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CHANGING ROUTINES: A PROCESS MODEL OF VICARIOUS GROUP LEARNING IN PHARMACEUTICAL R&D

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Prior research has indicated that groups frequently change their routines drawing on the experience of others and that this has significant performance effects. But how group routine change occurs through this process of vicarious learning is not clear. Using a qualitative field study of drug development teams in one pharmaceutical firm, I examine how groups change routines drawing on the prior related experience of other groups. An inductive analysis suggests that this process does not follow the simple find-and-copy model often assumed in the literature and identifies four distinct subprocesses involved: identification, translation, adoption, and continuation. This process model adds to understanding of vicarious learning by showing that it is a more varied process than it is commonly construed to be and that not only experience-seeking groups, but also groups that are the source of the experience, play important and shifting roles throughout. Thus, this study contributes to theories about how groups change their routines by elucidating how they alter their routines through vicarious learning.

Classic organizational theory posits that the changing of routines, defined as repeatable patterns of interdependent behaviors, is central to organizational renewal (Nelson & Winter, 1982). Growing competition and advances in technology in recent years have further increased the need for effective and efficient routine change (Edmondson, Bohmer, & Pisano, 2001; Feldman & Pentland, 2003). In response to these shifts, many organizations have adopted structures that rely on small groups to perform critical tasks (Zellmer-Bruhn, 2003), making groups a central locus of routine change in today's organizations (Dosi, Nelson, & Winter, 2000). Because organizations often have multiple groups performing similar tasks, some of them are likely to develop particularly innovative routines that can benefit other groups in the same organization. Research suggests that those organizations whose groups base changes in their routines on proven routines developed by other groups often benefit (Szulanski, 1996). When a group changes a routine drawing on the experience of others, it is said to have undergone a vicarious learning process (Levitt & March, 1988). Although the central role of vicarious learning in changing routines is noted in the literature (Denrell, 2003), empirical research on the topic remains scarce (see Parmigiani and Howard-Grenville [2011] for a review).

Considerable evidence suggests that routine change based on vicarious learning can produce significant and lasting performance effects in groups (Argote & Ingram, 2000), but existing research has relied chiefly on performance changes to infer that vicarious learning has taken place (e.g., Argote, Beckman, & Epple, 1990), leaving the process by which it happens unexamined. The few instances of empirical work on vicarious learning in which the process is mentioned tend to treat it as a matter of finding and copying practices (Baum, Xiao Li, & Usher, 2000; Haunschild & Miner, 1997). For instance, in a study of the diffusion of routines across stores within a pizza franchise, Darr, Argote, and Epple (1995) described an innovative workflow developed at one store that was then discovered by other stores and copied. Perhaps the most widely known example of routines being copied across organizational groups is the microprocessor firm Intel's approach to replicating its best manufacturing routines—aptly named Copy Exactly (Szulanski & Winter, 2002).

The concept of vicarious learning as find-and-copy is appropriate when associated with routines that are transferred in full from a group operating in

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one setting to another group operating in an identical setting (Darr et al., 1995) or, as is the case of Intel's Copy Exactly, to one that has no pre-existing routines at all. Yet in today's organizations many groups operate under constraints that do not fit this description. They work in dynamic environments where change is constant, resources are scarce, and time is short (Brown & Eisenhardt, 1997; Posen & Levinthal, 2012). In such conditions, which are common to many innovation-driven industries, it is rare for a group to find a routine developed by another group that it can copy exactly. There are at least two reasons for this. First, groups are likely to have already expended considerable effort developing routines that work satisfactorily; hence it would be wasteful to replace these existing routines entirely (Winter & Szulanski, 2001). Second, each is likely to operate in a unique context (Cohen & Levinthal, 1990), so it may be detrimental to performance to copy routines that do not originate in an identical setting.

However, even if copying routines wholesale is not a realistic mode of vicarious learning, there is still a strong motivation to learn from the prior related experiences of others: given time pressure and other constraints, groups may reap benefits from not repeating others' mistakes or from "reinventing the wheel" (Bresman, Birkinshaw, & Nobel, 1999). Rather than copying routines in full from others, groups may view others' new routines as models from which lessons can be extracted and used to change their own existing routines. If researchers treat routine change based on vicarious learning only as a process of finding and copying best practice (Szulanski, 1996), contradictory outcomes may be observed. Hence, the contribution vicarious learning might make to understanding how groups change their routines may be hindered (Parmigiani & Howard-Grenville, 2011). The purpose of this article, therefore, is to explore how groups in dynamic settings change their routines via vicarious learning.

"How" questions are well suited to qualitative research (Huber & Van de Ven, 1995; Yin, 1989), particularly in areas of nascent theory (Edmondson & McManus, 2007). For this reason I used qualitative techniques to study a set of strategically important small groups, specifically, drug development teams, at one of the world's largest pharmaceutical firms. Operating in a highly dynamic environment, these teams had to perform multiple routines, from assessing medical feasibility to conducting financial analysis. Because the tasks they were charged with involved considerable novelty, their existing routines were often inadequate. They therefore had an incentive to alter their routines to make them more efficient and effective. This created a natural setting for studying changes in routines.

Using an inductive approach, I propose a process model of vicarious learning with four subprocesses. The first of these, "identification," describes the process by which a group finds another group with prior related experiences. This helps to uncover routines and other kinds of knowledge that are relevant to how the group performs its existing routines. The second, "translation," describes how group members translate the identified knowledge into a vernacular that speaks to their own context, helping them reach a judgment about its value. Third, "adoption" details the way in which the group enacts changes in routines. Through this process vicariously learned knowledge is embedded in an existing routine, thereby changing it. Finally, "continuation" describes the process that determines whether a group continues to rely on the changed routine.

Several new insights emerged from the model. First, although the assumption in most research is that the identification of relevant external sources of knowledge in resource-constrained environments comes about through search triggered by a specific problem (e.g., Cyert & March, 1963), in this research I found that the search for other experienced groups frequently commenced from "day 1"—the very beginning of a team's efforts—even before members knew of the problems they might face. This calls into question the notion that groups working under time pressure only seek out others to learn from when they have a good idea about what they are looking for. Rather, they may do this as part of their modus operandi, regardless of particular conditions, in anticipation of problems or opportunities that are not yet known. Second, the existing literature posits that groups rely on their own ability to recognize the value of new external knowledge (i.e., rely on their "absorptive capacity" [Cohen & Levinthal, 1990]), when translating identified knowledge. However, I found that groups frequently also relied heavily on the capacity of the group that was the source of the knowledge to transmit its value. This highlights vicarious learning as a collaborative effort that may require as much commitment from the experienced group as from the group attempting to learn from that experience.

Third, although existing research tends to imply that new routines are adopted through copying, this study revealed several distinct adoption modalities, ranging from copying to extensive adaptation. This challenges the prevailing notion that vicarious learning occurs mainly across contexts that are essentially similar, suggesting instead that im-

portant lessons may be learned across very different contexts—with an unexpectedly diverse set of means and ends. Fourth, the study showed that whether a group continued to rely on a changed routine was determined not only by the group's experience of its outcome, as predicated by existing research (Feldman & Pentland, 2003), but also by the outcome experienced by others. In other words, this study sheds new light on the reasons why a group will continue (or not continue) to rely on a vicariously learned routine change and suggests that these reasons may themselves be vicariously learned.

In sum, for every step of the process I uncovered evidence that was aligned with existing conceptions but also insights that could not be inferred from prior work. More generally, the findings suggest that to understand better the link between vicarious learning and changes in group routines requires looking beyond the notion of finding and copying best practice to a more textured process by which vicarious experiences are adapted to specific circumstances. Importantly, this is a process that is two-sided in that both the group that is seeking experience and the group that is the source of the experience play critical and varied roles from beginning to end. As such, the central contribution of this study is to the literature on how changes in routines occur in groups (Edmondson et al., 2001; Feldman & Pentland, 2003). The study also advances understanding of how such changes might relate to group outcomes (e.g., Argote et al., 1990; Darr et al., 1995). Finally, the study contributes to the team learning literature: By explicating how vicarious learning happens, it sheds light on how the interaction between external and internal learning activities in teams is enacted (Argote & Miron-Spektor, 2011; Bresman, 2010; Wong, 2004).

THEORETICAL BACKGROUND

Organizational Routines

A review of organizational routines research reveals that elements of action, repetition, and multiple actors are common to most conceptions of routines (Parmigiani & Howard-Grenville, 2011). Given this understanding, I view routines as repeatable patterns of interdependent behaviors (cf. Cyert & March, 1963; Edmondson et al., 2001; Feldman, 2000; Nelson & Winter, 1982). It is further helpful to see routines as entailing an "ostensive" aspect (a plan or an idea) and a "performative" aspect (behaviors involved in actually performing the plan) (Feldman & Pentland, 2003). This notion, from structuration theory (Barley, 1986; Giddens, 1984; Orlikowski, 1992), is not an explicitly labeled component of the model introduced here, but it is useful to surface these ontological assumptions because they help to account for the fact that a routine often retains its original label and objective even as it is changing (Feldman & Pentland, 2003). For example, as described below, assessing medical feasibility is always an important routine in a drug development team's task; its inclusion in the task is unchanging (the ostensive aspect), but the way it is performed (the performative aspect) often changes as a team strives to improve its execution.

