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First, get your feet wet: The effects of learning from direct and indirect experience on team creativity

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ABSTRACT

How does prior experience influence team creativity? We address this question by examining the effects of task experience acquired directly and task experience acquired vicariously from others on team creativity in a product-development task. Across three laboratory studies, we find that direct task experience leads to higher levels of team creativity and more divergent products than indirect task experience. Moreover, our results show that the difference in team creativity between direct and indirect task experience persists over time. Finally, our findings demonstrate that transactive memory systems fully mediate the effect of direct task experience on team creativity. Teams who acquired task experience directly are more creative because they develop better transactive memory systems than teams who acquired experience vicariously. We discuss how our findings contribute to understanding the effects of prior experience on team creativity, and the role of transactive memory systems in creative tasks.

Introduction

As an increasingly important tool that organizations use to get work done, groups and teams dominate the makeup of many organizations (Devine, Clayton, Philips, Dunford, & Melner, 1999; Kozlowski & Ilgen, 2006). Through their groups, organizations strive to maintain and enhance their effectiveness within rapidly changing environments. To successfully achieve this goal, organizational members need to develop ideas that are novel, useful, and appropriate (Amabile, 1996, 1997, 2000) while working within their teams – i.e., they need to be creative.

Prior research has highlighted the role of prior experience in enhancing team creativity. Some studies have demonstrated that prior experience leads to faster execution of creative ideas (Taylor & Greve, 2006) and allows individuals to recognize opportunities to be creative (Shane, 2000). Yet, other studies have suggested that prior experience narrows attention toward working solutions at the expense of new ones (Audia & Goncalo, 2007). In addition, no prior research has examined which team processes explain the relationship between different types of experience and team creativity, and whether any differential effects of types of experience persist over time.

This paper addresses this gap by investigating how and why different *types of experience* affect team creativity. We distinguish between *direct* and *indirect* experience, and examine their effects on creativity in product-development settings. Across industries, companies whose employees quickly develop novel, in-demand products are likely to achieve greater success than companies that introduce more "run-of-the-mill" products (Brown & Eisenhardt, 1995). Thus, for many organizations, product development is a potential source of competitive advantage (e.g., Brown & Eisenhardt, 1997; Clark & Fujimoto, 1991).

An examination of the relationship between prior experience and team creativity is important, as more teams in organizations attempt to learn indirectly from the experience of others through programs that promote the transfer of best practices and the like (e.g., see Jensen & Szulanski, 2007) instead of acquiring experience directly. Indirect experience is valuable because it provides teams with access to knowledge about which they do not have direct experience. Both direct and indirect experience have been shown to enhance performance outcomes such as quality and speed (e.g., Argote, Gruenfeld, & Naquin, 2001; Edmondson, 1999; Ellis et al., 2003; Wilson, Goodman, & Cronin, 2007). However, direct and indirect experience may have different effects on a team's ability to generate new knowledge and find new solutions to a problem. For example, a team that adopts a new technology developed by another team may not have the understanding and

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tacit knowledge about possible alternative solutions that were tested during the development process.

We suggest that team creativity varies based on the type of experience considered, and that the development of transactive memory systems (TMS) among team members explains these differential effects. Transactive memory has been defined as the cooperative division of labor for learning, remembering and communicating team knowledge (e.g., Hollingshead, 1998; Lewis, 2003; Wegner, 1986, 1995). A TMS system provides the team with a system for distributing and coordinating knowledge based on members' areas of expertise (Gibson, 2001; Hinsz, Tindale, & Vollrath, 1997). Teams with well-developed TMS have been shown to perform better than teams lacking them (e.g., Austin, 2003; Hollingshead, 2000; Lewis, 2003; Liang, Moreland, & Argote, 1995; Moreland, Argote, & Krishnan, 1996; Moreland & Myaskovsky, 2000). Although the benefits of TMS have been documented for task performance dimensions such as speed or accuracy, no prior work has tested whether those benefits extend to creativity. Drawing on prior research on TMS and group creativity, we argue that the type of prior experience team members acquire affects the development of TMS which, in turn, influences team creativity.

Different types of prior experience

Groups and organizational units learn directly from their own experience and indirectly from the experience of others (Darr, Argote, & Epple, 1995; Levitt & March, 1988). Our concept of *direct task experience* is similar to the concept of learning-by-doing found in the learning and product-development literatures (for a recent review of the learning literature see Argote & Todorova, 2007). Participants in the direct experience condition in our studies practice on a task similar and related to the one that they will be asked to perform as a team.

Our concept of *indirect* experience is similar to the concept of knowledge transfer (e.g., Argote & Ingram, 2000; Szulanski, 2000) and the concept of vicarious learning (Bandura, 1969, 1977). These terms refer to the process through which individuals or social units learn to perform activities by absorbing the experience of others. In our study, we define *indirect experience* as the process in which members gain experience at the task at hand by watching another team practice a similar and related task. We also consider the case of *no prior task experience* – situations in which team members lack experience relevant to the task at hand.

We examine the effects of these types of prior experience on two major dimensions of team creativity that are relevant to product development: the level of creativity and component divergence. The level of creativity categorizes products based on their novelty and originality, while component divergence categorizes products based on the extent to which they recombine elements and knowledge of existing products. These two creativity dimensions can be independent. A creative product can consist of new materials and technologies that the team has no experience working with (high on component divergence) or can result from combining known materials and technologies in an entirely new way (low on component divergence) (Gatignon, Tushman, Smith, & Anderson, 2002; Goncalo & Staw, 2006).

Background and hypotheses development

Prior experience and creativity level

Prior experience can stimulate creativity by improving the capacity of each individual member to create a product and/or by improving the capacity of the team to share and combine individual contributions to create a collective product. By gaining first-hand experience, teams can better understand the task requirements, learn from their mistakes and learn to better coordinate their activities. Direct experience with the task allows individuals to develop a transactive memory system. Further, transactive memory systems transfer from one task to a related one (Lewis, Lange, & Gillis, 2005). As noted by Kozlowski and Ilgen (2006, p. 85):

> When each team member learns in a general sense what other team members know in detail, the team can draw on the detailed knowledge distributed across members of the collective. The development of transactive memory involves the communication and updating of information members have about the areas of the other members' unique knowledge. (...) In this way, team members use each other as external memory aids, thereby creating a compatible and distributed memory system.

Teams with well-developed transactive memories know who is good at which tasks and who knows what. This knowledge enables team members to exchange ideas smoothly and to envision new combinations of subtasks that members could perform, thereby increasing their creativity. In addition, prior knowledge and experience are important sources for the creation of novel solutions and original activities (Conti, Coon, & Amabile, 1996; Ruscio, Whitney, & Amabile, 1998). Thus, we expect teams with direct task experience to be more creative than teams with no prior task experience.

We also expect teams with direct task experience to be more creative than teams with indirect experience. Both direct experience and indirect experience allow teams to adopt successful approaches to task performance. Members are more likely to be able to identify good and bad practices when they tried the task themselves. Acquiring experience directly provides less noisy data compared to the case of indirect experience, where identifying good and bad practices underlying the performance of others is complicated by behavioral and social biases of inference (Denrell, 2003; Levitt & March, 1988). Further, teams learning through indirect experience do not have opportunities to learn who is good at what and how to coordinate their activities to develop a transactive memory system. Therefore, direct task experience will be more valuable to teams interested in creating original and useful products than indirect experience. Thus, we predict:

Hypothesis 1. The level of team creativity will be significantly higher in the direct task experience condition than in the indirect task experience condition or the no prior task experience condition.

