creation of additional ideas, to conflation of related ideas, and to a better understanding of how the various options interrelate (Star, 1989). It has often been observed that disclosure and advocacy are inherently contentious processes. Researchers have tended to focus on the task conflict associated with disclosure and advocacy, rather than on the variety of ideas disclosed and promoted in these processes.

Third, the divergent ideas that make for task conflict must be reconciled and a common course of action negotiated so that the team can move forward. Scholars have recognized that if the team does not converge on a course of action, or converges too quickly, the project is likely to fail (Chen, 2006; Ford & Sullivan, 2004; Gersick, 1988; Gersick & Hackman, 1990; Kratzer, Leenders, & van Engelen, 2004; Leonard & Swap, 1999; Lewis et al., 2007). To preserve distinctions between this and the preceding creative abrasion processes, we adapt Leonard and Swap's language (1999) and call the process of reconciling differences and negotiating actions and objectives the "convergence process." Convergence is subsequent to idea generation and advocacy/disclosure. If a team converges on an idea or course of action, it can move on to execution. If not, the team continues to generate ideas, disclose and advocate for them, and again try to achieve convergence. Teams that rush to convergence by generating, disclosing, or advocating for fewer ideas are likely to produce outcomes that are less novel and less useful. Teams that fail to converge are likely to miss

windows of opportunity for success or to abandon the attempt at collaboration altogether.

Convergence processes require resolution of differences and commitment to a course of action. This process can involve more disclosure and advocacy as previously unregistered issues come to the surface. Ideas about story and characters at Pixar are resolved into a "story reel" (Dunn, 2004) that guides the production process. Solutions to Frank Gehry's designs are translated into work packages for developing and deploying new technologies. Customer requirements and product characteristics are refined into product and process specifications.

Following Leonard and Swap (1999), we assume that each process partly enables the next. An effective sequence, as outlined here, combines an emphasis on novelty with a market orientation that stresses utility for some set of users. Each process in the sequence can be more or less effective in terms of helping to produce creative actions and outcomes. Enacting a full sequence of effective processes makes successful creative outcomes more likely. Teams that succeed in enacting the full creative abrasion sequence should be more creative than teams that emphasize only novelty or utility or that only partly realize the sequence.

While the bulk of our discussion is framed in terms of the initial concept phase of creative projects, creative abrasion is not something that simply happens once at the beginning of projects. Creative abrasion can happen whenever a team encounters a problem or opportunity that requires team, rather than individual, action. In most creative projects individual action is guided by the objectives negotiated in convergence, but there are many occasions during the later stages of creative projects where individual action is not enough. Interactions between components of the project or unexpected events frequently require teams to generate ideas, disclose and advocate for them, and converge again. Our focus here, however, is on the creative abrasion process that occurs at the beginning of a project.

REPEAT COLLABORATION IN CREATIVE PROJECT TEAMS

The creative abrasion sequence does more than help teams arrive at creative formulations of problems and solutions. Creative abrasion is simultaneously a structuration process (Barley, 1986; Giddens, 1976) that generates enduring, distributed cognitive structures that govern behavior (Bateson, 1972; Gersick & Hackman, 1990; Goffman, 1974; Polanyi, 1962; Weick, 1979). As team members become socialized to each other, their behavioral patterns are internalized so that subsequent changes in context have limited effects on behavior (Granovetter, 1985). In conventional views of creative projects, these structures fall out of use when a team disbands. With repeat collaboration they do not. Teams of repeat collaborators participate in distributed cognitive structures that provide templates for what to do and how to behave, even when faced with the ambiguous problems, tasks, goals, and processes of a new project.

This view of repeat collaboration suggests that as team members work on more projects together, creative project teams become more like stable work teams. We therefore draw on research on team mental models (Cannon-Bowers, Salas, & Converse, 1993; Klimoski & Mohammed, 1994; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Rico, Sanchez-Manzanares, Gil, & Gibson, 2008) to gain insight into the kinds of cognitive structures creative teams will develop. A common definition of mental models is that they are knowledge structures that allow individuals to explain, predict, and describe events (Cannon-Bowers et al., 1993). Team mental models differ from individual mental models because they are distributed among team members. For example, team members with different roles are likely to have differentiated, interlocking models of task knowledge (Mathieu et al., 2000; Nelson & Winter, 1982). Interlocking team mental models "enable teams to better explain phenomena, draw inferences and recognize relationships." They also allow team members to "act strategically without overt and extended interaction" (Cannon-Bowers et al., 1993: 227).

Team mental models are typically categorized as team or task related. Team-related models, which help team members interact with each other, are often identified with transactive memory systems (Austin, 2003; Kang, Yang, & Rowley, 2006; Lewis et al., 2007; Mathieu et al., 2000). Task-related mental models help team members understand specific tasks or task elements (Kang et al., 2006; Leveseque, Wilson, & Wholey, 2001; Mathieu et al., 2000; Standifer & Bluedorn,

2006). Team mental models are learned, enduring, taken-for-granted sets of parameters that define expected action in the team context and that are, in turn, modified or reaffirmed by action (Barley, 1986; Giddens, 1976).

We therefore define repeat collaboration as collaboration on creative projects in which internalized, distributed team mental models are carried forward by team members who have worked together on earlier projects. We adopt this definition because unless some form of distributed cognitive structure develops, there is no mechanism to explain how working together over an extended period would systematically alter a team's behavior (Bateson, 1972). We assume that team mental models become more fully internalized and therefore more resistant to change the longer the collaboration continues (Argyris & Schön, 1978; Audia & Brion, 2007; Barley, 1986; Giddens, 1976). We call this "resistant" quality "inertia" to highlight its passive nature. Mental models become more inert when repeated use leads them to be widely accepted, easy to use, and tacitly excluded from discussion. As with any structuration process, action influences structure, which influences future action, and so on. Innovative action in one project can become the basis for inertia in subsequent projects.

Although our theory development focuses on the effects of repeat collaboration rather than its causes, it is useful to briefly review existing research that describes how the inert distributed mental models that define repeat collaboration develop. Our intent in providing this review is to provide a basis for the propositions we advance later the paper. While there are many possible antecedents, we focus on three factors that affect how strong team mental models are at the beginning of a creative project, and thus impact the degree to which repeat collaboration may suppress creative abrasion: participation by insiders, new project selection on the basis of structural or content similarity, and the cognitive switching costs required to alter team mental models.

The most obvious characteristic of repeat collaboration is that the same people work together more than once. There is empirical evidence that team mental models emerge and become ingrained quickly in new project teams (Barley, 1986; Harrison, Mohammed, McGrath, Florey, & Vanderstoep, 2003). Liang et al. (1995) demonstrated that familiar teams facing new problems relied on mental models developed in a single prior task. This means that second projects will be qualitatively different from initial projects. We expect that additional subsequent projects will increase team mental model inertia, although the qualitative changes from project to project may diminish. While a single project is enough to produce inert mental models, internalization will be stronger when participants work together on numerous projects.