Routine change and knowledge are closely related. A routine is a form of knowledge (Zellmer-Bruhn, 2003) associated with behavior (e.g., Nelson & Winter, 1982) that is interdependent and involves multiple actors (Becker, 2004, 2008; Dosi et al., 2000; Greve, 2008). Although routines also exist at the individual level, this study focuses exclusively on organizational routines. The concept of routines thus has clearly identifiable boundaries. The concept of organizational knowledge is more ambiguous, which is why theoretical work tends to be premised on knowledge categories (Bingham & Eisenhardt, 2011), such as codified versus noncodified (Kogut & Zander, 1992) and declarative versus procedural (Moorman & Miner, 1998), rather than on knowledge in general.

Although the concept of routines is clearly bounded, the process leading up to a change in a routine that is based on the experience of another group involves other kinds of knowledge as well. Through the process of changing a routine via vicarious learning a group absorbs a range of knowledge that is then embedded in the changed routine. As discussed below, a routine change is often enacted in response to a defined problem (Cyert & March, 1963), for example, and the understanding of that problem is knowledge that does not constitute a routine. So though the focus of this study is routines and how they change, the broader notion of knowledge is central to any description of what a group gleans from another group's experience when changing a routine. It is with these distinctions in mind that I review the existing research on routine change and learning.

Routine Change and Learning

The notion of routine, with its emphasis on stability, invokes permanence rather than change, and hence may not be immediately associated with learning. Yet routines commonly undergo change (Feldman, 2000). A surplus of time and other resources may trigger routine change; here, this organizational slack is used to search for opportuni-

ties to do things in novel ways (Cyert & March, 1963). Such slack is rarely found in the dynamic organizational environments focused on here, where typically specific problems trigger routine change (e.g., Nelson & Winter, 1982). These may include disruptive events such as new demands from management (Becker, Lazaric, Nelson, & Winter, 2005) and organizational restructuring (Zellmer-Bruhn, 2003); performance feedback (Greve, 2008); events that lead to expectations of change in future performance (Bhardwaj, Camillus, & Hounshell, 2006); or issues surfacing when a team engages in a routine (Feldman, 2000). Whatever the nature of the trigger, it leads to a "problemistic" search for a solution to the problem (Cyert & March, 1963). Problemistic search is biased, motivated, and simple-minded: biased because it is guided by experience, motivated because it starts in reaction to a specific problem, and simple-minded because it proceeds sequentially from the basis of a model of causality in which the solution is believed to be close at hand until failure to find this local solution prompts a search in more distant locations.[1]

A common premise in the literature on organizational routines is that routine change comes about through learning (Cohen et al., 1996; Levitt & March, 1988)—the process by which experience alters an agent's behavior (Argote, 1999; Miner, Ciuchta, & Gong, 2008). Organizational theorists have long agreed that learning in organizations can take place either experientially or vicariously (Ancona & Bresman, 2007; Haunschild & Miner, 1997; Huber, 1991; Levitt & March, 1988; Madsen & Desai, 2010; Miner et al., 2008). Understanding of how routines change through experiential learning is good, because this has been the primary focus of research on routine change (Cohendet & Llerena, 2008). For example, Feldman described the learning process involved in routine change as involving group members "doing things, reflecting on what they are doing, and doing different things (or doing the same things differently) as a result of the reflection" (2000: 625). Similarly, Edmondson and her colleagues described group routine change based on experiential learning that occurs when teams are introduced to new technologies (Edmondson et al., 2001), showing how successful teams promote improvement through collective reflection. More recently, Rerup and Feldman (2011) studied the way experiential learning links the enactment of routines with the enactment of schemata.

Less is known, however, about routine change through vicarious learning. Yet the literature suggests that in building on routines learned by others, a group can speed up its process and improve its output (e.g., Argote, Gruenfeld, & Naquin, 2001; O'Leary, Mortensen, & Woolley, 2011). Losing out on such lessons and simply relying on the direct experiences of group members can lead to inefficiencies and quality problems (Szulanski, 1996). Indeed, the findings of a series of studies on learning curves by Argote and her colleagues indicate that routine change based on vicarious group learning does occur, can have significant performance effects (e.g., Argote et al., 1990; Darr et al., 1995), and may even be a source of sustainable competitive advantage (Argote & Ingram, 2000). They did not investigate the process of vicarious learning, however, and relied on performance improvements to deduce vicarious learning. Furthermore, as noted, vicarious learning is typically taken to involve finding and copying (Baum et al., 2000; Haunschild & Miner, 1997; Miner & Haunschild, 1995). More recent work examining the specific mechanism of team member rotation as a means to transfer routines across groups (Kane, 2010) showed that such routine adoption increased when rotated members shared a social identity with their new group and the new routines were demonstrably superior. Still, a salient omission from the literature is that it does not address how learning happens.

In summary, existing research: (1) identifies a number of triggers that lead to search for new or different routines, (2) suggests that groups change their routines through learning, drawing either from their own experience (experiential learning) or that of others (vicarious learning), (3) explores how groups change routines through experiential learning, and (4) indicates that routine change through vicarious learning does happen and can have significant performance benefits. But *how* groups change their routines using the experience of others remains unclear, and it is this failure to fully understand the way groups change routines and the way routines diffuse through groups and organizations that is the basis of the question guid-

[1] Problemistic search has been characterized as "a problem in search of a solution." In other work, March and his colleagues described a form of problemistic search that may be better characterized as "a solution in search of a problem" (Cohen, March, & Olsen, 1972). More recent research has investigated another variation on problemistic search: "broadcast" search, a notion that has emerged with the internet (Jeppesen & Lakhani, 2010). Broadcast search is similar to problemistic search in that it is biased and motivated by a problem, but differs because it is not simple-minded—solutions are sought near and far simultaneously.

ing this research: *How do groups change their routines using vicarious learning?*

METHODS

Research Setting

Research design. The existing literature did not contain enough detail to allow me to deduce hypotheses related to the research question (Edmondson & McManus, 2007). Therefore, I used a multiple-case research design as the basis for inductive theory development, an approach regarded as particularly appropriate to "understand how routines evolve" (Parmigiani & Howard-Grenville, 2011: 446). By "inductive" I mean that the theory presented here is emergent; it is "situated in and developed by recognizing patterns of relationships among constructs within and across cases and their logical arguments" (Eisenhardt & Graebner, 2007: 25). In other words, it starts with specific observations from which general patterns are identified and theory developed. Moreover, the multiple-case approach enables a replication logic, central to theory building, in which cases are treated as a series of independent experiments (Eisenhardt, 1989; Yin, 1989). The theory-building process itself, then, occurs via recursive cycling among case data, emerging theory, and existing literature (Eisenhardt & Graebner, 2007).

Empirical setting. The research presented here is the result of a two-year study of drug development teams at a pharmaceutical firm referred to as Pharmaco. The product of a recent merger, the firm provided an empirical setting with two distinct sites referred to here as Sigma and Beta. The newly hired senior vice president of licensing granted access to the sites as part of a drive at Pharmaco to expand its network in academia.

All teams of the study were "in-licensing" teams, groups charged with locating, researching, and negotiating the acquisition of a drug discovered by an external source, typically a biotechnology firm. Figure 1 provides an overview of the in-licensing process. For pharmaceutical firms, in-licensing has emerged as a strategically critical task in the wake of the molecular biology revolution. It is an attractive empirical setting for the purpose of this study, because it is a team-based operation dependent on precision and complex state-of-the-art routines. Teamwork in this task environment requires a high level of interdependence and intense interpersonal interaction. Hence, it is a context in which one would expect both routine change and team-level learning to be generally important. The in-licensing teams at Pharmaco were particularly suitable for a study of vicarious learning, not only because the drugs the teams worked on originated outside their own research organization, but also because the practice of in-licensing itself was relatively new to the firm. Moreover, critical human resources were scarce and could not easily be acquired. As a consequence, the focal teams could not rely on an established system of well-honed routines, something they could have done to a great extent had they worked on an internally originated drug in the traditional drug development process. The opportunity to draw on the related experiences of others who had trodden a similar path was thus a valuable option.

Routines in the empirical setting. Given the technical nature of the work, it is useful to describe how in-licensing teams conduct their work and the role of routines in the empirical setting. In-licensing teams are project-based groups. In the current research setting, each team had 8–14 members, referred to as "core" team members, who were engaged in their team's project from beginning to end. In addition, numerous "support" team members joined each project for part of its duration to help carry out certain routines. Most members were scientists representing functional areas such as discovery research, preclinical development, clinical development, and supply. The members' status as scientists is important because it helps explain the essentially nonhierarchical nature of team interactions. Although each team had a nominal leader, differences in authority were largely informal, minor, and a function of expertise level rather than formal status. Team members were co-located, and interactions were primarily face to face.

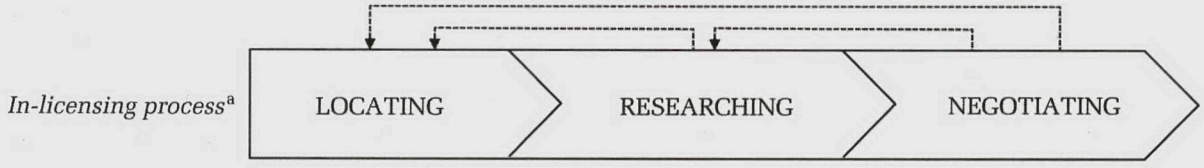
At the launch of an in-licensing project, a team is formed to execute a strategic decision to acquire an early-stage drug in a particular therapeutic class. The first step, locating the drug, begins with an effort to find as many prospective drugs as possible in the targeted therapeutic class. It ends with a decision, based on nonconfidential information, to take a closer look at one drug. The second step, researching the drug, starts with the acquisition of confidential data from the licensor and involves the analysis of all aspects of the drug. This step ends with a formal recommendation from the team either to acquire the drug, in which case the team moves to the next step; or to not acquire the drug, in which case it tries to locate another one. The final step, negotiating an acquisition, involves pursuit of an agreement with a licensor. This often overlaps with the research step, and iterations are common. If an agreement is reached, then the project is concluded. If not, the team goes back to step one for another cycle. Management may instead decide to disband the team, though that did not happen in

any of the cases studied here. Note that each team typically goes through numerous cycles before project completion. One implication of this is that routines learned in an early cycle are often repeated during a project.