Through indirect task experience, groups accumulate information by observing other groups working together on a similar task. Such information provides the basis for vicarious learning and creative thinking. Groups have been found to learn from the experience of other groups (Kane, Argote, & Levine, 2005). Team members use indirect experience to better evaluate the consequences of specific actions and approaches to the task. Observing members of another team leads to improvements in performance without team members having to actually perform the task (Bandura, 1969, 1977). Teams whose members engage in vicarious learning can avoid costly errors and search effort and choose creativity–enhancing sequences of action and interactions based on what they learn from the experience of others. Therefore, we predict that:

Hypothesis 2. The level of team creativity will be significantly higher in the indirect task experience condition than in the no prior task experience condition.

Prior experience and component divergence

Prior research on creativity and innovation has distinguished between ideas that largely draw on prior knowledge and experience, and divergent ideas that depart significantly from the current knowledge trajectory, introducing new solutions that were not tried before (Audia & Goncalo, 2007; Benner & Tushman, 2003; Gatignon et al., 2002). Guilford (1959), for example, suggested the extent to which generated ideas deviate from one another as an indicator for creativity (i.e., flexibility). Similarly, the extent to which patented ideas deviate from an inventor's previous patents has served as an indicator for the creativity of the generated ideas (Audia & Goncalo, 2007). And the innovation literature distinguishes between continuous innovations that heavily build on the existing experience and knowledge base, and discontinuous innovations that significantly deviate from the existing knowledge trajectory (Mascitelli, 2000).

Accordingly, we consider the degree of component divergence for products. A product characterized by low component divergence builds upon existing knowledge and experience within a team, as when a team recombines working solutions into new ones. A product characterized by high component divergence, on the other hand, requires a completely new knowledge and experience base. The process of generating divergent products requires deep tacit knowledge (Nonaka & Takeuchi, 1995) and involves insight (Mascitelli, 2000). Innovators are commonly described as individuals who have "tacit foreknowledge of yet undiscovered things" (Polanyi, 1966, p. 23) and can "see" solutions without the ability to explain their vision (Mascitelli, 2000).

Direct experience gives group members the opportunity to experiment with the task and develop tacit knowledge and competencies. When working together on the task, team members develop shared and tacit norms and practices that facilitate coordination and creativity (Leonard & Sensiper, 2005; Mascitelli, 2000). By contrast, in the case of indirect experience, group members observe other groups practicing a task. In this case, group members do not have the opportunity to develop tacit knowledge or understanding of creativity-enhancing team interactions. They also have no opportunity to experiment with the task and learn from their mistakes. Thus, we predict:

Hypothesis 3. Component divergence of products created by teams will be significantly higher in the direct task experience condition than in the indirect task experience condition.

Because component divergence is defined in terms of divergence of products from previous solutions or ideas, this second dimension of creativity is only relevant for products of teams who acquired prior task experience either directly or indirectly. For the above mentioned reason, it is not possible to develop a hypothesis regarding the no prior experience condition.

The present research

We examine the effect of prior experience on team creativity in three laboratory studies. In Study 1 we distinguish between direct, indirect and no prior experience and test the effect of learning from different experience types on team creativity in a new product-development setting. In Study 2, we replicate the findings of Study 1, and test whether the effect of direct versus indirect experience on creativity is due to experience with the task or with team members. Further, we examine whether the influence of experience on team creativity is explained by the development of TMS. In Study 3, we investigate the persistence of the differential effects of types of experience on team creativity over time.

Study 1: The effects of prior experience on team creativity

Method

Participants

One hundred and eight undergraduate students (64% male; $M_{age} = 20$, $SD = 1.00$) participated in the study as part of their organizational behavior class. Participants were randomly assigned to teams of three members each, and teams were randomly assigned to one of three conditions. We had 12 teams (36 participants) in the direct task experience condition, 11 teams (33 participants) in the indirect experience condition, and 13 teams (39 participants) in the no prior task experience condition.

Procedure

About a month into the course, students participated in a 1-h long study. Three female experimenters conducted four sessions each in each condition. Experimenters were randomly assigned to conditions such that each experimenter conducted each of three experimental conditions at least once.

In each session, we divided participants into teams of three members. Members of the same team sat at the same table, such that they could easily work on the same task together. The exercise was divided into two parts. In Part I, we manipulated the type of prior experience. In Part II, we assessed team creativity by asking each team to develop *original* origami products.

Product-development task. Part I differed across the three experimental conditions. In the direct experience condition, team members were given the opportunity to gain task experience working together to develop origami products. They were given detailed instructions on how to build the products, including color pictures and thorough explanations, as well as materials to build origami cows and milk buckets. Teams had 8 min to create as many cows and milk buckets as they could. Aside from the paper-folding instructions, the instructions read:

> Build as many origami cows and milk buckets as you can: this is your chance to gain experience in building origami products. In order to use your time efficiently, you should build the products together and all of you should work on the product simultaneously. For example each member can specialize in building a part of the product or in a specific activity. A scenario where each member creates a whole cow is not possible. Again – you must cooperate in creating the origami products.

After gaining experience in building origami products as a team, participants were given 3 min to reflect on their performance and to describe three elements that made their team work well together and three elements that made the team work poorly together. Thus, team members had opportunities to learn from their direct experience about each other, about the task of building origami products, about who was good at which aspects of the task, and about how to coordinate their activities.

In Part I of the indirect experience condition, team members were shown an 8-min long video of another team working together to build an origami cow.[1] Participants were also given the "building origami cows and milk buckets" instructions. After watching the video, participants completed a brief questionnaire about the team they had watched. In particular, they were asked to describe features of the team that made the team members work successfully or poorly together. Participants within each team had 3 min to discuss

[1] We conducted a pilot study in which we videotaped three teams while they completed the first part of the study only. The team that most successfully created origami cows with contributions from all the team members was selected for the video used in the main study.

the questions with their team members and to complete the questionnaire together. We used the questionnaire to insure that members within each team had the opportunity to learn about the task and become comfortable with each other. When teams first come together members usually experience anxiety, uncertainty about norms and interpersonal conflict (Tuckman, 1965). Filling out the questionnaire together gave teams in the indirect experience condition a chance to work through some of these developmental issues before they began the task performance phase of the study. The questionnaire afforded participants in the indirect experience condition the same amount of time to discuss team performance as participants in the direct experience condition. Because teams in the indirect experience condition did not actually perform the task, however, they did not have opportunities to learn about who was good at what or about how to coordinate their activities.

In Part I of the no prior task experience condition, participants were shown an 8-min-long clip from the film "12 Angry Men." The clip showed a discussion among 12 jurors, who had to make a decision about the guilt of a young man in a murder case.[2] After watching the video, the participants completed a brief questionnaire about the group of people they had watched. Participants within each team had 3 min to discuss the questions with the other members and to complete the questionnaire together. In particular, they were asked to describe features of the group that made the jurors work successfully or poorly together. Thus, participants were not given any experience with the task or opportunities to learn who was good at which aspects of the task, but were given an opportunity to become comfortable with each other.

Once Part I was over, the experimenter collected the origami products built by the teams as well as the materials that had not been used in this first part of the exercise. Participants received new materials during Part II of the exercise, the product-development task. The instructions read:

> Your task is to develop as many creative prototypes as you can for a décor object. The products should be novel and original. They should also be recognizable, meaning similar to an existing entity (e.g., object, animal, plant). To do that, you have a kit of origami items. In order to use your time efficiently, you should build the products together and all of you should work on the product simultaneously. For example, each team member can work on a part of the product or specialize in a specific activity. A scenario where each member creates a whole product on his/her own is not possible.

To complete Part II of the study, each team was given an origami kit that included the following items: 20 sheets of colored origami paper, a role of scotch tape, a ruler, a set of eight colored markers, scissors, and glue. They were given 20 min to complete the task assigned to them in Part II. They were told that the team that developed the most creative products would be rewarded with $20.