Although repeat collaboration is likely to be stronger in completely intact teams, it appears to be enough that some, rather than all, participants work together again. The inertia of team mental models may even be enhanced when partial teams come together again, because team members who buy into the dominant model are more likely to choose to participate, reaffirming the existing structures. At a minimum there is empirical evidence that mental models carry over between assignments and in the face of turnover. Bettenhausen and Murnighan (1991) reported that norms developed in an experimental setting carried forward to new decision-making groups. Lewis et al. (2007) showed that in teams with partial turnover newcomers tended to adopt the mental models of old-timers. We also expect inertia to be stronger if team members retain specific roles across projects, since this facilitates acceptance and retention of existing mental models.

Mental model inertia is also likely to be enhanced when earlier success or project similarity makes continuing relationships more attractive. When a new project is like a prior one, either in its objectives or its structure, there are stronger incentives to use existing team mental models without questioning them. Inertia may increase if repeat collaboration on a particular type of project enhances status differentiation, making participation more critical to team member identity (Podolny, 2005). Perretti and Negro (2007) and Schwab and Miner (2008) have shown that project participants and superordinate organizations such as film studios or grant-giving agencies prefer participants to work together repeatedly in similar roles, especially when prior projects have been successful and project objectives are similar.

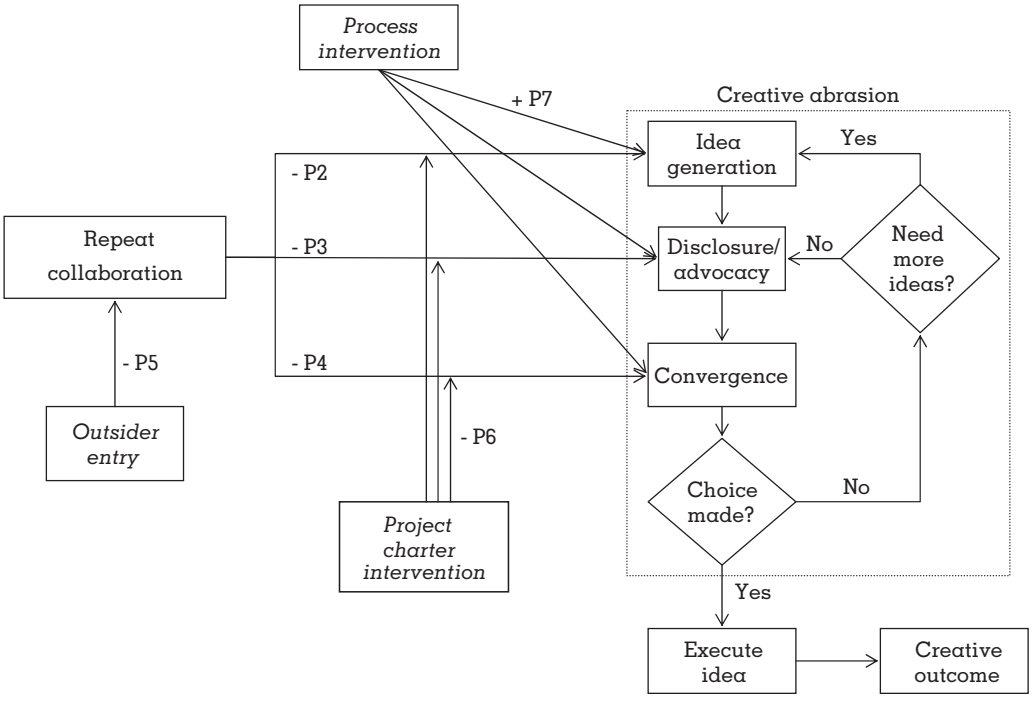
Meeting these conditions does not mean that team mental models in creative teams become completely inert. Because action influences

structure, there is always ongoing structural slippage (Barley, 1986; Giddens, 1976). For any context the important question is how much slippage there is, and the answer is usually "not much." This is because, as Barley notes, "Slippages are inconsequential for . . . structure when they are momentary and random or when they can be subsumed under a prior framework of prior action, interaction and interpretation" (1986: 80). When repeat collaboration has produced strong team mental models, events that alter or challenge structure are likely to be interpreted through and subsumed into existing schemata. Conservation of existing team mental models is more common than reinvention, simply because the disruption or modification of mental models is difficult, risky, and uncomfortable. Repeat collaborators have incentives to resume patterns of interaction that avoid these switching costs (Ford, 1996; Harrison et al., 2003; Hinds, Carley, Krackhardt, & Wholey, 2000; Murray & Haübl, 2007; Star, 1989). If reaffirming a taken-for-granted status quo ante makes interaction easier, it is not surprising to see creative knowledge workers do so (Delmestri et al., 2005; Uzzi & Spiro, 2005; Zuckerman, 2005), even if there is a known cost to creativity. The switching costs of change, including the risks of ineffective change, are avoided.

REPEAT COLLABORATION AND CREATIVE ABRASION

Figure 1 represents a cross-sectional moment from the history of a series of projects connected by repeat collaborators. The team mental models that define repeat collaboration have been internalized before the team starts a new project. Because we are interested in the relationship between repeat collaboration and processes in the current project, the figure does not show the feedback between action at time t to structure at $t + 1$ that characterizes project streams. Figure 1 provides a road map for the remainder of the paper, in which we propose that the negative relationship between repeat collaboration and creative project performance comes about because repeat collaboration has a constraining effect on the creative abrasion processes that generate and shape divergent ideas into coherent, creative team action. We conclude our theory development by proposing three categories of factors (the items shown in italics in Figure 1) that mitigate either the inten-

FIGURE 1
Theoretical Model



sity of repeat collaboration or its effects on creative abrasion.

Implicit in Figure 1 is the proposition that creative abrasion mediates the relationship between repeat collaboration and creative outcomes. We offer the proposition below to make this idea explicit and to direct attention to creative abrasion as a critical set of processes that contributes to creative outcomes by generating, developing, and converging on the objectives and solutions that are put into action in the execution phase of the project. Since, as we noted earlier, we assume that the creative abrasion sequence is positively related to creative outcomes because it creates the framework for execution, we do not propose new theory about the execution phase. Expanding our model to address issues of execution would require more space than is available and would reproduce theory developed by Ford (1996) and Leonard and Swap (1999).