For each step, an in-licensing team needs to perform a range of routines. These include developing a list of potential targets when locating a drug, assessing medical feasibility when researching a drug, and conducting financial analysis when negotiating the acquisition of a drug. Figure 1 captures many of the most important routines and how they relate to the in-licensing process. All routines require active involvement from most team members because effective execution depends on input crossing functions. Furthermore, many of the routines listed in Figure 1 may include "routines within routines" (Feldman & Pentland, 2003: 614). For example, the routine of assessing medical feasibility includes the pharmacokinetics test routine (a test of what the human body does to a drug). Although this may seem to introduce ambiguity about what a routine is, in the context of this empirical setting it is quite clear: a routine is essentially any repeatable pattern of behavior that requires a set of people to execute it. Once a routine is broken down to a level at which its execution involves only one team member, it is no longer considered a routine for the purpose of this study. As described below, the two coders independently assessed enactment of routines, and few disagreements emerged.

Some routines are always part of the in-licensing process and always executed the same way. One example is the formalized procedure by which every team member signs off on the request to a licensor for confidential data. Other routines are always part of the in-licensing process, but their execution typically varies with context; assessing the medical feasibility of a drug is an example of such a routine. Still others are not part of every in-licensing project, such as assessing regulatory feasibility (required for international transactions only). There are routines that team members know well and others that are less well known. There are routines that the members know how to perform in some contexts, but not in others. Each time a routine is less well known (in general or in the context of a specific project), it typically needs to be changed—to speed it up or to improve its quality. In such instances, teams face an implicit choice: to either change the routine themselves through expe-

FIGURE 1
Routines in the In-licensing Process



Routines[b]

• Lead generation process	• Negotiate nondisclosure	• Assess goals
• Identify key networks	• Assess strategic fit	• Identify decision makers
• Map sources of information	• Assess economic potential	• Assess needs and interests
• Develop target list	• Assess proprietary position	• Identify potential conflicts
• Identify targets	• Assess medical feasibility	• Assess leverage
• Prescreen strategic fit	• Assess regulatory feasibility	• Negotiate term sheet
• Prescreen economic potential	• Assess technical feasibility	• Conduct business due diligence
• Prescreen proprietary position	• Assess licensor competence	• Financial analysis
• Prescreen medical feasibility	• Develop product plan	• Contracting
• Prescreen regulatory feasibility	• Analyze implications for deal	• Negotiate final agreement
• Prescreen technical feasibility	• Data management	• Make case for top management

[a] *Locating*—A project team is formed to execute a top management decision to acquire a drug with a certain profile. The first step begins with finding as many leads as possible matching the profile. It ends with a decision to research one drug, requiring top management approval.

Researching—The second step starts with acquiring confidential and detailed data from the licensor and involves the analysis of all aspects of the drug. It ends with a recommendation to top management from the team. If the recommendation is positive, then the team moves to the negotiating step; if it is negative, then the team moves back to the first step of locating a drug.

Negotiating—The last step involves the pursuit of an agreement with the licensor to acquire the drug. Iterations back to researching are common during this phase. If an agreement is reached, then the in-licensing process is concluded and the drug integrated into the internal product development process; if not, then the team moves back to step one. Alternatively, the team may be disbanded.

[b] *Routines*—All routines require active involvement from team members representing many or all of the following functions: discovery research, preclinical development, clinical development, regulatory development, supply, finance, and patent. They are hence all enacted at the group level. The routines shown here are important examples, but they do not constitute an exhaustive list. Many of the routines include important subroutines.

riential learning, or to turn to others, seeking to change the routine through vicarious learning.

Data Collection

The primary sources of data were semistructured interviews with individuals and real-time observation of teams. Altogether I conducted 92 interviews, not including numerous follow-up conversations. Of the interviews, 54 were taped; some were not taped owing to confidentiality concerns. Interviews lasted between 30 minutes and three hours but were typically 90 minutes long. I conducted the first six interviews, which can be characterized as familiarization interviews, mainly with top management, with the goal of gaining mutual trust and understanding as well as establishing an infrastructure for the research project. Some features of the latter were a confidentiality agreement, a sponsoring letter from top management explaining the impetus for my research at Pharmaco, my own corporate telephone number, and an R&D director who became my internal research assistant on the project. Having selected eight project teams for in-depth study (the selection procedure is described below), I conducted team-specific interviews and engaged in real-time observation to build case histories of the teams' work. Because of the high level of detail desired, I conducted two to three follow-up interviews for each case and had interviewees review case descriptions and add information. I structured the interviews around a guide that contained open-ended questions related to team process as well as probing questions about how teams engaged in learning.

Additionally, I attended management meetings, project team meetings, presentations by management consultants, conferences, and workshops. This real-time observation was complemented with numerous conversations—in corridors, at restaurant tables, on domestic and transatlantic flights spanning four countries and two continents. Furthermore, I had access to secondary sources from Pharmaco, such as internal newsletters, e-mail correspondence, project reports, process manuals, and strategy documents. Finally, at the end of each day on site I wrote field notes with general observations.

The sampling frame used to select cases included three criteria designed to facilitate comparison: samples of teams on the two sites should be in the same therapeutic program; samples of projects at the two sites should be in therapeutic programs that were comparable in terms of the kinds of processes and technologies involved; and all sampled projects should involve molecules at a similar stage of development. The senior vice president of licensing felt strongly that sampled projects had to be relatively recent to be useful and therefore added the criterion that any project studied must have been concluded no longer than 15 months prior to my research. Finally, to enable the study of how routines change as they cross groups over time, the senior vice president and I selected projects on the basis of chronology; that is, we wanted to chose projects that started at different points in time so that we could look at how teams learned from the experience of teams that preceded them. With the help of the research assistant, I identified a total of eight project teams that fitted the sampling frame. Table 1 describes the eight cases. Team membership did not overlap, with one exception: a member of BetaOne also worked with BetaTwo. The pseudonyms chosen to label the groups of the study (SigmaOne, SigmaTwo, SigmaThree, SigmaFour, BetaOne, BetaTwo, BetaThree, and BetaFour) signify the site associated with each project and its place in the chronological order of projects studied

TABLE 1
Descriptive Group Data

Unit	Team	Therapeutic Area	Duration[a] (Months)	Members per Team[b]	Interviews per Team[c]
Sigma	SigmaOne	Infectious diseases	10 (June, year 1–March, year 2)	12	9
	SigmaTwo	Infectious diseases	12 (December, year 1–November, year 2)	14	12
	SigmaThree	Infectious diseases	5 (December, year 2–April, year 3)	12	12
	SigmaFour	Infectious diseases	8 (September, year 3–April, year 4)	9	Real-time data
Beta	BetaOne	Oncology	6 (November, year 1–April, year 2)	11	9
	BetaTwo	Oncology	5 (September, year 2–January, year 3)	8	8
	BetaThree	Oncology	6 (December, year 2–May, year 3)	9	9
	BetaFour	Oncology	10 (September, year 3–June, year 4)	9	Real-time data

[a] The years during which the projects took place have been disguised at the request of Pharmaco.
[b] Refers to core team members with major responsibilities.
[c] Not including numerous phone calls and follow-up conversations.

at the site. SigmaFour and BetaFour were investigated in real time, whereas the other six teams were studied retrospectively. Data for teams studied in real time were obtained by observation in team meetings, a few of which were taped, coupled with continuous probing of team members about the evolving process. The design allowed me to both trace phenomena backwards and follow them forward as they occurred. The combination of retrospective and real-time data is helpful because the former promote collection of multiple observations of routine change (improving external validity), and the latter enable understanding of how events unfold (leading to better internal validity) (Bingham & Eisenhardt, 2011; Leonard-Barton, 1990).

Data Analysis

As is appropriate in inductive research, I started out by building individual case histories with a view to leaving further analysis until all cases were completed (Brown & Eisenhardt, 1997), thus maintaining the independence of the replication logic (Yin, 1989). Once the case stories were written, I checked with a number of informants for each project that the stories I had crafted corresponded with facts. After the individual case histories were developed, the research assistant reviewed them to form an independent view. Specifically, the histories were used for both within-case and cross-case analysis. Within-case analysis centered on how each team changed its routines through vicarious learning. Given the focus on process, I closely tracked the sequence of events in each case. Once a clear understanding of the individual cases was established, cross-case analysis began. Tables and graphs to facilitate cross-case comparisons were created as the case histories were revisited to identify similarities and differences across cases. Events and behaviors that emerged were carefully coded.

For each emerging insight, the original field notes, interview notes, and tapes were revisited to further refine the understanding of events. Though the study was based on no a priori hypotheses, comparison with existing research was added to highlight similarities and differences, sharpen definitions, and develop the emergent theory's generalizability. The iteration between theoretical insights and data improved definitions and relationships between constructs. Notably, although the existing literature does not systematically examine how routines are vicariously learned, a two-step process can be deduced by which a routine is first found and then copied. Darr and his colleagues (1995), in an example noted earlier, described how a better boxing arrangement that improved the workflow was invented at one store of a pizza franchise. They then described how other stores in the same franchise discovered and copied the routine. From my data, it soon became clear that what was emerging did not align with the two-step process that can be extrapolated from the literature. These data were independently coded by the research assistant and by me. As a further check, two researchers with no prior exposure to the research were asked to read the original interviews to form independent views of the cases. Specifically, the data revealed that before an identified routine change was adopted, teams went through a process of translation to judge its value. Furthermore, the data revealed that after a routine change was adopted, teams experienced a separate process during which the continued use of the changed routine was determined. Thus, from a lengthy iterative process, a process with four distinct subprocesses emerged, which is described in detail below.