Final questionnaire. After completing both Parts I and II of the study, participants completed a final questionnaire, which included measures of prior experience in building origami products or developing new products, manipulation checks, and demographic questions. The two questions used as manipulation checks stated: (1) "I observed another team that made origami products," and (2) "I worked together with my team to develop cow origami products."

Dependent measures

We included two main dependent measures in our study: the level of creativity and component divergence of products. The level of creativity was operationally defined by the creativity levels of the origami products that participants developed within their teams. All products were analyzed using a consensual assessment technique developed by Amabile (1983). Two independent judges who were blind to the research hypotheses rated the overall creativity of each origami product on a 5-point scale (1 = low to 5 = high). Specifically, the two judges independently evaluated each product based on the following dimensions: creativity, novel use of materials (e.g., cutting the paper or folding it in a unique way), novel association (e.g., unique or unusual association with existing products or objects), variation of materials used (e.g., different colors of origami papers, number of colors, originality), level of detail in the product(s) created, complexity (e.g., of the design or decoration) and display (i.e., how good it would look in a home or office).

The inter-rater agreements ranged from .78 to .90 for each dimension, indicating sufficient agreement levels.[3] ICC values across the different dimensions of creativity ranged from .64 to .81, and Cronbach's alpha values ranged from .78 to .89. A Cronbach's alpha of the entire scale was .92, indicating high levels of reliability. We averaged the evaluations of the two judges to create two creativity scores for each team: (1) the average creativity score of all created products (mean creativity) and (2) the creativity score for the most creative product created by each team (maximum creativity). We included maximum creativity since organizations and their managers are often interested in and select only the most creative product or idea teams can create. The analyses presented for this study and for our subsequent studies were initially conducted with both measures. There were no differences in the nature and significance of the results between the two sets of analyses in any of our studies. Thus, we only present the results of the analyses conducted with mean creativity as the dependent variable.

Component divergence of products was operationally defined as the extent to which participants combined parts of the products used in the "building origami cows and milk buckets" instructions (available to participants during Part I of the study) in new ways in the origami products they created within their teams during Part II. All products created by the teams in the direct and indirect task experience conditions were analyzed using a consensual assessment technique. The two independent judges who rated the creativity of each product also rated the extent to which products were recombinations of parts of other products on a 5-point scale (1 = low to 5 = high). Specifically, two items asked about the extent to which parts of the products used in the instructions were combined in different ways in the work products and were re-created for use in the work products. We reverse scored both items and created a single measure for component divergence by averaging them. A higher score indicated a more divergent product (i.e., a product that was different from the products created or seen during the training phase) while a lower score indicated that participants were recombining existing parts of the product. The inter-rater agreement was .94, indicating high agreement.

[2] We conducted a pilot study on a non-overlapping group of participants ($N = 42$) to test whether the videos used in the indirect and no prior task experience conditions influenced the emotional state of participants. In the pilot study, participants watched one of two video-clips: either the clip showing the team building origami products used in the indirect task experience condition, or the clip from "12 Angry Men" used in the no prior task experience condition. After watching the video clip, participants completed the Positive and Negative Affect Schedule (PANAS, Watson et al., 1988) to assess their mood, along with a few other filler questions unrelated to the study. Differences across the two experimental conditions for both positive- and negative-affect scores did not approach significance (both $ts < 1$), suggesting that the videos did not elicit different moods.

[3] For each dimension of creativity we first computed the intra-class correlation coefficient and then used the formula $[(j * \text{icc})/1 + (j - 1) * \text{icc}]$ with j being the number of judges to compute the inter-rater reliability coefficient (or inter-rater agreement).

Pilot study

In the indirect experience condition of Study 1, teams watched a video clip of a team that successfully created origami cows with contributions from all team members. We focused on a high-performing model in this initial study because in organizations managers generally study which practices lead to better performance and use those as the model or template from which other groups are encouraged to learn (e.g., Jensen & Szulanski, 2007).

In order to investigate whether groups learned more or less from a high-performing or low-performing model, we conducted a pilot study ($N = 75$) with a non-overlapping group of undergraduate students who received $10 for their participation. Participants were randomly assigned to teams of three members each. Teams, in turn, were randomly assigned to one of two conditions: a good-model condition (13 teams, 39 participants) or a poor-model condition (12 teams, 36 participants). The pilot study followed the same procedure used in the indirect task experience condition of Study 1 but manipulated the type of movie clip team members watched in Part I of the product-development task.[4] In the good-model condition, team members watched the video of a well-functioning team that successfully created origami cows with contributions from all group members. In the poor-model condition, team members watched the video of a poorly functioning team that was not able to successfully create origami cows within the allotted time.

Using the consensual assessment technique developed by Amabile (1983) and employed in the main study, two independent judges blind to the research hypotheses evaluated the creativity of the products teams produced, as well as their component divergence. The inter-rater agreements ranged from .73 to .95 across the dimensions evaluated, indicating sufficient agreement levels. A Cronbach's alpha of the entire creativity scale was .93, indicating high levels of reliability. The results showed that teams in the good-model condition created products that were more creative ($M = 2.56$, $SD = 0.69$) than those produced by teams in the poor-model condition ($M = 1.98$, $SD = 0.61$; $t\ [23] = 2.24$, $p < .05$). As for the component divergence of products created by teams, we found no significant difference across conditions ($p = .54$). Thus, the level of team creativity was higher when teams learned vicariously from a good rather than from a poor model. This finding suggests that the hypothesized dominance of direct experience over indirect experience would likely be even stronger when teams learn vicariously from poor rather than good models.

Results

Table 1 reports descriptive statistics for the main variables measured in each study.

Manipulation checks

Consistent with our manipulations, we found significant differences in agreement with the statement about teamwork ("I worked together with my team to develop cow origami products") across conditions, $F\ (2, 105) = 55.80$, $p < .001$, $\eta^2 = .52$. Post-hoc tests revealed that participants in the direct task experience condition reported higher agreement with this statement than did participants in either the indirect task experience condition (6.33 versus 3.76, $p < .001$) or the no prior task experience condition (6.33 versus 2.15, $p < .001$), and participants in the indirect task experience condition reported higher agreement with this statement than did participants in the no prior task experience condition ($p < .001$). We also found significant differences across conditions when considering agreement with the statement about observing another team ("I observed another team that made origami products"), $F(2, 104) = 14.00$, $p < .001$, $\eta^2 = .21$. Participants in the indirect task experience condition reported higher levels of agreement with this statement than did participants in either the direct task experience condition (4.12 versus 1.71, $p < .001$) or the no prior task experience condition (4.12 versus 2.41, $p = .001$), while responses of participants in the direct task experience condition did not differ from those of participants in the no prior task experience condition ($p = .37$). Furthermore, responses of participants in no prior task experience condition did not differ between statements ($p = .72$).

The effects of prior task experience on team creativity

An ANOVA using our measure for mean creativity as the dependent variable and the experimental conditions as a between-subjects factor revealed a significant main effect for condition, $F\ (2, 33) = 13.39$, $p < .001$, $\eta^2 = .45$. Products that teams created were more creative in the direct experience condition ($M = 3.31$, $SD = 0.82$) than in the no prior task experience condition ($M = 1.85$, $SD = 0.47$; $t\ [23] = 5.49$, $p < .001$). Products were also more creative in the direct experience condition than in the indirect experience condition ($M = 2.47$, $SD = 0.79$; $t\ [21] = 2.49$, $p = .02$). Furthermore, the mean creativity score was higher in the indirect experience condition than in the no prior task experience condition ($t\ [22] = 2.37$, $p = .03$). These results provide support for Hypotheses 1 and 2.