> *Proposition 1: The relationship between repeat collaboration and creative outcomes is mediated by the creative abrasion sequence.*

Repeat Collaboration and Idea Generation

In theory, idea generation should produce a set of diverse ideas that stimulate the team to move toward a more novel and useful outcome. While idea generation is often considered an individual process, it has collective aspects. In repeat collaboration both individual and collective elements will be constrained by team mental models that create predispositions and expectations about the kinds of actions to be taken in the idea generation process. Examples of idea generation–related mental models are those that define participants' freedom of action, scenarios for search (external, random, local, targeted), expectations for effort and variety, and contingency rules, such as when to stop trying to come up with ideas.

For example, in a team where established mental models favor external search, the preexisting cognitive structure will tend to direct attention away from internally generated ideas that might arise. A model privileging engineering ideas might reduce the production of administrative ones (Leonard-Barton, 1992). When repeat collaboration is stronger, team members will be more likely to think along the same lines as before, producing ideas that are related to prior projects. This would be the case even in teams where the members had different functional backgrounds and world views. While the ideas produced by each team member might be different, expectations about what is possible or desirable would constrain the variety of ideas produced within each functional way of thinking. The resulting set of ideas would be less varied than in a team without preexisting team mental models related to idea generation tasks.

Repeat collaboration is also associated with team mental models that help participants relate to other team members, such as transactive memory systems (TMSs) and relational schemas. These also influence creative idea generation. TMSs consist of "a representation of members' shared understanding of 'who knows what' . . . and a process component—consisting of a set of *transactive processes* (encoding, storage, and retrieval processes) related to knowledge acquisition and use" (Lewis et al., 2007: 160). A TMS can be viewed as a composite of interlocking relational schemas that link persons, contexts, and rules (Baldwin, 1992; Elsbach, Barr, & Hargadon, 2005). Like relational schemas, TMSs develop through intensive interaction as team members negotiate expertise claims and establish information exchange relationships (Wegner, 1987).

In repeat collaboration it is easy to see how a TMS could develop into a static representation of who knows what that would suppress idea generation. We think this would be the case particularly for knowledge related to previously disclosed and advocated ideas. Our reasoning is that in initial projects team members are likely to disclose and advocate for a variety of ideas. Because the team cannot pursue all of these ideas, it carries a portfolio of ideas that have been publicly advocated for, discussed, and considered but not pursued. To the extent that a portfolio of ideas is retained and valued, it will be protected from the introduction of new options. The existence of this kind of portfolio is likely to suppress idea generation processes in subsequent projects as team members bring up their earlier ideas again.

In addition, models of a team's own know-how and capabilities developed in prior collaborations will tend to limit consideration of ideas to the familiar. This is a form of self-typecasting

based on the notion that what the team has done before is what it is capable of doing. Teams with well-developed ideas of what team members know and know how to do may also experience less frequent or less effective updating of knowledge of who knows what—a form of reciprocal typecasting—that keeps the variety of possible ideas static. All in all, the influence of repeat collaboration on idea generation should be negative.

Proposition 2: Repeat collaboration suppresses the diversity of idea generation in creative project teams.

Repeat Collaboration and Disclosure/Advocacy

Disclosure and advocacy processes are supposed to facilitate the exchange of ideas between team members and further their development through advocacy and interaction. In repeat collaboration teams have preexisting task-related mental models of disclosure and advocacy that create predispositions and expectations about the kinds of actions to be taken, such as who will disclose ideas and how vigorously they will advocate for them. Task-related mental models include scenarios for timing of disclosure and advocacy (e.g., do team members disclose as ideas arise, take turns, or disclose simultaneously?), contingencies for self-censorship, and the influence of roles and status on advocacy. In the presence of these models, the set of ideas disclosed and advocated for will be more constrained than it would be in a team newly developing its distributed cognitive structures.

Studies of task-related information processing models suggest that team members are more likely to disclose, advocate for, and discuss options that are shared among team members (Gigone & Hastie, 1993; Gruenfeld, Mannix, Williams, & Neale, 1996; Stewart & Stasser, 1995; Wittenbaum, Hubbell, & Zuckerman, 1999). This collective bias means that team members will be more likely to disclose and advocate for ideas related to prior projects that are shared, and less likely to mention ideas that are not related to prior work (Wittenbaum, 2003). Disclosing and discussing ideas that are already shared increases confidence in them and gives greater weight to advocacy (Gigone & Hastie, 1993). At its most basic, this is because when ideas are shared, the group is less likely to believe that the ideas are tainted by recall errors or process losses. Shared ideas will also be preferred because of what Wittenbaum et al. (1999) call "mutual enhancement"—the tendency of team members to positively evaluate each other when discussions are based on shared information. The level of consensus within the group further biases disclosure and advocacy because decisions made in teams where there is strong consensus are biased toward ideas received early in the process so that disclosure and advocacy are often cut off prematurely (Schulz-Hardt, Jochims, & Frey, 2002).

This stream of research challenges the idea that when little information is disclosed, creative teams will seek more. Instead, creative teams with established disclosure and advocacy models will be more likely to stick with what they already know. They will be less likely to disclose or advocate for ideas that might be relevant to the project but that do not conform to expectations. This could occur even in teams where it is the norm to disclose and contend over multiple ideas; there could still be task conflict over a reduced set of ideas. In extreme cases teams may exhibit a "not invented here" bias or various forms of self-censorship (Cohen & Levinthal, 1990; Williams, 2002; Wittenbaum, 2003).

Team-related mental models governing information exchange influence disclosure and advocacy. Research shows that established teams with accurate TMSs have more routine processes for specific tasks (Austin, 2003; Brandon & Hollingshead, 2004; Faraj & Sproull, 2000; Lambert & Shaw, 2002; Levesque et al., 2001; Lewis, Lange, & Gillis, 2005; Liang et al., 1995; Palazzolo, 2005). Team members know what they are responsible for encoding and retaining, where to go for help, and how to get it without a lot of discussion, disclosure, or advocacy. Coding schemes are well known. Autonomy increases and interaction decreases. Established relational schemas (political alliances, deference, friendship, relationship conflict) also help routinize patterns of interaction.

Disclosure of and advocacy for new ideas (Langfred, 2004) in repeat collaborations may become less frequent as team members cede responsibility for parts of the problem to trusted colleagues and monitor them less. Because team members monitor each other less, they are

less likely to discover this type of process loss (Katz, 1982). Detailed static knowledge of who knows what might further lead collaborators to anticipate responses, rather than disclosing ideas, advocating for them, and soliciting negotiation (Rico et al., 2008). Teams with strongly established information exchange processes may be more likely to "collectively recognize functional similarities and underlying principles" (Lewis et al., 2005: 585) in new tasks and, thus, more likely to map prior models onto new projects, obscuring differences between them. Lambert and Shaw (2002) conclude that the resulting lack of fit between information exchange processes and a novel task will increase failure to disclose information, requirements, and insights that do not conform to existing models. Established information exchange process structures among repeat collaborators are likely to reduce the number and variety of ideas disclosed and advocated for.