In work with interviewees' recollection of past events—a significant component of this data analysis—retrospective bias may be an issue. This may entail recall problems. A related concern is halo error (i.e., the risk that general feelings about the outcome of a process may color judgment of the process itself). Research on teams has shown that retrospective judgments about team processes (e.g., about quantity and type of communication) are typically not significantly affected by halo error, even if team members widely shared awareness of team outcome (Bresman, 2010; Haas & Hansen, 2005). In this study, the focal concepts were of a kind less likely to be affected by halo error (e.g., types of team activities were explored, rather than team performance); furthermore, ultimate project outcomes were not known at the time of this research (none of the drugs had reached the market). Therefore, retrospective bias should not be a significant issue when interpreting the findings of this study.[2]

[2] Even so, two additional measures were taken to mitigate concerns about retrospective bias. First, I compared data from the two groups that were studied in real time with data from the six teams that were studied retrospectively to detect any discrepancies in how the process was described. No discrepancies between real-time and retrospective accounts emerged. Second, I gained access to internal newsletters, project reports, and e-mail correspondence pertaining to SigmaOne, SigmaTwo, and SigmaThree. The records were not complete and not focused on aspects of vicarious learning specifically. They were produced in real time, however, and are thus useful for triangulation. Retrospective responses assessing aspects of vicarious learning corresponded well with the archival records.

Boundary Conditions

Each routine in this study is embedded in a group and its structures and is specific to its context (Becker, 2004). This has implications for generalization of the study's findings. Therefore, in addition to the description of the research setting, a description of some general features of the context should be useful. As noted, the focal groups operate in a dynamic environment characterized by constant change, resource scarcity, and time pressure. They do not have organizational slack—that is, more resources than their task requires (Cyert & March, 1963). The routines the groups perform are complex and shifting; routines developed by one group are seldom a perfect match for another group, and execution requires mindfulness (Becker, 2004). Moreover, these are self-managed teams, or collections of individuals working interdependently on tasks for which they hold themselves mutually accountable (e.g., Hackman, 1987). Although some degree of hierarchy typically characterizes teams (Coriat & Dosi, 1998), hierarchy was not pronounced in the groups in this study. As noted, the studied teams worked mainly face to face rather than virtually. This made them different from groups such as "communities of practice" (Cohendet & Llerena, 2008).

In sum, the empirical setting is one in which group routine change based on the experience of others is likely to be valued and in which the focal groups have the agency to pursue vicarious learning opportunities if they perceive a need to do so. They are not, therefore, representative of all organizational groups—nor was such representation the goal of the research design. Indeed, research based on the case study method can neither claim representativeness nor test theory (Siggelkow, 2007). As Cohen and his colleagues pointed out, the high cost of data collection associated with field studies of routines is justified because its purpose is to provide "essential grist for theory development" (Cohen et al., 1996: 681). This purpose notwithstanding, it is important to be explicit about and aware of the study's boundary conditions so that the applicability of its findings can be thoughtfully assessed.

ROUTINE CHANGE AND VICARIOUS LEARNING IN GROUPS

From these rich data, a detailed account emerged of how teams changed their routines by engaging in vicarious learning. This is captured by a model with four subprocesses labeled identification, translation, adoption, and continuation. I chose the labels in view of the field data and the theory that emerged from them, using the process described above. Figure 2 presents a general overview of the process. For reasons of space, I use illustrative examples from only a few of the studied teams in this section. Data from all teams are shown in Tables 2–5.[3]

Identification

How does one group, henceforth called "seeker," identify another group—or "source"—with prior

[3] Most interviews were conducted in a language other than English. Therefore, a majority of the quotes in the text and in the tables are translations.

FIGURE 2
A Process Model of Routine Change Based on Vicarious Group Learning

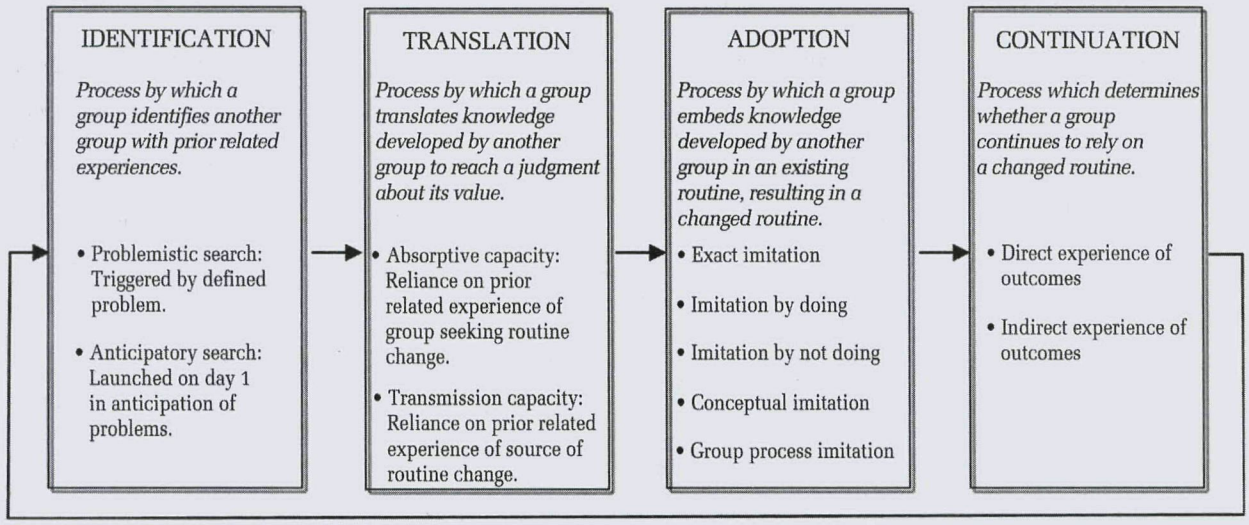


TABLE 2
Identification Subprocess

Team	Examples of Anticipatory Search
SigmaOne	"I sat down by the lab computer, started to talk to the guy next to me, and it turned out that the efficacy issue he had worked on earlier was as relevant to me as to him. . . . I asked him 'what else' and it was amazing how much I left with. Really really important things that I had no idea were out there [in the organization]. . . . That's how a lot of it happened. From the start we got in touch with a bunch of different people, different teams, as many as possible, in different places, and we learned from them a great deal of what we had to do . . . and how to do it."
	"You know you are going to have a problem, but you don't know what it is. The trick is find out, and then, find out how to deal with it. That's why we fanned out right away to ask people about the landscape. . . . And then we understood that we needed to develop a target list, that we needed to spend serious time keeping top management in the loop, and so on. . . . And at the same time we could start to ask about procedures and processes to deal with the challenges we found."
SigmaTwo	"It starts with going all out to talk to people, many people, about their experience. It's all very unstructured, but it's important to do it and to continue to do it. You must find the opportunities. Before we even had our first [SigmaTwo] team meeting, I went to dinner with [members from SigmaOne]. Nice place, we talked a lot about the wine. Of course, I was going to bring up the project at some point, but they did it first. . . . They talked about what they didn't have and what we would need. . . . I hadn't even thought about asking about all the things they told me. Things like the need to assess strategic fit, to analyze implications for deal structure, and how to do it. . . . It was Klondike."
	"I'm a numbers guy, I like to think of it as options. We made a lot of connections from the start. Big, small, far, near. You don't expect all of them to pay off. But those that do get us a whole lot in terms of what we have to know about and what we have to do."
SigmaThree	"For an outsider it might have looked like cluelessness. From the get-go . . . we asked around in all kinds of places, all the time, without actually knowing the questions to ask. But people were understanding. They knew how tough our task was. . . . Some of what we found was frustrating, some of it quite positive, much of it unexpected . . . the pieces started to come together. We found more of the right questions and more of the right answers as we went along. In particular, we found out what a big deal it was to assess regulatory feasibility, and we found out about ways to deal with it."
	"We first went around asking, on the phone, and through our networks. And asking about what we needed to know, what we needed to do. But then you need to listen. . . . Do you know what really happens is . . . you go down the hallway and you hear someone saying something and you go 'Oh my god, we didn't even realize.' . . . That's, for example, how we figured out the need to prescreen [technical feasibility] early."
SigmaFour	The team, which was observed in real time, searched intensely for others with relevant experience from the outset. Some probes led nowhere, others were critical. For example, team members identified members from SigmaTwo responsible for biostatistics in that team from whom they learned how different the procedures involved in analyzing large and small compounds were. Before SigmaTwo talked to them, the SigmaFour members did not view the differences as critical. Afterwards they did.
BetaOne	"There were a lot of 'unknown unknowns.' That we knew. Which really means we didn't know much. . . . I walked around the cafeteria, let people know what I was doing. Then you hope that people will hear and get back to you, and some did. . . . Others got in touch with people at places they used to work. One guy got in touch with a consultant. This went on all the time, from the kickoff. The topics changed, but it went on all the time. In fact, it was from the [teams found in this way] that we learned about such things as term sheets and business due diligence . . . how we could do those things better."
	"Honing in on the real issues often includes an element of serendipity, a chance conversation or meeting, and that's why it is so important to have many of them . . . from the start. You need to put yourself in a position to get lucky. We were actually very methodical about it in the sense that we generated as many chance conversations as possible without wasting time. We learned a lot about prescreening that way, we learned a lot about the need to assess the licensor's competence that way."
BetaTwo	"We started out with looking everywhere for leads and we kept doing it, to find lessons learned, others to talk to about the [project]. . . . For example . . . you spread the word that you are working on a [project], then you sit like a spider in its web waiting for something to be snared. . . . You never know what it's going to be, but often it's something good. . . . See, when you don't know what the problem is you don't know what to ask."
	"The scoping of potential challenges and how to manage them started broadly, and we looked pretty much all over the place in no particular order . . . and we did this from the beginning."
BetaThree	"In the team meeting several of us said 'what they hell do we do now?'; we didn't know enough. . . . What we did was to ask, ask, ask, everyone. About the problems we would face, about what we needed to solve them. . . . Quality assurance was one thing that popped up as a real issue, and we started to ask people with more experience about practices and different tests to do quality assurance in different functions and how to integrate across functions."
	"You hope to come across stuff about how to work [more effectively] by talking to many different people who might know something . . . teams that have done it before . . . . That takes time. . . . But sometimes it's the best way to save time, to go out there from the first day to find lessons learned."
BetaFour	The team, which was observed in real time, engaged in relatively few instances of anticipatory search, though it did occur. For example, one team member attended a workshop at the very beginning of the project specifically to identify experienced others to connect to.