We next examined the effect of direct versus indirect experience on the component divergence of the products teams created. Component divergence was significantly higher in the direct task experience condition ($M = 4.30$, $SD = 1.17$) than in the indirect experience condition ($M = 3.08$, $SD = 1.58$, $t\ [21] = 2.12$, $p = .05$), thus supporting Hypothesis 3.

It is possible that the improved team creativity found in the direct experience condition is due to a general improvement in team effectiveness. To investigate this possibility, we tested the effect of type of experience on team productivity, operationalized as the number of products generated by each team (Shalley, 1991). Type of experience had no effect on number of generated products ($F\ (2, 32) = 2.83$, *ns*). Therefore, the effect of direct experience on creativity cannot be attributed to a general enhancement in team effectiveness.

Discussion

The findings of Study 1 suggest that task experience of any type (direct or indirect) enhanced creativity compared to no task experience. Further, direct experience was more beneficial than indirect experience: direct experience enhanced both the overall level of team creativity and the rated component divergence of products introduced by teams.

Although teams in the three experimental conditions in Study 1 had the same amount of time to discuss team performance (3 min), participants in the direct experience condition may have developed a higher level of experience with each other because they worked together to create products. Thus, the contribution of direct experience to creativity could be due to experience team members gained with the task or due to team member stability or their greater experience working with each other. Experience working together is increased when group membership remains stable (see Argote, Insko, Yovetich, & Romero, 1995; Hollenbeck

[4] The movie clips were selected from videos recorded in a different pilot study ($N = 36$) in which participants received $7 for their participation. They were divided into 12 teams of three members each. They were given the instructions on how to build origami cows and milk buckets used in Study 1 and were asked to work as a team to create as many of these products as possible. Teams were given 15 min to work on the task and were videotaped. After watching the videos of each of the 12 teams, we selected two videos to use in the pilot study: one for the good-model condition and one for the poor-model condition. We then selected an 8-min clip from each of these two selected videos.

Table 1
Descriptive statistics for the main variables measured in each study (Studies 1–3).

	Study 1				Pilot study for Study 1			
	Mean	*SD*	1	2	Mean	*SD*	1	2
1. Creativity level	2.53	0.92	1.00		2.23	0.70	1.00	
2. Component divergence	2.28	1.49	.25	1.00	2.14	0.40	.27	1.00
3. Number of products	4.50	3.35	−.58**	−.50*	2.80	1.00	−.32	−.46*

	Study 2				
	Mean	*SD*	1	2	3
1. Creativity level	3.26	0.81	1.00		
2. Component divergence	1.69	0.87	−.01	1.00	
3. Number of products	2.17	1.58	−.63**	−.11	1.00
4. Transactive memory	5.14	0.77	.37**	.11	−.25*

	Study 3							
	Mean	*SD*	1	2	3	4	5	6
1. Creativity level P1[a]	2.64	1.00	1.00					
2. Component divergence P1	3.85	0.87	.25	1.00				
3. Number of products P1	2.09	1.40	−.48**	.34	1.00			
4. Creativity level P2	2.73	0.84	.34*	−.02	−.20	1.00		
5. Component divergence P2	3.90	0.99	.06	.38*	.05	−.16	1.00	
6. Number of products P2	2.12	2.03	−.40*	.29	.43*	−.61*	.29	1.00
7. Transactive memory	4.78	1.35	.80**	−.09	−.23	.42*	.07	−.31

* $p < .05$.
** $p < .01$.
*** $p < .001$.
[a] Study 3 included two performance phases. P1 refers to the first performance period and P2 refers to the second performance period.

et al., 1995). Thus, in Study 2 we investigate whether the creativity-enhancing benefits of direct experience found in Study 1 depend on stable membership. Team membership stability may be a double-edged sword for interdependent creative tasks, such as new product development. On the one hand, team membership stability has been shown to decrease the number of ideas generated by groups (Choi & Thompson, 2005). On the other hand, team membership stability has been shown to contribute to the development of cognitive structures, such as transactive memory systems (Moreland, 1999; Okhuysen & Waller, 2002) and to improve decision making (Jehn & Shah, 1997; Shah & Jehn, 1993) and performance (Harrison, Mohammed, McGrath, Florey, & Vanderstoep, 2003). Thus, in light of the mixed findings on the effect of team membership stability on processes involved in new product-development tasks, we investigate the influence of team membership stability in a second study. The study examines whether or not the effects of direct and indirect experience on creativity observed in Study 1 depend on stable membership.

Study 2: Prior experience, transactive memory and team creativity

Our first study demonstrated that different types of prior task experience differentially affect team creativity. We suggest that the observed benefits of direct experience on team creativity can be explained by the development of a transactive memory system among team members. In the direct experience condition, team members acquire knowledge about the task and about how to coordinate their activities of subtasks. In the indirect experience condition, in contrast, team members acquire indirect knowledge only about the task.

We suggest that having the opportunity to perform a task in the direct experience condition will stimulate the development of transactive memory in teams. Members with task experience learn about the task and also gain experience in developing and using structures of specialized expertise to perform the task. Team members learn to locate expertise in the team and share their expertise with team members. Such knowledge and information sharing also increases members' abilities to direct information to appropriate team members and enhances their teammates' ability to coordinate with one another. Therefore, we hypothesize the following:

Hypothesis 4. Direct task experience will lead to more highly developed transactive memory systems than indirect experience.

Transactive memory has repeatedly been linked to dimensions of team performance such as speed and quality (e.g., Lewis, 2003; Liang et al., 1995). We also believe that transactive memory can benefit team creativity in product development. A transactive memory system reduces the redundant overlaps in knowledge and clarifies who will remember what information through specialization. Increased specialization leads to more efficient cognitive processing, as only the person assigned to a particular expertise attends to the relevant information and encodes it in memory. This frees up other individuals to concentrate on their own tasks. The improved information processing results in higher levels of creativity within the team, because members do not need to waste cognitive resources by encoding information relevant to subtasks to which other members are assigned.

The potential to create novel ideas as a team is also dependent on team members' ability to efficiently exchange knowledge and build on each other's ideas (Hargadon & Bechky, 2006; Monge, Cozzens, & Contractor, 1992). The development of transactive memory systems for creative tasks will improve the coordination of knowledge exchange and use, as well as the capacity of team members to trust their teammates' ideas. Therefore, we hypothesize that the development of transactive memory systems within teams will lead to higher levels of creativity:

Hypothesis 5. Transactive memory will positively influence the level of creativity of products within teams.

We also hypothesize that the influence of experience on team creativity is explained by the development of transactive memory systems. That is, we hypothesize that transactive memory is the mechanism through which experience affects creativity. Indeed, TMS help team members share, coordinate, and efficiently encode information gathered through experience. TMS also enhance information processing among team members who can thus dedicate cognitive resources to the creative process without focusing on the details of subtasks on which other team members are expert. The knowledge and deep understanding of a specific task acquired through experience and stored in a team's TMS is thus an important antecedent of team creativity. In our context, direct experience gives participants deep experience with the task, which allows them to better understand its dimensions. This knowledge enhances participants' ability to quickly specialize in ways that make use of what people know and are best able to do and apply this knowledge to new tasks. Having deeper experience with the task by performing it as team also helps members learn how to coordinate their specialized expertise better than participants in the indirect experience condition. Thus, the development of TMS within teams is a key ingredient linking experience to the level of creativity, such that direct experience will result in higher levels of creativity within the team due to a greater development of TMS in this condition. As a result, we expect:

Hypothesis 6. Transactive memory will mediate the relationship between experience and the level of creativity of products within teams.