Proposition 3: Repeat collaboration suppresses disclosure of and advocacy for new ideas in creative project teams.

Repeat Collaboration and Convergence

Convergence processes involve negotiating between and reconciling the various options for action that the team brings forward in the disclosure and advocacy process. Effective convergence processes enable a team to narrow down the set of options disclosed and advocated for. Whereas successful disclosure and advocacy make individual ideas more attractive, convergence deals with the set of options and, thus, has as much with what not to do as with a final positive choice. Because it involves negotiation and reconciliation of competing choices, convergence will seldom produce well-structured solutions based on total consensus and completely defined action plans. More commonly it will produce shared objectives and other boundary objects that guide distributed action and, hence, lead to coherent outcomes (Star, 1989).

Repeat collaboration influences convergence through team-related mental models, such as TMSs and relational schemas, which reflect a team's beliefs about its own identity and capability. In convergence a team has to reconcile pressures for novelty and market utility with its own potential for executing the necessary actions. In a new team, where the team's ability to execute is uncertain, the team may tend to focus the convergence process on novelty and how users will receive the project, since it has no established knowledge of its capabilities. New teams can only reduce uncertainty by working hard to find a course of action that will produce something more certainly novel and appealing to the market. Repeat collaboration gives teams greater certainty about their ability to execute some options and, thus, adds an element of certainty that offsets the ambiguity associated with novelty and market needs. If a team produces an idea that it is novel enough, with enough appeal to a market and that it thinks it will be good at executing, the team can more easily negotiate commitments to the associated course of action. When a team has models of what it is capable of, we think convergence will tend to favor options that team members believe are consistent with those capabilities, if for no other reason than that doing so will allow the team to benefit from its investment in those capabilities. A team's mental models of its own identity and capability will thus be associated with satisficing and other "fast and frugal" selection models (Browne & Pitts, 2004; Newell, Weston, & Shanks, 2003; Todd & Gigenrenzer, 2001) that may lead the team to adopt courses of action that are good enough rather than optimal.

Inertia in task-related mental models will make convergence less effective. An important point to make here is that many different types of convergence processes can be effective, depending on context. For example, relegating convergence tasks to a leader may help teams converge on superior creative solutions under some contexts, whereas other contexts may be better served by processes that structure the task as one of extensive discussion of a range of alternatives, resolved only through consensus. Because nonroutine changes in context favor adaptive behavior (Waller, Gupta, & Giambatista, 2004), mental model inertia that leads teams to favor one type of process over others can limit the effectiveness of convergence processes. Repeat collaboration will tend to make teams less adaptive in convergence processes.

The effects of repeat collaboration on convergence build with the effects of repeat collaboration on the earlier creative abrasion processes. If repeat collaboration limits the kinds and num-

bers of ideas generated, disclosed, and advocated for, and particularly if the options produced tend toward the familiar, creative teams will have fewer and more familiar options, facilitating fast and frugal choices that draw on existing capabilities and are amenable to familiar convergence processes. In a team where repeat collaboration is strong, the team should be more likely to converge on a course of action from this limited choice set than to generate, disclose, and advocate for additional unfamiliar ideas.

Proposition 4: Repeat collaboration makes creative project teams more likely to converge on familiar objectives and courses of action than on unfamiliar ones.

FACTORS AFFECTING REPEAT COLLABORATION AND CREATIVE ABRASION

To manage the effects of repeat collaboration, teams must find ways to restructure and renew the team mental models at the heart of the problem, ways to moderate the negative relationships between repeat collaboration and the initial elements of creative abrasion, or ways to improve creative processes directly. While space does not permit us to develop a complete catalog of the factors that might accomplish these goals, the factors that we previously recognized as making repeat collaboration stronger are an obvious place to start. We therefore discuss ways of managing team composition, project selection, and project team behavior in order to mitigate the effects of team mental models carried forward from earlier projects.

Influencing the Strength of Repeat Collaboration: Outsider Entry

The hallmark of repeat collaboration is that insiders work together on multiple projects. The most obvious response to inertia is therefore to alter team composition by introducing newcomers into the team. Although we might expect turnover of personnel to have an impact on repeat collaboration, bringing new people in does not necessarily alter the nature or content of the team mental models that define repeat collaboration (Lewis et al., 2007; Liang et al., 1995). As we noted above, there is evidence that newcomers are often socialized into preexisting team mental models. Once we realize that turnover per se is not sufficient, the question becomes, "What kinds of turnover lead to restructuring and therefore facilitate creative abrasion?"

Team mental models will presumably be more inert if an entire team comes to the new project intact and will be less inert if more team members are new. However, since participation in creative project teams, as defined here, is voluntary, it is probable that turnover will weed out team members who experience high levels of relationship conflict, lack of trust, or reduced status. If dissenting, abrasive team members exit, the level of cohesiveness and commitment to preexisting cognitive structures is likely to increase. If there is a core of repeat collaborators familiar with each other, even a small minority may be able to strongly influence newcomers to "buy into" existing mental models (Lewis et al., 2005). Replacing one functional expert with another who has the same skills is unlikely to significantly restructure mental models because existing schemas will apply. The likelihood of restructuring will also be less if newcomers have preexisting relationships with returning team members. A friend or subordinate recruited to join an ongoing team for a new project may be less likely to challenge the status quo.

In contrast, replacement is more likely to be disruptive and generative if newcomers are true outsiders who bring new knowledge bases to the team, do not defer to old-timers, and have to construct new relationships with the existing team. Lack of deference, new knowledge, and new relationships will make it more difficult for existing team members to simply apply existing relational schemas (Baldwin, 1992). For example, when Bob the graphic designer replaces Linda the programmer, existing scripts are less likely to be applied than when Mary the programmer replaces Linda. This suggests that the "outsider-ness" of new members will be likely to lead to restructuring in both content- and process-related cognitive structures because the team will need to adjust its ideas of who knows what, how knowledge bases fit together, and how knowledge is encoded, stored, and retrieved. Outsiders will be more likely to have their own ideas about problems and solutions, as well as their own ideas concerning how ideas should be generated. They will have connections to outside sources that are new to the team

and presumably will operate under different expectations as to what a good idea is and how to converge on a desirable course of action.

Proposition 5: The degree to which new team members are outsiders is positively associated with the restructuring of team mental models.