TABLE 3
Translation Subprocess

Team	Examples of Interaction between Seeker and Source
SigmaOne	"It's difficult to work on a compound of a class that you haven't worked on before. It is even more difficult when no one else has either. And we had no other teams at [Sigma] that had worked on in-licensed compounds in infectious diseases before. . . . We were in luck and found this guy [whose team had worked on similar issues before]. There were big differences between the drug we were working on and the one they had been working on. But using their experience and what we knew about the drug we had enough to design an experiment that had the chance to succeed." "It is hard to understand the results, how it is done, the language. So getting together with old colleagues [who had worked on similar issues] helped to understand the language and figuring out how things should be done, what could be done, what'd been done."
SigmaTwo	"A few days after we first talked, they [members from SigmaOne] came over to our office and we spent hours in our conference room. It was incredible. They brought this list of do's and avoid's that they had written as part of their post mortem, and we went through it together. For every point we discussed what it meant and what it meant for us. Did it apply? Did it not apply? Why? Why not?" "Quality assurance is always tricky when someone else [the licensor] has done the preclinical trials. This was a Phase III drug and we needed to be detectives, retracing the history of the compound. And as I said, we couldn't do it, so we found some more experienced detectives to work with [from SigmaOne] who could help us understand what the clues meant, whether we needed to investigate them further or not. They couldn't do it all for us, and we knew more about some things that they did, but it definitely helped. We wouldn't have understood what we had without them."
SigmaThree	"And sometimes it is that the language is different. You think you know what something means, but you don't. In this case we were working with a large molecule, and most of us were familiar mainly with small molecules. But even if you know that these are different kinds of molecules, sometimes you forget. And they [SigmaTwo members] helped us understand that we didn't understand the vocabulary. And then we came up with a new vocabulary together that everyone could understand. And you must do this before you try to use what others have done." "So these two guys who had worked with [SigmaOne] made us realize that the supply issues we were facing were even more complicated that we had realized. In fact, pulling from their own experience they painted a scenario where it seemed almost impossibly difficult [to break even]. But some of us also had at least some experience and we pushed back, and we explained why their experience had to be translated because our situation was different in important ways, and in the end we agreed that we could use some of the formulas [in the financial model], some of the assumptions that they used, but not others."
SigmaFour	The team leader of SigmaFour and one other member met with SigmaThree members twice to reach a judgment about whether the experience that they had had with structuring the confidentiality disclosure agreement in their project was applicable to the project that SigmaFour was currently working on. The SigmaTwo team was very knowledgeable about the general differences between analyzing large and small compounds. SigmaFour members met several times to gauge the extent to which that general knowledge was applicable to the specific project that they were working on.
BetaOne	"We interviewed people . . . asked what they thought had gone well, what they thought had not gone well, what they could have done better. Then, together with them, we tried to figure out the difference between their experiences and our situation, to assess what was relevant and what wasn't. . . . A lot of what they had learned . . . was applicable to some extent." "We developed a 'skeleton' of how we thought we might do it, then we started to walk around with this skeleton and knock on people's doors . . . to have them 'squeeze' it, to hear what they thought. This was a way we could bring their experience to bear. . . . Most of it we couldn't use, because no one had worked on the same class before, but some of it could be tweaked and used."
BetaTwo	"We had these experienced people . . . and we started an advisory group. They felt a certain loyalty since they had gone through similar things. . . . They demonstrated a lot of the things we needed to do in the lab so we could observe them work. . . . They shared the mistakes they felt they had made and told us what they would have done differently and how they thought we could work on our project more effectively. . . . Then we questioned their advice, but being very appreciative of course, and then they adjusted, until we had a sense of what we might use." "To have a chance to actually watch those who are doing similar [work in the lab] is gold. Some things are very difficult to describe in words. . . . You learn lessons you wouldn't have. . . . You can talk about how your task is different from theirs. . . . They say, 'This is what worked for us,' and we say, 'Can't do that because of this'; 'OK then,' they say, 'but then we can change this thing over here, then it will work for you too.'"
BetaThree	"It was best when people from [BetaOne] came over so that we were together in the lab fiddling with the system. If they had just sent over their specs, chances are nothing would have happened. But now we could talk directly about . . . how we could improve on what they had done. . . . The trick is to know what lessons are actually helpful." "You talk about what they did right and about how this can help you, or maybe can't help you, with the challenges your team is facing. . . . We didn't do this enough. It takes time."
BetaFour	Member who assessed metabolism got together with members from BetaTwo in order to assess whether anything that team had learned was useful. They came up with very little at first, then a computer modeling procedure that seemed helpful. Several members in charge of patent issues had a conference call with their counterparts in BetaOne. They identified some issues that were similar, others that were somewhat similar, and some that were not similar at all.

TABLE 4
Adoption Subprocess

Team[a]	Exact Imitation	Imitation by Doing	Conceptual Imitation	Imitation by Not Doing	Process Modification
SigmaOne (12)	"In terms of the [drug] market, there are no dummies and we talk about our past [drug] heritage, but that was ten years ago. So we used the competitive analysis [developed by in-house strategists] and used it precisely. Because we would forget who we were up against."	"You can get the learning curve going, so that you don't have to reinvent the wheel. . . . But at some point you have to learn yourself, get your hands dirty. Otherwise you can't . . . do [test]." "We received [lab tech] and directions from [other group], but it took time for us to learn to use."	"So for example, such assumptions about how to structure milestone payments are valid, but they have to be revisited." "Price is dependent on how it is positioned and how it is perceived. These two P's [learned from another team] guided us."	"We try to make original mistakes, not repeating old ones. . . . We try to find showstoppers by talking to people who have done this before, instead of finding them ourselves." Learned from others not to use the assumption "market growth will continue at current rate."	"We had many misunderstandings with [the licensor] in the beginning. A team that had worked with them before told us, 'You must have many many informal meetings to break the barriers. Travel.' So we changed to a more informal process and it worked much better."
SigmaTwo (25)	"I carried this card in my wallet that we got from [SigmaOne] with the buckets that go into the heads of agreement. Up-front payments, milestone payments, royalty, and so on. [We] don't have enough experience. But when [we] followed those point by point, people thought [we] were smarter than we were." Copied SigmaOne procedure for analyzing patent situation.	"We were given the instrumentation used by [SigmaOne], and a guy even took time to show us how to use the equipment. But still it took quite a while before we had learned how to operate it. This is something of an art. . . . Once we had learned how to use it, it was great." "The [SigmaOne] life cycle model was not plug-and-play. We needed practice."	"Marketing makes all kinds of assumptions . . . and one of the sets of assumptions they make is how much of this potential drug can be resold outside of the U.S. . . . And sometimes the assumptions are better and sometimes worse. So, we had to throw out some. . . . For example, in some communities you would never put something underneath your tongue."	Skipped lab test found unnecessary by SigmaOne. "[SigmaOne] had assumed that with the introduction of [drug] there would be a period of patent protection where the generics would be unable to enter the market for a period of time in South America. But it was wrong and we didn't make that assumption."	"'Don't hesitate to be extremely explicit in your team meetings,' [SigmaOne] told us. 'Assuming that something is understood without verifying it is a disaster.' At first we didn't understand why this would be different from any other team, but soon we did and we really used that advice." Adopted SigmaOne process of "checking team commitment" before licensor meeting.
SigmaThree (33)	"There was a lot back-and-forth with [SigmaTwo] about it. In the end . . . [we] bought the exact equipment they had and used their procedure exactly." "[SigmaTwo] had developed this checklist of criteria to use when evaluating the proprietary position of a [drug]. It was great. We used that process as ours." "The receptor-binding plots were elegant. We copied [procedure] after a long talk with them."	"With the permission of the licensor we sent [team members] to the lab at Stanford to do similar experiments [to what SigmaTwo had done]. We used their method, but we were doing it in an evaluatory way . . . with some trial-and-error." "The output looks great, but learning how to use the [SigmaTwo] software, it took plenty of hands-on learning."	"We, the scientists, took information from what [SigmaOne] had done and from our lawyers and tried to mix it all together to come up with something that was better and better for us." "We took [SigmaTwo's] advice to negotiate marketing under one label in Brazil, but it needed extensive work to do. Implementation was very different."	"People from [SigmaOne] came and suggested that certain people at that company were slimy. And so that was taken at face value. We did not deal with them." Commenting on decision not to do a formulation test, because SigmaTwo experienced it as a waste of time: "The only thing I take is their conclusion because I trust them." Canceled absorption test found pricey by SigmaTwo.	"We were racing to get going, but [SigmaTwo member] pushed hard for us to slow down. He felt that you've got to take your time at the outset to plan or else the team will break down from conflicts and disagreements later on. 'You won't regret it,' he said, and we didn't." Adopted a SigmaTwo process, "going around the table" after each meeting for each person to summarize the "most important thing."
SigmaFour (45)	Team wanted to present the drug as a "breakthrough agent" rather than a new drug in an existing class. They used a presentation from SigmaThree to make the case—and only changed the drug name in the argument.	Member 1: "Can't we use [SigmaThree's] forecasting?" Member 2: "Well, we could. But it will take a lot of time. Not as easy as you think." After extensive practice with the software, SigmaFour used it successfully.	The general habit of asking "Do we really measure the right things?" at every possible juncture was adopted and applied to, e.g., old animal studies that had already been done by others.	SigmaThree had a very long list of "prelaunch activities" (down to hiring needs in case of success). In hindsight, much of the time spent on this list was wasted. SigmaFour, therefore, chose a different procedure.	Drawing on advice from SigmaThree, the team agreed on a "flag early" rule to guide the team process, meaning that if any member saw a problem of any kind they should "raise a flag" so that everyone was aware.