While we believe TMS explains the relationship between experience and the level of creativity of products within teams, we do not expect the same relationships to hold for component divergence. The development of TMS allows team members to be efficient in the use of their cognitive resources since different members are repositories of different pockets of knowledge about the various subtasks involved in the creative task. TMS also allow members to coordinate their activities and use their unique expertise to create novel and original products. Component divergence, however, requires a different use of the knowledge acquired through experience. It requires team members to avoid recombining elements and knowledge of existing products and make radically new decisions on how to develop products. Such knowledge use is not affected by the development of TMS.

We test Hypotheses 4–6 in a second study in which we crossed the manipulation of type of prior experience (direct versus indirect) with whether teams were trained and performed with the same or different group members (membership stability manipulation). The addition of these two conditions enabled us to determine whether the benefits of direct experience we observed in Study 1 were due to previous direct *task* experience, to previous experience *working with the same members* or to the *interaction of the two types of experience*.

Method

Participants

Two hundred and thirty nine college students from local universities (55% males; $M_{age} = 22$, $SD = 2.95$) participated in the study for a $10 payment. The team that developed the most creative products received an additional $20. Participants were randomly assigned to condition and to groups within condition. We had 21 teams (58 participants) in the indirect experience/different-members condition, 23 teams (62 participants) in the indirect experience condition/same members condition, 22 teams (60 participants) in the direct experience/different-members condition, and 23 teams (59 participants) in the direct experience/same members condition. In each session, the experimenter divided participants into teams of two or three members.[5]

Design and procedure

The study employed a 2 (type of prior experience) × 2 (membership stability) between-subjects design with the following four conditions: (1) Direct experience, train and perform with same group members; (2) Direct experience, train and perform with different group members; (3) Indirect experience, train and perform with same group members; (4) Indirect experience, train and perform with different group members. Conditions 1 and 3 are the same as in Study 1, while conditions 2 and 4 are new.

The study followed the same procedure as in Study 1, but with two main differences. First, in the new different-members conditions, after Part I of the product-development task, members of each group were scrambled so that each participant worked within a new team during Part II of the product-development task. That is, participants in the different-members conditions trained with one group (in Part I of the product-development task) and performed with a different one (in Part II of the product-development task). Before Part II of the product-development task, groups were entirely scrambled so that all members of groups in the second part of the study were different: nobody worked with the same members from the first part of the study. The second difference occurred in the final questionnaire participants filled out individually at the end of the product-development task. The final questionnaire included manipulation checks and also measures for transactive memory. We used four questions as manipulation checks (reported below). For each, participants indicated their answers using a 7-point scale, ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

Transactive memory. Transactive memory was measured using the scale developed by Lewis (2003). The scale contains 15 items (5 items per dimension) designed to assess team member specialization (e.g., "Different team members were responsible for expertise in different areas"), credibility (e.g., "I trusted that other members' knowledge about the task was credible"), and coordination (e.g., "Our team worked together in a well-coordinated fashion"). Each item was scored on a 7-point Likert-type scale ranging from 1 *(strongly disagree)* to 7 *(strongly agree)*. A factor analysis on the team-level data showed that all items had acceptable factor loadings above the .40 cutoff. The cumulative percentage of explained variance was 71%, and the maximum cross loadings were .45 and .41. We thus aggregated the items in each subscale by averaging the answers for each construct: specialization (Cronbach's alpha = .87), credibility (Cronbach's alpha = .80), and coordination (Cronbach's alpha = .87). Because of the high, positive, and significant correlations across these three constructs, we aggregated them into a single scale. The Cronbach's alpha for the entire transactive memory scale was .90.

We used the within-team inter-rater agreement (r_{wg}) index (James, Demaree, & Wolf, 1984) to justify aggregating individual members' responses to the team level. Median r_{wg} values greater than .70 are generally considered sufficient agreement to warrant aggregation (Bliese, 2000; Chen, Mathieu, & Bliese, 2004). The median r_{wg} was .89 for transactive memory. We also calculated scale intra-class correlations (ICC), which index the reliability of individual ratings (ICC1) and the reliability of the group average rating (ICC2). The results for transactive memory were .35 for ICC1 and .62 for ICC2 ($F = 2.61$, $p < .001$), which are within the acceptable range (Bliese, 1998, 2000; James, 1982). Finally, we calculated the team-level scale internal consistencies using the

[5] Twenty-eight teams had two members. There were no significant differences in the number of members per team across conditions.

average item response per team as the inputs, which yielded high reliability values for the transactive memory construct, as explained below. These results indicate that sufficient intermember agreement and reliability existed to warrant aggregating to the team level of analysis.

Dependent measures

As in Study 1, we included two main dependent measures: level of creativity and component divergence. We used the mean creativity levels of the origami products that participants developed within their teams to measure the level of creativity. Two independent judges who were blind to the research hypotheses rated the overall creativity of each product using the same creativity and component divergence scales used in Study 1. The inter-rater agreements ranged from .83 to .95 for the various dimension of creativity, the level of creativity and the component divergence of products. ICC values ranged from .78 to .89, and Cronbach's alpha values ranged from .83 to .93. A Cronbach's alpha of the creativity scale was .94, indicating high levels of reliability. We averaged the evaluations of the two judges to create the creativity and component divergence scores for each product.

Results

In all our analyses, we initially tested for the effect of team size on performance variables and found no effect. Furthermore, the nature and significance of our results did not change when controlling for team size. Team size is thus not discussed in the analyses presented below.

Manipulation checks

Consistent with our manipulations, participants in the direct experience conditions reported higher agreement with the statement about teamwork ("I learned together with my team how to develop cow origami products before I was asked to create new products with my team") than did participants in the indirect experience conditions (5.40 versus 3.57, $F(1, 230) = 42.85$, $p < .001$, $\eta^2 = .16$). Participants in the indirect experience condition reported higher agreement with the statement about observing another team ("I observed a video of another team that made origami products before I was asked to create new products with my team") than did participants in the direct experience condition (6.47 versus 1.26, $F(1, 230) = 1384$, $p < .001$, $\eta^2 = .86$).[6] Participants in the same members' conditions reported higher agreement with the statement about working with the same group ("I performed the training session and the product-development session with the same team members") than did participants in the different-members' conditions (6.31 versus 1.80, $F(1, 230) = 466$, $p < .001$, $\eta^2 = .67$). Finally, participants in the different-members conditions reported higher agreement with the statement about working with a different group ("After the training session, the composition of my team changed") than did participants in the same members' conditions (6.18 versus 2.14, $F(1, 230) = 321$, $p < .001$, $\eta^2 = .58$).[7] These results suggest that our manipulations of type of experience and membership stability were effective. Furthermore, our experience manipulation did not affect the membership stability manipulation and vice versa, suggesting that our manipulations were orthogonal.

The effects of prior experience on team creativity

We subjected our measure for mean creativity to an ANOVA in which experience type (direct versus indirect) and team membership stability (same members versus different members) served as between-subjects factors. This analysis revealed a significant main effect for experience type, $F(1, 85) = 8.72$, $p = .004$, $\eta^2 = .10$. Products that teams created were more creative in the direct experience condition ($M = 3.50$, $SD = 0.75$) than in the indirect experience condition ($M = 3.01$, $SD = 0.79$). These results provide further support for Hypothesis 1, which predicted that the level of team creativity would be higher in the direct experience conditions than in the indirect experience conditions. The effect of membership stability was insignificant ($p = .98$), as well as the experience type × membership stability interaction ($p = .98$). Therefore, the effect of direct experience on the overall level of creativity did not depend on whether the teams acquired the experience with same members or with different members.