Moderating the Effects of Repeat Collaboration: Project Charter Interventions

We noted earlier that prior project success and project similarity increase the chances of repeat collaboration (Schwab & Miner, 2008). This implicates the choice of which project to pursue as a factor that moderates the relationships between repeat collaboration and creative abrasion processes. Up to this point we have assumed that project teams have complete freedom of action in choosing which projects to pursue. This is not always true—creative project teams are often responsible to project managers and resource providers who dictate the broad outlines of a project's problem space (Schwab & Miner, 2008). In such cases it is possible for project managers to impose novel project charters on teams, where a project charter is understood to establish the boundaries of the problem-solving space, without proposing the details of problems or solutions. Examples of project charter interventions are ones that require a team to define problems and to develop solutions using new technologies, solutions for new markets, or solutions involving new applications of expertise.

Being directed into an unfamiliar problem space will not immediately alter the cognitive structures that constitute repeat collaboration, but it is likely to loosen the grip of those structures on idea generation, disclosure, and advocacy and convergence processes. Because creative abrasion is simultaneously a structuration process, factors that moderate the effects of repeat collaboration may contribute to restructuring, but this is more relevant for future projects than the current one. Our immediate concern is with the moderating effects of charter interventions.

Applying existing structures to a novel problem space will tend to reduce the impact of repeat collaboration on idea generation. Existing team mental models concerning freedom of action, search scenarios, effort, and requisite variety will be exposed to a novel domain of knowledge, making it possible for teams to produce novel ideas. Teams will be able to think along the same lines only by imperfect analogy, which is likely to produce additional unfamiliar ideas. Mental models of who knows what may not shift, but the problem of how to relate what is known to the new charter will stimulate new exploration and sensemaking.

Generating more ideas about how to define and solve the problems of a novel charter may, in turn, increase disclosure and advocacy. A new charter, in and of itself, would be unlikely to alter existing team mental models of how and when ideas were disclosed and advocated for, but it might change the mix of ideas, who had them, how they were arrived at, and how team members would know which were important. Thus, while new ideas that are shared by team members are still more likely to be disclosed and advocated for, at least there is the opportunity for novel options to be disclosed. In addition, when faced with an unfamiliar situation, where it is not clear who the experts are, teams may interact more in the process of disclosing ideas and advocating for them.

Project charter interventions may not alter a team's mental models of its own capabilities, but it will make the value of those capabilities less certain. This will move the team back toward the state where convergence has to focus more on novelty and market utility than on team capability. While teams will therefore be less likely to satisfice, it is difficult to say whether they will be more or less likely to adopt a different, more appropriate convergence model than their previously preferred one.

Proposition 6: Project charter interventions moderate the relationships between repeat collaboration and creative abrasion processes. The negative effects of repeat collaboration on creative abrasion are weaker when a project charter intervention requires the team to engage with new technologies, markets, or applications.

Direct Influence on Creative Abrasion Processes: Process Interventions

The third factor we associated with the strength of repeat collaboration has to do with

the switching costs associated with identifying, unfreezing, and restructuring team mental models in order to change behavior. Project managers and creative teams sometimes deliberately try to change behavior by deploying process interventions. There is a significant body of literature that advocates such methods as brainstorming, wide-ranging external search, benchmarking, and experimentation (Amabile, 1997; Leonard & Swap, 1999; Nonaka, 1994). These techniques are intended to enhance creative processes by promoting reflection, opening teams to outside ideas, and helping teams execute better versions of creative processes. They operate directly on the creative processes and are carried out by existing team members, without trying to directly alter team mental models. The intention of process interventions usually is for team members to learn better models for creative processes by doing them, but the changes effected are often temporary. When team mental models are highly inert, teams are likely to revert to internalized ways of behaving once the intervention ends. Process interventions can produce a burst of idea generation, more complete disclosure and advocacy, or use of a novel convergence strategy, without fundamentally affecting the team's underlying mental models.

This does not mean that process intervention is not effective, but it does suggest that it does not necessarily change structure as much as many team process consultants would hope. Although we expect that most process interventions work as intended, they sometimes have adverse effects on process. Interventions can be viewed as intrusive, interrupting a team's work flow, so team members become hostile. Process interventions can also lead teams to focus more on process than on the quality of the ideas generated, disclosed, and advocated for. They may lead to accelerated or delayed convergence. Process interventions, like charter interventions, may contribute to future restructuring, but the effects on team mental models (as opposed to the effects on the targeted creative process) are unlikely to be immediate. Because process interventions address the symptom (i.e., ineffective creative abrasion) rather than the underlying team mental models that hinder creativity in the long run, they should influence creative abrasion processes independently of repeat collaboration.

Proposition 7: Process interventions influence creative abrasion processes independently of the negative effects of repeat collaboration.

CONCLUSION

Studies of project team processes have made considerable progress in enhancing our understanding of what happens inside single projects but have not given much attention to project streams. The first contribution of this paper is to recognize that many creative projects are parts of project streams connected by repeat collaboration among team members. Repeat collaboration is a phenomenon that existing categorizations of organizing, such as project team, work team, ad hoc organization, and project-based organization, have obscured. By challenging the assumption that creative projects should always be viewed as discrete events, this paper makes it possible to recognize the risks that repeat collaboration poses for team creativity.

We have also proposed that whether or not a team effectively enacts the creative abrasion sequence depends in large part on the strength of repeat collaboration, defined in terms of the inertia of team mental models carried forward from prior projects. Carrying forward mental models from one project to the next can diminish team creativity by suppressing creative abrasion processes. We have developed our theory of how and why this happens by combining multiple views of social cognition: structuration theory, team mental model theory, and creativity theory. Combining ideas like creative abrasion and team mental models with structuration's emphasis on inertia allows us to show the connection between repeat collaboration and the processes that constitute creative abrasion.

In doing so we have emphasized the effects of repeat collaboration on all three of the components of creative abrasion: idea generation, disclosure/advocacy, and convergence processes. We have taken this approach, rather than concentrating on the constructs that have been popular in creativity research (such as the diversity of knowledge, information sharing, task conflict, or boundary objects), because what we are proposing is essentially a theory of weak effects. Because even partial suppression of any of these three processes could be damaging to creative performance, we have tried to develop a

more general theory of a system of processes in which action contributes to structure, which, in turn, guides future action. We think that the constructs scholars have introduced in prior innovation and creativity research can be integrated into the framework we propose if in future research scholars also see the problem of creative team performance as involving a complex system of action and structuration.

In this paper we have tried to attend simultaneously to the enduring consequences of having learned mental models and the possibilities for plasticity implied by the belief that learning is always possible. We regard efforts to improve creative abrasion processes or to restructure preexisting team mental models as necessary periodic disruptions of structures that quickly regain their inertia. Repeat collaborators who stay together over many projects would need to go through difficult restructuring interventions repeatedly in order to keep creative abrasion vital. The interventions we propose for managing repeat collaboration's negative effects are examples that both practical and theoretical reasons suggest should enhance creative abrasion. As we noted previously, we think that there are many other interventions that have the potential to combat the effects of repeat collaboration, opening the door to important future research.