(Continued)

TABLE 4
(Continued)

Team[a]	Exact Imitation	Imitation by Doing	Conceptual Imitation	Imitation by Not Doing	Process Modification
BetaOne (8)	"The cost of marketing approval varies, and we need to consider costs on a territorial basis. This is hard, it takes time, and we didn't have time. So we used a [way to analyze] from another project and we didn't change it."	"When we first ran an elimination test it raised a lot of issues. It was based on a different team's tests. Turns out we didn't do the test right. We had to do and adjust. . . . In the end we could trust the results."	"[We] asked about profit numbers in Europe. [An experienced team] responded that in the U.S. profit is higher because of higher cost of the drugs. This helped us [analyze] what forms of the drugs would be most profitable."	"Other teams had showed details, what kind of promotional expense in terms of direct mail, details, samples, etc., for our finance folks. But they said, 'That's starving resources,' so we felt we didn't have to do that."	"Others we talked to who had done licensing emphasized how important it is to create an atmosphere for 'fun in the process.' In-licensing can be very frustrating. We tried a few things, but it's difficult to find the time."
BetaTwo (15)	"Price raised a whole lot of issues. In some certain markets it is illegal to co-promote. In Italy, it is illegal to co-promote and you can't talk about price. We needed to talk to [licensor] where we should co-promote, and we used the [BetaOne procedure] with no changes."	"[Licensor] accepted our plan for pharmacology study but would not send us substances just for testing. So we needed to simulate. We could ask [BetaOne] for help, but [their drug] was different. We needed to do a lot of fine-tuning, make our own mistakes."	"Perhaps if [BetaOne] had prepositioned itself better, it could have achieved more earlier on. We used this concept of 'prepositioning' a lot, as a guide, when we talked about how to launch, where to launch, when to launch, and a lot of other stuff we did."	"[Competitor drug] is in the traditional market. [This drug] is in the [nontraditional] market. Have you got nonsteroidals in a different class? The answer is yes. This offers another opportunity. [BetaOne] missed this opportunity and pushed us not to do what they did."	"A guy from [BetaOne] stopped by a meeting we had, and suddenly he interrupted and shouted, 'Time out! What are your goals? What do you want to do?' And we realized we needed to step back and clarify a few things before we could have a productive meeting."
BetaThree (7)	"[BetaTwo] strongly urged us to enter clauses in the agreement to ask for a sample for testing resistant isolates. . . . We used a procedure of adding clauses exactly as they did."	"It is difficult to test for resistant isolates. [BetaTwo] helped a lot, but in the end we had to figure out the details ourselves. . . . This took a lot of experimentation, a lot of trying."	"BetaOne used scenario planning, so we did too. But we had [a strong rival], and they didn't, so our exercise was very different. . . . We did 'launch first,' 'simultaneously,' 'after.'"	"We have to make a real commitment, but the commitment must be to the right things. [BetaTwo] thought it was useless to be committed to promotional intensity early, and we skipped it."	"[BetaTwo] told us to continuously 'update our environment.' Trends, competitors, etc. They had become insular. We tried to change our process to do more of that."
BetaFour (7)	"I think [points to member] makes a good argument. We must consider differences. But we also must realize that [BetaThree's] process for analyzing [patents] is all we have, and it seems solid. We will use exactly as is. . . . We've spent a long time talking to them about this. They think it works."	[BetaFour] designed many of its experiments without consultation, but for one test [distribution of substance throughout the tissues of the body], it lacked equipment and asked BetaTwo. After substantial learning by doing the team made the borrowed equipment work well enough.	Drawing on the concept of customer-driven pricing, which was used by BetaTwo, and on the concept of competition-driven pricing, used by BetaThree, the team devised its own pricing process, a mix of both concepts.	BetaTwo listed "expansion into OTC segment" as a critical success factor. In hindsight, it turned out that the OTC market was not very interesting for the focal class of drugs. BetaTwo relayed the lesson learned to BetaFour, and the team struck the OTC research from its list.	The team heard from BetaOne that they had to work hard on goal clarity and role clarity, and members set up a meeting in which everyone was asked to formulate the team goals and their own roles as they understood them. A number of discrepancies were uncovered in this meeting.

[a] The number in parentheses is a frequency count of each team's routine change adoptions based on vicarious learning. Coding was based on transcripts and interview notes. Adoption was considered to have occurred when two or more informants described the same event.

TABLE 5
Continuation Subprocess

Team	Examples of Continuation Based on Direct and Indirect Experience
SigmaOne	"The experiment to test efficacy that we set up based on [the experiences of another team] worked really well. We kept using it for other leads that we wanted to test for the project." (Direct experience)
	"A major issue in the early formulation development was the lack of analytical methods at [the licensor], and we didn't have the expertise either. . . . We transferred a process used by a group in Groningen. However, we could not detect changes in the drug quality with this method. But the group in Groningen was very enthusiastic, and we didn't have an alternative, so we continued to use it." (Indirect experience)
SigmaTwo	"The [do's and avoid's] list we developed with [SigmaOne] turned out to be phenomenally helpful. There's no way we could have done as well without it. We relied on it over and over again." (Direct experience)
	"Our efficacy study results were good. They indicated a dose-efficacy correlation that was required in the [Minimum Acceptable Profile]. But [SigmaOne] raised suspicions regarding the lot we used. They had detected the presence of endotoxins and poor bioactivity using a similar lot. . . . Therefore, we changed the study design. . . . The material was replaced by in-house material with higher bioactivity. We used this every time after that." (Indirect experience)
SigmaThree	"The financial model that we put together with [SigmaOne] was very reliable, very robust. It became an important tool in our toolbox. Every time it gave us numbers we could trust." (Direct experience)
	"We established a draft version of the clinical development plan. . . . Scoring was regarded as reasonable. In December, the clinical team visited two opinion leaders who had developed clinical protocols for scoring together with [members of SigmaTwo]. They regarded their system as more reasonable for our purposes. So we had a good experience with our protocol, but we changed it anyway because they had more experience and we trusted their expertise more, and we used it for every cycle after that." (Indirect experience)
SigmaFour	A biostatistics for large molecules roadmap provided by SigmaTwo was successfully used early in the project. The team returned to it repeatedly over the next several months." (Direct experience)
	A licensor rejected an initial proposal involving an equity investment (in accordance with advice from SigmaThree). SigmaFour was skeptical that the equity investment procedure was the best way forward. SigmaThree, drawing on that team's experience, convinced SigmaFour to continue with proposals that included the equity investment component, and they continued to use it in every instance for the rest of the project. (Indirect experience)
BetaOne	"People told us that we should work with [an independent research firm] to help us with analyzing the drug actions. Apparently they'd had a great experience with them. . . . Meeting with [the research firm], we concluded that there was little mutual interest to discuss further, and the scheduled meeting in December was canceled." (Direct experience)
	"This product is a whole new ball game, and so when someone outside the team said 'in our experience this drug was too complex to produce for the generics firms' we added that assumption to our model . . . and we added a whole bunch of other assumptions, procedures, but we didn't always know if they were correct assumption and procedures for us. We only knew that they had been correct for someone else." (Indirect experience)
BetaTwo	"We had a workshop with our advisory group about how to find a 'wow' factor to present to [the licensor]. We were really dumb about this, but they knew a lot of things we could add to make the presentation sexier. It really worked and we kept using them." (Direct experience)
	"Patients were advised to take [the drug] on an empty stomach. . . . It's interesting, we used this [procedure] because [BetaOne] did. But we don't know that it matters. We don't know that it makes a difference." (Indirect experience)
BetaThree	"Some of the things [BetaTwo] said, about how to test for interactions with some enzyme proteins, were really good, really important. We had important results. This became an important part of our efficacy tests." (Direct experience)
	"We kept testing for resistant isolates just as [BetaTwo] had said. I'm not sure whether it was needed, we didn't see anything, but kept testing anyway." (Indirect experience)
BetaFour	Team members responsible for analyzing drug metabolism received help from members of BetaTwo to set up a computer procedure. Results were satisfactory, and team members continued to use the routine for the duration of the project. (Direct experience)
	The team was happy about its cooperation with a large supplier of a key ingredient of the drug under investigation. BetaTwo cited a negative experience with the same supplier (the supplier had filed suit in two European countries for infringement of patent in a manner seen as extremely aggressive by SigmaTwo), whereafter BetaFour decided to find another supplier. (Indirect experience)

related experiences from which to learn vicariously how to change its routines? The central activity of the identification process is the search for sources to consider in the profusion of possibilities. As mentioned, the classic theory posits that in dynamic environments this kind of search is likely to be problemistic (Cyert & March, 1963). Indeed, several instances of problemistic search emerged from the study; in response to a specific problem, the seeker first approached the potential source most likely to offer a solution, as the following scenario illustrates. A critical routine for any drug development team is to assess medical feasibility. This involves ensuring the safety and the efficacy of the drug. An important subroutine is the pharmacokinetics test mentioned earlier. Although members of SigmaTwo needed to alter the test they had previously used to fit a new drug, they did not have the

experience to do so themselves. In short, they knew they had a problem and what the problem was. Therefore, they sought out members of another team who were considered likely to have recently conducted a similar test. In this way they identified a test they could potentially use to better fit the drug under investigation, as well as experienced others who could help them use it.