We next examined the effect of experience on the component divergence of the products teams created. Component divergence was significantly higher in the direct experience conditions ($M = 4.52$, $SD = 0.73$) than in the indirect experience conditions ($M = 4.11$, $SD = 0.96$; $F(1, 85) = 5.32$, $p = .024$, $\eta^2 = .06$), thus supporting Hypothesis 3. This analysis also revealed a significant effect for membership stability ($F(1, 85) = 4.38$, $p = .039$, $\eta^2 = .05$). Acquiring experience with different members on the team led to higher component divergence than acquiring experience with the same members ($M = 4.51$, $SD = 0.72$ versus $M = 4.13$, $SD = 0.96$). The experience × membership stability interaction was not significant ($p = .64$).

Transactive memory

We conducted further analyses to investigate whether type of prior experience and membership stability influenced the emergence of transactive memory. In all of our analyses, we used transactive memory as the dependent variable and type of experience (direct versus indirect) and membership stability (same versus different) as between-subjects factors.

Transactive memory was significantly higher in the direct experience conditions ($M = 5.35$, $SD = 0.67$) than in the indirect experience ($M = 4.93$, $SD = 0.81$; $F(1, 85) = 7.84$, $p = .006$, $\eta^2 = .08$). In addition, transactive memory was significantly higher for teams that acquire task experience with the same members conditions ($M = 5.30$, $SD = 0.65$) than for teams that acquire task experience with different members ($M = 4.98$, $SD = 0.86$; $F(1, 85) = 4.44$, $p = .038$, $\eta^2 = .05$). The type of experience by membership stability interaction was insignificant ($p = .31$). These results are consistent with Hypothesis 4, which predicted that direct experience would positively influence the development of transactive memory systems.

Mediation analysis

Our sixth hypothesis proposed that the effects of experience on the level of creativity of products within teams would be mediated by transactive memory. To test for mediation, we conducted a series of regression analyses using the method suggested by Baron and Kenny (1986) (see also Kenny, Kashy, & Bolger, 1998). The results are summarized in Table 2. In all regressions, we controlled for whether the team trained and performed with the same or a different group, and we included the interaction of experience type and membership stability. The level of team creativity was regressed on type of experience ($\beta = .31$, $p < .05$), membership stability (*ns*) and their interaction (*ns*). Transactive memory was regressed on type of experience ($\beta = .39$, $p < .01$), membership stability ($\beta = .32$, $p < .05$) and their interaction (*ns*). The results of these regressions satisfy the first and second requirements for mediation and are consistent with Hypotheses 4 and 5.

Regarding the third requirement for mediation, the level of creativity was regressed on type of experience, membership stability, their interaction, and team transactive memory. Transactive

[6] On both items, the main effect of membership stability and the membership stability × experience type interaction were insignificant (all *ps* > .10).

[7] On both items, the main effect of experience type and the membership stability × experience type interaction were insignificant (all *ps* > .10).

Table 2
Mediation analyses, Study 2. Each mediation step contains a regression analysis. The table reports standardized coefficients.

	Dependent variables				
	Transactive memory Β	Level of team creativity β	F	R^2	ΔR^2
Mediation analysis, Step 1					
Experience		.31*	2.91*	.09	
Membership Stability		.01			
Experience × membership stability		−.01			
Mediation analysis, Step 2					
Experience	.39**		4.32**	.13	
Membership stability	.32*				
Experience × membership stability	−.18				
Mediation analysis, Steps 3					
Experience		.18	4.81**	.19	.09**
Membership stability		−.10			
Experience × membership stability		.06			
Transactive memory		.33**			

* $p < .05$.
** $p < .01$.
*** $p < .001$.

memory significantly affected the level of team creativity when controlling for experience ($\beta = .33$, $p < .01$), satisfying the third mediation requirement. After controlling for transactive memory, the effect of experience on the level of team creativity became insignificant ($\beta = .18$, $p = .22$). The mediation effect of transactive memory was significant by Sobel's (1982) test, $Z = 2.03$, $p < .05$. Therefore, Hypothesis 6 was supported. These results suggest that transactive memory fully mediates the effect of experience on the level of team creativity.

Discussion

Our second study replicated the results of Study 1 and showed that direct task experience leads to higher levels of both team creativity and component divergence of products compared to indirect task experience. We were concerned that in Study 1 participants in the direct experience condition gained more experience with the other team members compared to the other conditions and thus designed a separate study to explicitly manipulate whether direct experience was acquired with the same or different members. The results show that direct *task* experience leads to higher level of creativity than indirect *task* experience. There was no interaction between membership stability and type of task experience. Thus, whether experience is acquired with the same team members or with different team members does not change the effect of direct experience versus indirect task experience on the level of team creativity. We also found that transactive memory fully mediates the effect of task experience on the level of creativity of products within teams.

One might argue that our findings about membership stability are somewhat inconsistent with prior work on transactive memory (Moreland et al., 1996), which found that it is only when participants train and perform in the same group that transactive memory develops and enhances performance. We found that membership stability positively affected the development of TMS; which supports prior research on the development of TMS. However, we did not find that TMS mediated the effect of membership stability on team performance in terms of team creativity. An important difference between the Moreland et al. (1996) and our study is that we asked participants to be creative, while past work had participants perform the same task in both the training and the performing phase. It is likely that membership stability is more beneficial for routine tasks that require the same procedures and steps to be repeated over and over than for tasks that require creativity and novel procedures to be employed (Argote et al., 1995; Perry-Smith & Shalley, 2003).

As we noted previously, experience with team members may serve as a double-edged sword in new product-development tasks. On the one hand, membership stability enhances information exchange in the team and the development of TMS (Lewis, Belliveau, Herndon, & Keller, 2007; Moreland et al., 1996). On the other hand, interaction with new members may provide a greater informational return in the creative process (Perry-Smith & Shalley, 2003) and has been shown to increase the number of ideas generated by groups as well as the variance of those ideas (Choi & Thompson, 2005). Membership change broadens the knowledge base of the team through the combination of new information, perspectives, and ideas (Kim, 1997). Thus, it seems likely that the negative effect of membership change on transactive memory systems was counterbalanced by the positive effect of having new members with fresh perspectives and new ideas. Consistent with this line of argument, we found that acquiring experience with different members led to higher component divergence than acquiring experience with the same members (the benefits of membership change) and that acquiring task experience with different members led to lower TMS than acquiring experience with the same members (the downsides of membership change).

Study 3: Prior experience and creativity over time

While the effects of prior direct experience appear to be robust, it is unclear whether teams in the indirect experience would "catch up" once they acquired direct experience and thereby develop products that were as creative as those produced by teams in the direct experience condition. To examine this issue, Study 3 includes two performance periods instead of the one period used in our previous studies.

We expect that group processes and outcomes will persist over time. Kelly and Karau (1993) examined the effect of time and time limits on group creativity and found that creativity levels persisted over performance periods. Related empirical research has shown that team members persist in their interaction patterns over time and in the pace or speed they establish for themselves during initial trials of production tasks (Kelly, 1988; Kelly, Futoran, & McGrath, 1990; McGrath & Kelly, 1986). In the indirect experience condition, team members start developing interaction patterns only in the first performance period and lack the deep understanding of the task and its components that teams in the direct experience condition acquired during training. Teams in the indirect experience condition are likely to focus on performing rather than learning (Bunderson & Sutcliffe, 2003; Dweck, 1986) and thereby miss opportunities to learn about who is good at what or how to coordinate their activities. Thus, we predict that the difference in team creativity between learning from direct and indirect experience will persist over time. Specifically, we hypothesize that:

Hypothesis 7. The level of team creativity will be significantly higher in the direct experience condition than in the indirect experience condition across both performance periods.

Hypothesis 8. Component divergence of products created by teams will be significantly higher in the direct task experience condition than in the indirect task experience condition across both performance periods.

Method

Participants

One hundred and two students from local universities (49% males; $M_{age} = 21$, $SD = 2.85$) participated in the study for $10. The team that developed the most creative products received an additional $20. Participants were randomly assigned to conditions and to three-member groups within each condition. We had 17 teams (51 participants) in the indirect task experience condition and 17 teams (51 participants) in the direct task experience condition.