Just as the means for change we propose are not a complete catalog, we have to recognize that repeat collaboration is not the only source of inertia in creative team mental models. Porac et al. (2004) and Uzzi and Spiro (2005) have proposed that creative teams that are embedded in small worlds in which all potential collaborators are connected by direct or indirect social ties are less likely to develop innovative ideas, in part because the variety of mental models enacted in such a context is likely to be small. Even in a project team made up of first-time collaborators, mental models and schemas inherited from the environment will tend to be homogeneous and inertial. Such small worlds represent an embedding layer of action and structure in which many creative teams exist. Environments that are the reverse of the stultifying small world also exist. Hargadon and Sutton (2000) and Schilling (2008) have described how IDEO and other design firms create and sustain "expansive world" environments for idea generation and exchange.

Our theory rests on the assumption that while creativity is determined by team processes, it is valued in the marketplace. If we do not attend to market outcomes, we can easily be distracted by measures of performance such as speed or efficiency that may not be related to market success. These kinds of performance are driven primarily by execution after creative abrasion, a distinction that is important because it could be argued that teams of repeat collaborators are likely to become more efficient at managing the details of execution, and therefore more likely to have successful creative projects. We would agree with this reasoning if we were talking about a stable work environment. In creative projects, however, the literature suggests that teams of efficient repeat collaborators might actually be more susceptible to process losses (Lambert & Shaw, 2002; Waller et al., 2004) because taken-for-granted details would "slip through the cracks" since trust reduces monitoring in favor of emphasis in novel elements. Although teams of repeat collaborators working on derivative projects might be more efficient, the outcomes would not necessarily be more creative or more effective. The relationship between repeat collaboration and execution phase performance in creative projects is a promising area for future research.

Because we acknowledge that user judgments drive performance, we must also recognize that markets for creative products are widely varied. Avant-garde artistic projects and cutting-edge science are often addressed to small audiences, but this does not mean they have less potential for success than projects aimed at mass markets. In both types of audiences, blockbusters are often followed by flops (Caves, 2000). While a blockbuster and bust pattern would be consistent with our theory, we intend the theory to suggest that performance suffers more frequently at quotidian levels of success. The message of this theory is that repeat collaboration makes it more difficult to reproduce even moderate creative success and makes major successes even less likely than they would ordinarily be.

Our theory has implications for the practice of project managers and resource providers. The most salient of these is that if repeat collaboration matters, trying to transfer lessons learned into established teams through training or briefing (which has been the thrust of most project-

based learning research) would only moderate the effects of repeat collaboration on creative abrasion. Transfer of lessons learned would be more likely to occur if managers could facilitate true outsider entry *and* accept the disruption that is likely to accompany it. To promote creativity resource providers and project managers must recognize their own tendencies toward inertia (Schwab & Miner, 2008). They must balance exploitation of established teams against the need to make new discoveries and break new ground (March, 1991). On the exploitation side, favoring well-established teams could be beneficial if teams could overcome their own inertia just enough to stimulate creative abrasion without eroding the efficiency of repeated collaboration. On the exploration side, the challenge is greater. How can managers and resource providers manage context in ways that encourage creative abrasion when they themselves are vulnerable to inertia? If creative abrasion matters in project teams, does that mean that every project team should be created from scratch? Are there better ways to renew cognitive structures in teams with histories of repeat collaboration? How much creative abrasion and how much restructuring are necessary? The possibilities for research in this area are very wide ranging.

Finally, our theory has some limitations. Its scope is limited to project teams intended to produce unique creative outcomes. Although we recognize that teams are chartered by managers and resource providers, we have not addressed the question of whether or how assignment of employees to creative projects inside organizations would alter this theory. Although we expect that the projection of organizational mental models onto a new project would have the same effects as a small world, we have not considered what it would mean if participants were not self-selecting. While our theory should apply to creative teams in organizations, it does not apply to permanent work teams, since the routine tasks of such teams mean that idea generation, disclosure, and advocacy are not as critical.

What we propose is that team mental models persist in repeat collaboration. The persistence of inert team mental models along a stream of projects should reduce the effectiveness of creative abrasion processes that are necessary for creative project performance. Repeat collaboration therefore stands in a mediated negative relationship with creative project team performance. What we propose is not that teams of talented, motivated people are rendered incapable of creative insight when they work together repeatedly but, rather, that enduring, internalized cognitive structures carried forward from prior projects constrain the processes that turn creative insights and ideas into successful creative outcomes.

REFERENCES

Amabile, T. M. 1997. Motivating creativity in organizations: On doing what you love and loving what you do. ***California Management Review,*** 40(1): 39–58.

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. 1996. Assessing the work environment for creativity. ***Academy of Management Journal,*** 39: 1154–1184.

Ancona D. G., & Caldwell, D. F. 1992. Demography and design: Predictors of new product team performance. ***Organization Science,*** 3: 321–341.

Argyris, C., & Schön, D. A. 1978. ***Organizational learning: A theory of action perspective.*** Reading, MA: Addison-Wesley.

Atkinson, P., Batchelor, C., & Parsons, E. 1998. Trajectories of collaboration and competition in a medical discovery. ***Science Technology & Human Values,*** 23(3): 259–284.

Audia, P. G., & Brion, S. 2007. Reluctant to change: Self-enhancing responses to diverging performance measures. ***Organizational Behavior and Human Decision Processes,*** 102: 255–269.

Austin, J. R. 2003. Transactive memory in organizational groups: The effects of content, consensus, specialization and accuracy on group performance. ***Journal of Applied Psychology,*** 88: 866–878.

Baldwin, M. W. 1992. Relational schemas and the processing of social information. ***Psychological Bulletin,*** 112: 461–484.

Barley, S. R. 1986. Technology as an occasion for structuring: Evidence from observations of CT scanners and the social order of radiology departments. ***Administrative Science Quarterly,*** 31: 78–108.

Bateson, G. 1972. ***Steps to an ecology of mind.*** New York: Ballantine.

Bettenhausen, K. L., & Murnighan, J. K. 1991. The development of an intragroup norm and the effects of interpersonal and structural challenges. ***Administrative Science Quarterly,*** 36: 20–36.

Boland, R. J., Jr., Lyytinen, K., & Yoo, Y. 2007. Wakes of innovation in project networks: The case of digital 3-D representations in architecture, engineering, and construction. ***Organization Science,*** 18: 631–652.

Brandon, D. P., & Hollingshead, A. B. 2004. Transactive memory systems in organizations: Matching tasks, expertise, and people. ***Organization Science,*** 15: 633–644.