Interestingly, another kind of search behavior emerged (summarized in Table 2) that did not seem to fit the classic definition of problemistic search, because it was neither motivated by the need for a solution to a defined problem, nor was it simple-minded. In particular, it was distinct in that the teams engaged in this search behavior from the outset of each project before knowing what specific problems they would face. I refer to this as "anticipatory search," since it is conducted in anticipation of as yet undefined problems among sources near and far that might help define and address those unknown problems.

One example of anticipatory search emerged from the experience of the BetaTwo team that had been charged with in-licensing a drug in a new therapeutic class. Few team members had any experience with this class of drugs. The person responsible for clinical development described how the team searched for sources that could help them:

> From the early days we were all over the place . . . I walked over to the building [where a former BetaOne member was working], knocked on the door, and asked, "What do I need to know that I don't know that I need to know?" . . . I e-mailed a friend from grad school asking if he knew something, I called someone I had met at a conference recently, I posted messages on [two listservs], I asked people in the cafeteria almost at random whether they'd done any in-licensing lately. . . . The point is that I asked as many people as possible, and I continued to do that, and the others too. . . . Some [sources] made more sense than others [to ask], but we didn't really sit down to prioritize.

The majority of these probes did not lead anywhere, but some did. For example, one interaction led to the realization that members of the BetaOne team, who had already concluded their work, had a range of experiences that were relevant to the task facing BetaTwo. This helped uncover important knowledge relevant to BetaTwo's work, the most important of which related to the routine of medical feasibility assessment. The interaction led to the recognition that this routine posed a challenge, in particular the subroutine concerning pharmacovigilance (the science of evaluating information on the adverse effects of a drug), for which the team lacked detailed threshold values for various aspects of the drug. Ultimately, the anticipatory search that helped BetaTwo identify members of BetaOne with relevant experience not only uncovered this problem, but also a subroutine that provided a promising start to solving it.

Reliance on anticipatory search may seem to be counterintuitive, particularly given the intense time pressure that the focal teams were under. Notably, March's (1991) widely cited work on organizational learning would seem to suggest that the exploration of unknown sources tends to be crowded out by the exploitation of known ones, particularly under conditions of no organizational slack, at least until the potential of the known sources has been exhausted. One reason that emerged here for why, despite intense time pressure, groups engage in anticipatory search is that it may ultimately save time. Indeed, several team members at Pharmaco professed to engage in anticipatory search in pursuit of efficiency gains. Specifically, by relying on a multitude of low-cost probes to identify experienced sources to learn from in both local and distal locations, they hoped to skip unnecessary steps, avoid repeating mistakes, and simplify existing routines.

Translation

Once a source with prior related experience has been identified, a seeker has to make sense of the routines and other knowledge developed by the source to reach a judgment about their value. The descriptive account in the literature of this translation process is to a great extent rooted in the widely cited notion of absorptive capacity—the ability of a firm or a group to recognize the value of external knowledge and then apply it effectively (Cohen & Levinthal, 1990). Specifically, the theory suggests that absorptive capacity is a function of prior related experience.

The data from this study, as seen in Table 3, present a more nuanced picture. Although not contradicting the literature, what emerged was an active process of translating the knowledge conveyed by vicarious experience into a vernacular of rules and conceptions that fit a group's own context. Through this translation process, a seeker judged whether the experience of the source could be built upon in its own context, and how. Most significantly, I found evidence that *both* parties, seeker and source, developed this vernacular together as they jointly engaged in discussion and problem-solving activities. The translation process was thus greatly facilitated in this way: by continuously verbalizing important issues and insights in conjunction with experiencing a problem-solving activity

together. What the evidence of this research highlights, therefore, is that success in recognizing the value of external knowledge is not merely a function of a seeker's prior experience but is also determined by a source's experience and, importantly, how the source applies this experience in the translation process. I refer to this as the source's "transmission capacity"—the ability of a source to recognize the value of its knowledge to other groups and how to apply it effectively in the context of those other groups.

Consider the case of SigmaFour as it grappled with how to perform financial analysis to determine the commercial viability of a drug. This constitutes one of the most important routines of the in-licensing process. Although they had competently performed financial analysis related to other drugs before, they lacked the necessary expertise pertaining to the new drug they were currently focused on, but they identified members of SigmaThree as having relevant and recent experience that they could potentially build on. They then needed to figure out to what extent this potential could be realized. In the exchange below, between a member of SigmaFour and a SigmaThree member, two members of SigmaFour had invited a former member of SigmaThree to discuss how the latter team had estimated the cost of an important drug ingredient:

> SigmaThree member: You must use the right metrics. The cost and the waste.
>
> SigmaFour member 1 (*irritated*): But what does that *mean*? That doesn't mean anything to me.
>
> SigmaThree member: Most people look at the cost of the amount of [the ingredient] that goes into the pill, but that's not enough. You need to know how much of it is wasted in the [manufacturing] process. A lot of [the ingredient] is wasted in the process. . . . Much more than we thought, and it came back to bite us. . . . It's a very inefficient process. So you might think it's cost effective, but it's not.
>
> SigmaFour member 1 (*very interested now*): I see, we need to know the cost and the amount we need [for the pill] *and* the waste.

This dialogue crossed the team boundary between the source and the seeker and then continued inside the seeking team. When the team member featured in the exchange above took his insights back to the team, the following exchange occurred:

> SigmaFour member 1: We need to take waste seriously. I think we should include it in the [financial] model.
>
> SigmaFour member 2: How much waste?
>
> SigmaFour member 3: I don't think it is as much in our case. Actually, I'm pretty sure. I did this [once before].
>
> SigmaFour member 2: So, how much waste?
>
> SigmaFour member 3: I think a third.
>
> SigmaFour member 1: A third of the number [SigmaThree] used?
>
> SigmaFour member 3: Yes.

Through these interactions across and within team boundaries, members of SigmaFour and SigmaThree together translated the experience of SigmaThree and found that although it did not apply perfectly, it was applicable enough to the new context for SigmaFour to consider adopting as part of its financial analysis routine. Taken together, a multitude of such interactions involving people from both teams helped translate many important components of SigmaThree's financial analysis routine into a language that was used to judge its applicability in the context of SigmaFour's task.

A parallel can be seen in BetaTwo's concerns over how to evaluate possible adverse drug effects as part of its medical feasibility assessment. BetaOne, a team that had faced a parallel issue earlier, had eventually developed a set of numerical heuristics. The application of these helped team members decide whether various data points in their pharmacovigilance test results called for further scrutiny. Seemingly simple, application was complicated by the fact that the process included multiple functional areas requiring the simultaneous participation of many team members. In determining whether BetaTwo could use the same heuristics, something of a "dance" ensued. First, the BetaOne member joined BetaTwo to help oversee a preliminary test. Then, having reflected further on the results, two members of BetaTwo had dinner with the BetaOne member and a colleague to discuss the topic further. Two BetaOne members decided to join BetaTwo for another test, and so on. Eventually, members of both teams jointly concluded that the heuristics developed by BetaOne could be applied by BetaTwo. As a BetaTwo member commented, "It took a while because it's important, but also because it was hard to know if both of us were really talking about the same thing. . . . It took some time to come up with a language that we all understood, so we could come up with a judgment that we all understood."

One reason why a seeker engages in a sometimes time-consuming translation process relying heavily on interaction with the source may be the context specificity of the routines involved (Hansen, 1999). Routines developed from experience are often con-

text specific. In the above example, it is clear that even though the notion of incorporating waste into the cost estimation routine was transferable, it needed to be translated to the specific context before the team could judge whether it could be adopted. The context facing BetaTwo was not identical to the context in which BetaOne had been operating. Furthermore, routines developed from experience are often not codifiable and not easily expressed (Hansen, 1999). As mentioned, it may be difficult for the seeker to know what to ask for, but the noncodified nature of a routine may make it just as difficult for the source to express it. For example, instead of simply explaining to members of SigmaThree how to run a complex toxicology experiment as part of the medical feasibility assessment routine, members of SigmaTwo ran the experiment while SigmaThree continuously asked questions. The experience led to SigmaThree adopting the same experiment as part of the team's medical feasibility assessment routine.