Procedure

The study followed the same procedure as in Study 1 but with two main differences. First, we only considered the direct and indirect experience conditions of Study 1. To ensure that we tested for the effect of task experience only, members of each group were scrambled after the training phase so that each participant worked within a new team during the two performance periods of the product-development task. The members of the team remained the same for each of the two performance periods. Second, we eliminated the 3 min in which members shared their thoughts about their performance (direct condition) or the team they had watched (indirect condition). This enabled us to attribute differences in performance to direct or indirect experience without the possible confound of opportunities to reflect on experience. Finally, we included two performance periods. Once the 20 min of the first performance period were over (Phase II of the product-development task), teams were given another 20 min to work on the same task. Prior to the beginning of this new phase, teams were given new materials (i.e., origami paper), and the products they built during Phase II were stored in a box to signal phase completion. At the end of the second performance period, participants completed a final questionnaire which included demographic questions, manipulation checks and items assessing transactive memory.

Transactive memory. A factor analysis on the team-level data showed that all the items measuring transactive memory had acceptable factor loadings above the .40 cutoff. The cumulative percentage of explained variance was 84%, and the maximum cross loadings were .59 and .48. We thus aggregated the items in each subscale by averaging the answers for each construct (specialization, credibility, and coordination). Because of the high, positive and significant correlations across these three constructs, we aggregated them into a single scale (Cronbach's alpha = .98).

The median r_{wg} was .84 for transactive memory, suggesting sufficient agreement to warrant aggregation (Chen et al., 2004). We also calculated scale intra-class correlations (ICC), which index the reliability of individual ratings (ICC1) and the reliability of the group average rating (ICC2). The results for transactive memory were .86 for ICC1 and .96 for ICC2 ($F = 24.95$, $p < .001$). These results indicate that sufficient intermember agreement and reliability existed to warrant aggregating to the team level of analysis.

Dependent measures

As before, we included the level of creativity and component divergence as dependent measures in our study. Two independent judges who were blind to the research hypotheses rated the creativity of each product on several dimensions (i.e., creativity, novel use of materials, novel association, variation of materials used, the level of detail, complexity, and display). The inter-rater agreements were above .85 across items, indicating high agreement levels. ICC values ranged from .74 to .84, and Cronbach's alpha values ranged from .85 to .93. A Cronbach's alpha of the entire scale was .95, indicating high levels of reliability. We averaged the evaluations of the two judges to create a mean creativity score for each team.

The two independent judges also rated the component divergence of the products teams created, using the same two items as in our first two studies. The inter-rater agreements was .83, indicating high agreement. We averaged the evaluations of the two judges to create a component divergence score for each product.

Results

Manipulation checks

We used two questions as manipulation check: (1) "I learned together with my team how to develop cow origami products before I was asked to create new products with my team" and (2) "I observed a video of another team that made origami products before I was asked to create new products with my team." Consistent with our manipulations, participants in the direct experience conditions reported higher agreement with the first statement than did participants in the indirect experience conditions (6.02 versus 2.65, t [100] = 10.89, $p < .001$). Participants in the indirect experience condition reported higher levels of agreement with the second statement than did participants in the direct experience condition (6.61 versus 1.08, t [100] = 33.41, $p < .001$).

The effects of prior task experience on team creativity

We subjected our measure for mean creativity to an ANOVA in which experience type (direct versus indirect) served as a between-subjects factor and performance period (one versus two) served as a within-subjects factor. This analysis revealed a significant main effect for experience type, $F(1, 32) = 8.08$, $p < .01$, $\eta^2 = .20$. Products that teams created were more creative in the direct experience condition ($M = 3.02$, $SD = 0.83$) than in the indirect experience condition ($M = 2.35$, $SD = 0.90$). The effect of performance period was insignificant ($p = .62$), as was the experience type × performance period interaction ($p = .56$). Teams in the direct experience condition created products that were more creative than those built in the indirect experience condition in both the first (t [32] = 2.42, $p < .05$) and the second performance period (t [32] = 2.04, $p = .05$). These results are depicted in Fig. 1. It is noteworthy that the higher level of creativity in the direct as opposed to the indirect experience condition found in Studies 1 and 2 was replicated here in Study 3, even when participants were not given time to reflect on their experience. Thus, Study 3 removes a potential confound in Studies 1 and 2 and also suggests that reflexivity is not necessary to establish the effects that we observed.

We next examined the effect of prior experience on the component divergence of the products teams created. Component

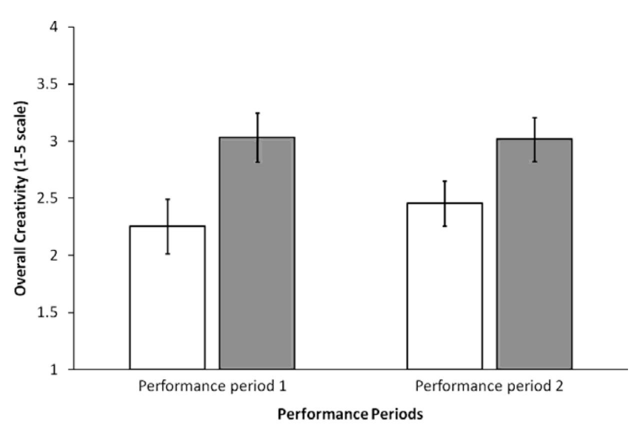

Fig. 1. Mean level of creativity across conditions and by performance period, Study 3. Error bars represent standard errors.

divergence was significantly higher in the direct experience conditions ($M = 4.28$, $SD = 0.63$) than in the indirect experience conditions ($M = 3.48$, $SD = 1.01$; $F(1, 32) = 11.76$, $p < .01$, $\eta^2 = .27$). The effect of performance period was insignificant ($p = .79$), as was the experience type × performance period interaction ($p = .86$). Teams in the direct experience condition created products that were more divergent than those built in the indirect experience condition in both the first ($t[32] = 3.09$, $p < .01$) and the second performance period ($t[32] = 2.39$, $p < .05$).

Transactive memory

We conducted further analyses to investigate whether type of prior experience influenced the emergence of transactive memory. As expected, transactive memory was significantly higher in the direct experience conditions ($M = 5.33$, $SD = 0.72$) than in the indirect experience conditions ($M = 4.24$, $SD = 1.61$; $t[32] = 2.55$, $p < .05$).

Mediation analysis

To examine whether transactive memory mediated the effect of direct experience on the level of team creativity (evaluated in the second performance period), we followed the steps recommended by Baron and Kenny (1986). The results of this analysis are summarized in Table 3. The effect of experience was reduced to non-significance when transactive memory was included in the equation, and transactive memory was a significant predictor of the level of team creativity. As confirmed by a Sobel test ($Z = 2.38$, $p < .05$), these results suggest that transactive memory fully mediates the effect of prior experience on the level of team creativity.

Discussion

Study 3 provided further support for our hypotheses and showed that direct experience leads to greater team creativity compared to indirect experience. The study included two performance periods to test for the possibility that the performance advantage of teams in the direct experience condition compared to teams in the indirect experience condition might decrease over time. We did not find any evidence of such decrease. Our results demonstrate that in the second performance period, teams that had learned from direct experience remained more creative than teams that had learned from indirect experience. Providing further support for the findings of Study 2, our results also showed that transactive memory fully mediates the effect of direct experience on the level of team creativity.

Table 3
Mediation analyses, Study 3. Each mediation step contains a regression analysis. The table reports standardized coefficients.