Browne, G. J., & Pitts, M. G. 2004. Stopping rule use during

information search in design problems. ***Organizational Behavior and Human Decision Processes,*** 95: 208–224.

Cannon-Bowers, J. A., Salas, E., & Converse, S. A. 1993. Shared mental models in expert team decision making. In N. J. Castellan, Jr. (Ed.), ***Individual and group decision making: Current issues:*** 221–246. Hillsdale, NJ: Lawrence Erlbaum Associates.

Caves, R. E. 2000. ***Creative industries: Contracts between art and commerce.*** Cambridge, MA: Harvard University Press.

Chen, M.-H. 2006. Understanding the benefits and detriments of conflict on team creativity process. ***Creativity and Innovation Management,*** 15: 105–116.

Chen, M.-H., & Chang, Y.-C. 2005. The dynamics of conflict and creativity during a project's life cycle: A comparative study between service-driven and technology-driven teams in Taiwan. ***International Journal of Organizational Analysis,*** 13: 127–151.

Cohen, W. M., & Levinthal, D. A. 1990. Absorptive capacity: A new perspective on learning and innovation. ***Administrative Science Quarterly,*** 35: 128–152.

Delmestri, G., Montanari, F., & Usai, A. 2005. Reputation and strength of ties in predicting commercial success and artistic merit of independents in the Italian feature film industry. ***Journal of Management Studies,*** 42: 975–1002.

Drazin, R., Glynn, M. A., & Kazanjian, R. K. 1999. Multilevel theorizing about creativity in organizations: A sensemaking perspective. ***Academy of Management Review,*** 24: 286–307.

Dunn, A. 2004. Welcome to Planet Pixar: How the pixel-packing upstart became an animation superpower and left Disney in the dust. ***Wired,*** 12(6): http://www.wired.com/wired/archive/12.06/pixar.html, accessed April 9, 2009.

Elsbach, K. D., Barr, P. S., & Hargadon, A. B. 2005. Identifying situated cognition in organizations. ***Organization Science,*** 16: 422–436.

Faraj, S., & Sproull, L. 2000. Coordinating expertise in software development teams. ***Management Science,*** 46: 1554–1568.

Ford, C. M. 1996. A theory of individual creative action in multiple social domains. ***Academy of Management Review,*** 21: 1112–1143.

Ford, C. M., & Sullivan, D. M. 2004. A time for everything: How the timing of novel contributions influences project team outcomes. ***Journal of Organizational Behavior,*** 25: 279–292.

Gersick, C. J. G. 1988. Time and transition in work teams toward a new model of group development. ***Academy of Management Journal,*** 31: 9–42.

Gersick, C. J. G., & Hackman, J. R. 1990. Habitual routines in task-performing groups. ***Organizational Behavior and Human Decision Processes,*** 47: 65–97.

Giddens, A. 1976. ***New rules of sociological method: A positive critique of interpretive sociologies.*** New York: Basic Books.

Gigone, D., & Hastie, R. 1993. The common knowledge effect: Information sharing and group judgment. ***Journal of Personality and Social Psychology,*** 65: 959–974.

Gilson, L. L., & Shalley, C. E. 2004. A little creativity goes a long way: An examination of teams' engagement in creative processes. ***Journal of Management,*** 30: 453–470.

Goffman, E. 1974. ***Frame analysis: An essay on the organization of experience,*** New York: Harper & Row.

Grabher, G. 2004. Temporary architectures of learning: Knowledge governance in project ecologies. ***Organization Studies,*** 25: 1491–1514.

Granovetter, M. 1985. Economic action and social structure: The problem of embeddedness. ***American Journal of Sociology,*** 91: 481–510.

Gruenfeld, D., Mannix, E. A., Williams K. Y., & Neale, M. A. 1996. Group composition and decision making: How member familiarity and information distribution influence process and performance. ***Organizational Behavior and Human Decision Processes,*** 67: 1–15.

Guimerà, R., Uzzi, B., Spiro, J., & Nunes Amaral, L. A. 2005. Team assembly mechanisms determine collaboration network structure and team performance. ***Science,*** 308: 697–702.

Hargadon, A., & Sutton, R. I. 2000. Building an innovation factory. ***Harvard Business Review,*** 78(3): 157–174.

Harrison, D. A., Mohammed, S., McGrath, J. E., Florey, A. T., & Vanderstoep, S. W. 2003. Time matters in team performance: Effects of member familiarity, entrainment and task discontinuity on speed and quality. ***Personnel Psychology,*** 56: 633–669.

Hinds, P. H., Carley, K. M., Krackhardt, D., & Wholey, D. 2000. Choosing work group members: Balancing similarity, competence and familiarity. ***Organizational Behavior and Human Decision Processes,*** 81: 226–251.

Hirshberg, J. 1998. ***The creative priority: Driving innovative business in the real world.*** New York: Harper Business.

Jehn, K. A., & Mannix, E. A. 2001. The dynamic nature of conflict: A longitudinal study of intragroup conflict and group performance. ***Academy of Management Journal,*** 44: 238–252.

Kang, H.-R., Yang, H.-D., & Rowley, C. 2006. Factors in team effectiveness: Cognitive and demographic similarities of software development team members. ***Human Relations,*** 59: 1681–1710.

Katz, R. 1982. The effects of group longevity on project communication and performance. ***Administrative Science Quarterly,*** 27: 81–104.

Klimoski, R., & Mohammed, S. 1994. Team mental model: Construct or metaphor? ***Journal of Management,*** 20: 403–438.

Kratzer, J., Leenders, R. T. A. J., & van Engelen, J. M. L. 2004. Stimulating the potential: Creative performance and communication in innovation teams. ***Creativity and Innovation Management,*** 13: 63–71.

Lambert, M. H., & Shaw, B. 2002. ***Transactive memory and exception handling in high-performance project teams.*** CIFE Technical Report No. 137, Stanford University, Stanford, CA. Available at http://cife.stanford.edu/

online.publications/TR137.pdf, accessed December 21, 2008.

Langfred, C. W. 2004. Too much of a good thing? Negative effects of high trust and individual autonomy in self-managing teams. ***Academy of Management Journal,*** 47: 385–399.

Leonard, D. A., & Swap, W. C. 1999. ***When sparks fly: Igniting creativity in groups.*** Boston: Harvard Business School Press.

Leonard-Barton, D. 1992. Core capabilities and core rigidities: A paradox in managing new product development. ***Strategic Management Journal,*** 13: 115–125.

Levesque, L. L., Wilson, J. M., & Wholey, D. R. 2001. Cognitive divergence and shared mental models in software development project teams. ***Journal of Organizational Behavior,*** 22: 135–144.

Lewis, K., Belliveau, M., Herndon, B., & Keller, J. 2007. Group cognition, membership change, and performance: Investigating the benefits and detriments of collective knowledge. ***Organizational Behavior and Human Decision Processes,*** 103: 159–178.

Lewis, K., Lange, D., & Gillis, L. 2005. Transactive memory systems, learning and learning transfer. ***Organization Science,*** 16: 581–598.

Liang, D. W., Moreland, R., & Argote, L. 1995. Group versus individual training and group performance: The mediating role of transactive memory. ***Personality and Social Psychology Bulletin,*** 21: 384–393.

March, J. G. 1991. Exploration and exploitation in organization learning. ***Organization Science,*** 2: 71–87.

Mathieu, J. E., Heffner, T. S., Goodwin, G. F., Salas, E., & Cannon-Bowers, J. A. 2000. The influence of shared mental models on team process and performance. ***Journal of Applied Psychology,*** 85: 273–283.

Merton, R. K. 1968. The Matthew effect in science: The reward and communication systems of science are considered. ***Science,*** 159: 56–63.

Meyers, P. W., & Wilemon, D. 1989. Learning in new technology development teams. ***Journal of Product Innovation Management,*** 6: 79–88.

Murray, K. B., & Haübl, G. 2007. Explaining cognitive lock-in: The role of skill-based habits of use in consumer choice. ***Journal of Consumer Research,*** 34: 77–88.

Nelson, R. R., & Winter, S. G. 1982. ***An evolutionary theory of economic change.*** Cambridge, MA: Harvard University Press.

Newell, B. R., Weston, N. J., & Shanks, D. R. 2003. Empirical tests of a fast-and-frugal heuristic: Not everyone "takes-the-best." ***Organizational Behavior and Human Decision Processes,*** 91: 82–96.

Nonaka, I. 1994. A dynamic theory of organizational knowledge creation. ***Organization Science,*** 5: 14–37.

Palazzolo, E. T. 2005. Organizing for information retrieval in transactive memory systems. ***Communication Research,*** 32: 726–761.

Perretti, F., & Negro, G. 2007. Mixing genres and matching people: A study in innovation and team composition in Hollywood. ***Journal of Organizational Behavior,*** 28: 563–586.

Pinto, J. K., & Prescott, J. E. 1988. Variations in critical success factors over the stages in the project life-cycle. ***Journal of Management,*** 14: 5–18.

Podolny, J. M. 2005. ***Status signals: A sociological study of market competition.*** Princeton, NJ: Princeton University Press.

Polanyi, M. 1962. ***Personal knowledge: Towards a post-critical philosophy.*** London: Routledge and Kegan Paul.

Porac, J. F., Wade, J. B., Fischer, H. M., Brown, J., Kanfer, A., & Bowker, G. 2004. Human capital heterogeneity, collaborative relationships and publication patterns in a multidisciplinary scientific alliance: A comparative case study of two scientific teams. ***Research Policy,*** 33: 661–678.

Purser, R. E., Pasmore, W. A., & Tenkasi, R. V. 1992. The influence of deliberations on learning in new product development teams. ***Journal of Engineering and Technology Management,*** 9: 1–28.

Reagans, R., Zuckerman, E., & McEvily, B. 2004. How to make the team: Social networks vs. demography as criteria for designing effective teams. ***Administrative Science Quarterly,*** 49: 101–133.

Rico, R., Sanchez-Manzanares, M., Gil, F., & Gibson, C. 2008. Team implicit coordination processes: A team knowledge-based approach. ***Academy of Management Review,*** 33: 163–184.

Schilling, M. A. 2008. ***Strategic management of technological innovation*** (2nd ed.). New York: McGraw-Hill/Irwin.

Schulz-Hardt, S., Jochims, M., & Frey, D. 2002. Productive conflict in group decision making: Genuine and contrived dissent as strategies to counteract biased information seeking. ***Organizational Behavior and Human Decision Processes,*** 88: 563–586.

Schwab, A., & Miner, A. S. 2008. Learning in hybrid-project systems: The effects of project performance on repeated collaboration. ***Academy of Management Journal,*** 51: 1117–1149.

Skilton, P. F. 2003. Portable integration expertise as the foundation of flexible integration capability. ***International Journal of Organizational Analysis,*** 11: 319–339.

Standifer, R., & Bluedorn, A. 2006. Alliance management teams and entrainment: Sharing temporal mental models. ***Human Relations,*** 59: 903–927.

Star, S. L. 1989. The structure of ill-structured solutions: Boundary objects and heterogeneous distributed problem solving. In L. Gasser & M. N. Huhns (Eds.), ***Distributed artificial intelligence,*** vol. II: 37–54. London: Pitman.

Stewart, D. D., & Stasser, G. 1995. Expert role assignment and information sampling during collective recall and decision making. ***Journal of Personality and Social Psychology,*** 69: 619–628.

Todd, P. M., & Gigenrenzer, G. 2001. Putting naturalistic decision making into the adaptive toolbox. ***Journal of Behavioral Decision Making,*** 14: 381–382.

Uzzi, B., & Spiro, J. 2005. Collaboration and creativity: The

small world problem. ***American Journal of Sociology,*** 111: 447–504.

Waller, M. J., Gupta, N., & Giambatista, R. C. 2004. Effects of adaptive behaviors and shared mental models on control crew performance. ***Management Science,*** 50: 1534–1544.

Wegner, D. M. 1987. Transactive memory: A contemporary analysis of the group mind. In B. Mullen & G. R Goethals (Eds.), ***Theories of group behavior:*** 185–208. New York: Springer-Verlag.

Weick, K. E. 1979. ***The social psychology of organizing.*** Reading, MA: Addison-Wesley.

Whitley, R. 2006. Project based firms: A new organizational form or variations on a theme? ***Industrial and Corporate Change,*** 15: 77–99.

Williams, S. D. 2002. Self-esteem and the self-censorship of creative ideas. ***Personnel Review,*** 31: 495–504.

Wittenbaum, G. M. 2003. Putting communication into the study of group memory. ***Human Communication Research,*** 29: 612–623.

Wittenbaum, G. M., Hubbell, A. P., & Zuckerman, C. 1999. Mutual enhancement: Toward an understanding of the collective preference for shared information. ***Journal of Personality and Social Psychology,*** 77: 967–978.

Woodman, R. W., Sawyer, J. E., & Griffin, R. W. 1993. Toward a theory of organizational creativity. ***Academy of Management Review,*** 18: 293–321.

Wuchty, S., Jones, B. F., & Uzzi, B. 2007. The increasing dominance of teams in production of knowledge. ***Science,*** 316: 1036–1039.

Zuckerman, E. 2005. ***Do firms and markets look different? Repeat collaboration in the feature film industry.*** Working paper, Massachusetts Institute of Technology, Boston.

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