	Dependent variables				
	Transactive memory β	Level of team creativity β	F	R^2	ΔR^2
Mediation analysis, Step 1					
Experience		.39*	5.85*	.16	
Mediation analysis, Step 2					
Experience	.41*		6.48*	.17	
Mediation analysis, Steps 3					
Experience		.08	28.30***	.65	
Transactive memory		.77***			.49***

* $p < .05$.
** $p < .01$.
*** $p < .001$.

General discussion and conclusion

The main goal of the research presented here was to investigate the effects of learning from different types of prior experience (direct and indirect) on both the level of creativity and the component divergence of products created by teams. We found differential effects of learning from direct versus learning from indirect experience on team creativity and showed that such effects persist over time. Specifically, direct experience led to higher levels of both team creativity and component divergence of products than indirect experience, independent from whether teams acquired experience with the same members or with different members. Thus, rather than constraining creativity, experience, and especially direct experience in teams, seems to facilitate it. In addition, we investigated the role of team processes in explaining the relationship between learning from experience and creativity. We showed that transactive memory mediates the relationship between experience and the level of team creativity.

Our findings contribute to the literature on creativity and learning in two important ways. Within the learning and creativity literatures, studies have focused on team composition, processes, and structures that affect team learning and creativity (e.g., Choi & Thompson, 2005; Hargadon & Bechky, 2006; Kane et al., 2005; Taggar, 2002). These literatures, however, have remained relatively disconnected, with little known about the effect of team learning from experience on team creativity (Gino, Todorova, Miron-Spektor, & Argote, 2009). This paper addresses this gap in the literature by examining the effect of different types of prior experience on team creativity. Further, to the best of our knowledge, the present study is the first in the literature to compare the effects of direct versus indirect task experience on team creativity, and to explain what may account for the performance advantage of one type of experience over another.

From a theoretical perspective, the findings help to reconcile conflicting findings on the effects of experience on creativity. Previous research on this topic has yielded mixed results. Some studies provide evidence that experience leads to faster execution of creative ideas (Taylor & Greve, 2006) but also narrows attention toward strategies that proved successful in the past. As a result, experienced people tend to generate more ideas, but their ideas tend to be incremental (Audia & Goncalo, 2007). Similarly, the exploration and exploitation literature suggests that exploitation of past knowledge leads to incremental innovation and may hinder radical innovation (Benner & Tushman, 2003; Gupta, Smith, & Shalley, 2006). Other studies suggest that prior experience is an essential component for the development of radical new products because it allows individuals to recognize opportunities to be creative (Shane, 2000). Our research suggests that these mixed findings might be due to the role played by different types of prior experience. As our results show, prior experience leads to higher or lower levels of creativity (and to the development of products that vary in their component divergence) depending on whether the experience was acquired directly or indirectly.

Finally, our study contributes to the understanding of the role of TMS in creativity tasks. So far, researchers have focused on how the development of TMS predicts team outcomes related to production tasks (Lewis et al., 2005; Liang et al., 1995). These tasks tend to be repetitive in nature and often do not provide room for creativity or innovation. Departing from prior work which focused on this type of tasks, we considered creative tasks and showed that TMS improve team creativity. Indeed, the development of TMS within teams allows team members to create a common knowledge base which combines information, perspectives, and expertise of the different team members – elements that are important antecedents of creativity.

Limitations and directions for future research

Although the laboratory studies provide causal evidence about the effects of prior experience on the level of creativity and on component divergence, there are limitations associated with our experimental methodology. In particular, the generalizability of the findings may be questioned, given that undergraduate students participated in a team exercise for a limited period of time. Although prior research has suggested that there are few differences in the outcome of laboratory studies conducted with either students or professionals as participants unless the task involves complex statistical procedures (Gordon, Slade, & Schmitt, 1986), field studies are clearly required to further explore the nature of these relationships.

For instance, future field research could examine whether learning dysfunctions are associated with direct experience over an extended time period. In our studies, team members were part of small teams who worked together for a limited amount of time. Given these features of our studies, learning dysfunctions such as core rigidities, learning myopias or overgeneralization biases were unlikely to develop. Further research that examines whether our findings generalize to bigger teams or teams whose members work together for extended periods of time is needed.

Future work should also investigate the environmental, organizational and temporal contexts in which experience is acquired. The benefits of direct experience are likely to be especially pronounced in environments when the knowledge base is uncertain and not well understood. Studies suggest that direct task experience plays an important role in both creativity and innovation processes, particularly in rapidly changing environments. For example, studying the development of new manufacturing processes in a sample of process-development projects in biological-based pharmaceutical companies, Pisano (1994) found that "learning-by-doing," as contrasted with what he termed "learning-before-doing," was advantageous in the rapidly changing biotech industry. Similarly, we expect that direct experience will be especially beneficial in dynamic environments, where knowing who knows what is most valuable (Ren, Carley, & Argote, 2006). In addition to studying how characteristics of the environment moderate the relationship between prior experience and creativity, examining how team structures and processes moderate the relationship is also an important issue for future research.

Our results suggest that a possible mechanism for stimulating creativity in experienced teams is membership change. Previous research has shown that new members are often the source of new ideas (Choi & Thompson, 2005). Our results indicate that teams experiencing membership change produced more divergent products than stable teams. Thus, introducing membership change into experienced teams may serve to reinvigorate them and enable them to maintain high levels of creativity.

Another important boundary condition future research could explore is the extent to which the results observed in our studies are limited to production tasks and do not replicate to intellectual tasks such as brainstorming. In our studies, team members were encouraged to initially discuss the products they wanted to create and how they wanted to create them so everybody in the team had the chance to speak up and suggest ideas. This discussion might have worked similarly to a brainstorming phase in which each team member shares ideas on products to create and on how to best accomplish the task. Addressing this question is an interesting venue for future research.

Practical implications

Our research may have important practical implications for assembling groups or teams. As noted by Harrison et al. (2003, p. 636), when teams "are initially assembled, which is increasingly common given the rise in group-based work structures, organizations are faced with important choices about team membership." Our findings suggest that organizations and their leaders may benefit from composing teams based on the type of prior task experience members acquired in the past. Choices made at the time of assembling groups or teams may indeed be important variables that are under managers' control and, at the same time, can boost creative performance at the team level.

Our study provides evidence on the limitations of learning from experience of others for the purpose of creativity. We showed that direct experience leads to more creativity than indirect experience and the effects seem to persist over time. Thus, while vicarious learning might be beneficial for team performance, it does not enable teams to be as creative as teams that learn from their own experience. This finding also contributes to understanding the development of team creative processes and capabilities as a source of sustainable competitive advantage (Teece, Pisano, & Shuen, 1997). The imitation of creativity-related processes does not allow the team to "catch up" with the team that developed the processes from its own experience.

In organizations, indirect experience may provide teams with access to knowledge about which they do not have opportunities to acquire direct experience. For example, a team may learn about a new process from another team. The current study suggests that such learning from indirect experience may be more effective when it is complemented with internal learning and opportunities to acquire direct experience with practice (e.g., see Bresman, in press).

Our study may also have implications for the design of organizations. Over the past decade, an increasing number of US companies have transferred production and jobs abroad, with the goal of importing products and services back into the United States. This phenomenon, known as offshoring, has been driven primarily by firms' goals to reduce labor costs and gain access to new knowledge and expertise (Fifarek, Veloso, & Davidson, 2008). A recent worldwide survey found that 70% of the participating firms employ R&D talent abroad (Venkatraman, 2004). Our results suggest that offshoring R&D practices may have hidden costs. The loss of direct experience may impair a unit's creativity. The benefits of cost reduction may indeed be outweighed by a loss in the ability to be creative. The effects of changes in the distribution of experience on creativity should be included in assessments of new organizational forms, such as those engendered by offshoring to another country or outsourcing to another firm.

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