Adoption

Once a group judges that the knowledge of another group should be used to change an existing routine, how is it adopted? How does the vicariously learned knowledge get embedded in the existing routine, thereby changing it? According to existing research on vicarious learning in organizations, the adoption of indirect experiences largely transpires through copying (Baum et al., 2000; Denrell, 2003; Haunschild & Miner, 1997). As noted, however, such findings largely stem from studies of vicarious learning in identical and stable settings, unlike the dynamic environments focused on here. Indeed, evidence did emerge of adoption events that resembled copying, similar to those found in the literature, but the events in this research setting revealed more nuances than can be extrapolated from existing accounts. Specifically, even when parts of routines were copied, the process was not trivial, since typically a lengthy translation process preceded copying. For example, BetaTwo copied a subroutine developed by BetaOne, applying a set of numeric heuristics without adjustment to evaluate the results of pharmacovigilance tests. As a result, the medical feasibility assessment routine (of which pharmacovigilance is a key aspect) that team members had performed for other drugs was significantly altered. As indicated, the translation process preceding adoption was lengthy, iterative, involved many team members, and relied on a commitment from the source. The key point is that even when a group relies on "exact imitation" (the term used here for a mode of adoption that involves copying), the process is not without effort.

In all instances in which adoption (leading to routine change) involved exact imitation, the adopted subroutines or other knowledge could be described with precision in a codified format and were therefore relatively straightforward to adopt once they had been judged to be a good match. More often, however, the adopted knowledge was less easily expressed, required substantial tailoring, or both. As a consequence, the process of exact imitation was just one of several modes of adoption. What emerged was a wide range of adoption modalities with varying degrees and methods of adaptation. I define four distinct adoption modalities (in addition to exact imitation) that emerged from the data, with illustrative examples. Data are summarized in Table 4.

Some vicarious experiences were easy to understand conceptually but required significant trial and error to be adopted effectively as part of a routine. A common example was when one team learned from another about the need to use a certain kind of experiment or equipment. I refer to this mode of adoption as "imitation by doing," since adoption is achieved through a matching process in which a routine is imitated and then adjusted through learning by doing until it is performed to an adopting team's satisfaction. There were several examples of this among the focal teams. For instance, once SigmaThree had decided to adopt the toxicology experiment demonstrated to them by SigmaTwo, considerable practice was need before it worked as part of the medical feasibility assessment routine in their own context. Another example was recalled by a member of SigmaTwo:

> We were given the instrumentation used by [SigmaOne], and a guy from that team even took the time to show us how to use it. But still it took quite a while before we had learned how to operate it. This is something of an art. . . . Once we had learned how to use it, it was great.

A new subroutine for operating a piece of equipment offers limited opportunity for improvisation, but other subroutines can convey rules for generative and innovative routine change. Although the specific content may vary, there is an underlying concept or principle that can be adopted. I refer to this as "conceptual imitation" because once it has been learned, it can be used to generate routine change that goes beyond the routines used by other teams in the past. Using conceptual imitation, a team may enact routine changes involving anything from negotiation styles to information-processing procedures. Consider the following comment on

the financial analysis routine from a SigmaTwo team member:

> There are certain assumptions that drive the valuation and the target product profile. These assumptions are not static, but evolve over time. They also have to be adjusted. . . . It is very important that we can draw on the assumptions used by the teams before us.

Conceptual imitation can be incremental, as in the example above, but it can also be creative. Teams can combine aspects of various models that they have imitated into a constellation that differs substantially from the original models. The example of the contract design routine explained by another SigmaTwo member is a case in point:

> The contracts that we write have become more and more sophisticated. We have this library of old contracts from past projects that we sift through. . . . We go through them with the teams that wrote them . . . and we combine different clauses and techniques that have been used in the past into a new and better structure.

A team can also learn from another team what *not* to imitate. Although it may be argued that not doing something does not amount to routine change, it can be seen as a mode of adoption, because when part of a routine is removed as a result of learning from others' experience, the routine may be significantly changed. I refer to this adoption modality as "imitation by not doing." For example, having learned from SigmaOne that a particular lab test had not yielded useful information, the members of SigmaTwo decided to bypass the test altogether as part of its medical feasibility assessment routine, thereby saving significant time and resources.

The data presented so far have shown how teams at Pharmaco changed routines that were technical, in that they were associated with the drugs that were the focus of the teams' work. But there were also instances in which the application of others' knowledge resulting in routine change was associated with group processes: how roles were distributed, how decisions were taken, how members interacted with one another, and so on. I refer to this modality of adoption as "group process imitation." Experienced others took on a role akin to a professional coach in a formal leadership development setting, re-telling stories of where they went wrong and how they wanted the seeker to do better, how team members needed to challenge each other, step up to take responsibility, and communicate better. The following exchange, in which a member of BetaTwo challenged members of BetaFour in a team meeting, offers an illustration (as a result of the exchange, BetaFour went on to adopt an "always speak up" rule that BetaTwo had used).

> BetaTwo member: You don't question this enough. You don't question each other enough. We had the same issue, and it created a lot of problems. Communicate, use the same data.
>
> BetaFour member (*after awkward silence*): Maybe we avoid questions because we don't want to offend.

The multitude of adoption modalities that emerge from this research, in contrast to earlier work, may be traced to the fact that the focal teams operated in a dynamic environment. As a result, the contexts in which teams accumulated their experiences were never identical to those of the teams seeking to learn lessons from them. In some cases, once the value of knowledge developed in one context has been determined and described through the translation process, a team may conclude that the knowledge can be imitated exactly as part of a routine change. In others, a team realizes that tacit skills are needed for adoption (e.g., use of new equipment) and hence relies on imitation by doing. In yet other cases, the fit between the context in which knowledge was developed and the seeker's context may not be obvious, in which case conceptual imitation may be used to extract common principles, to improvise new solutions, and to develop new subskills, with a creatively forged changed routine the result. Essentially, when learning from experienced others, the seeker relies critically on a broad range of knowledge—about the skills needed for adoption, about the difference between the context in which the routine was first developed and the team's own context, and so on. It is during the adoption stage of the vicarious learning process that this broader range of knowledge becomes embedded in a changed routine.

Continuation

After a routine has been changed, a group may continue to use the changed routine, or it may consider making further changes. In this study, continued use is taken to mean that a group relies on an enacted routine change until the conclusion of a project without further alteration. The process of continuation determines whether a group continues to rely on a changed routine or not. Existing research suggests that continued use is determined by a group's direct experience of outcomes (Feldman, 2000; Greve, 2008). Feldman and Pentland (2003), for example, described how a group continued to interview job candidates via videoconferencing, after first adopting this method amidst a snowstorm, with a positive outcome. Similar in-

stances were found during this study. For example, BetaFour members continued using the "always speak up" rule that they had adopted from BetaTwo as part of their group process after they found that it worked.

The study also found that continuation was affected by indirect experience—the outcomes experienced by other groups. Consider once more the pharmacovigilance assessment made by BetaTwo relying on the set of numerical heuristics passed on to them by BetaOne. Once they had adopted the heuristics as part of the process to evaluate large data sets, the actual results came in far below the levels suggested by the heuristics that they used. Normally, this would be a good outcome, but in this case they were so far below the benchmark numbers that two members questioned whether they were really applicable. At the team meeting during which the topic was discussed, the person responsible for clinical development recalled one team member ending the argument by declaring, "If it was good enough for [BetaOne], it's good enough for us." The use of the heuristics from BetaOne continued without change.

Another example involves a screening procedure used in tests as part of comparing the medical feasibility of different compounds. SigmaFour used the procedure recommended by SigmaThree. Having used it once, they did not notice a difference compared to the older procedure. In fact, a few members expressed a preference for the older procedure that had been replaced, as they felt it was easier to use. Still, the new procedure was left in place in view of the satisfaction with the outcome of its use expressed by SigmaThree.

Trust is one factor that may determine whether groups accept the outcomes experienced by others as a basis for continuing to use a changed routine. If an experienced group is respected, a seeker may give them the benefit of the doubt, even though the seeker has not experienced the positive outcome itself. Another reason may be time pressure and scarce resources. If a team has other more pressing concerns, the routine change is left in place even in the absence of evidence that its use is beneficial. A comment from a SigmaFour member, made at a team meeting about the new screening procedure described above, captures both sentiments: "I think it is going to work. [SigmaThree] did a great job and I'm sure they've got this right too. Let's stick with this. And besides, we can't spend time shifting back [to the other procedure] right now."

Evidence further suggested that the dual processes associated with continuation (direct and indirect experience of outcomes) extend beyond the specific in-licensing-related routine to the process of vicarious learning itself. In other words, the reasons to continue relying on vicarious learning as a learning process were themselves learned both experientially and vicariously. When a group satisfactorily changed a routine by drawing on the experience of others, members would often continue to search for opportunities to refine the routine further based on vicarious learning. Furthermore, the experience of success spilled over to an increased propensity to use vicarious learning to find solutions to unrelated problems. For an illustration of a cycle of increasing reliance on vicarious learning, consider the experience of SigmaTwo. Early on the team had success in identifying a promising drug using a routine for identifying targets learned from SigmaOne. The success generated enthusiasm for going back for more. Said one member of SigmaTwo, "After a while we went straight to [SigmaOne] when we had a problem. . . . We went to them whether we thought we had a problem or not." The data also suggested that reliance on vicarious learning could be affected by indirect experience, as one SigmaThree member's account makes clear: "Only design experiments [yourself] if you absolutely must, that's what we learned from [a member of SigmaTwo]. 'Most of what you need has been done already [by others].' So I think what we did was asking around first, and only then . . . think about how to do it ourselves."

The data also showed some evidence of increasingly less reliance on vicarious learning in the wake of outcomes perceived to be negative. Notably, an advisory group was formed including former members of BetaOne with the purpose of helping BetaTwo to assess medical feasibility, and drug metabolism in particular, but the outcome of this collaboration was generally seen as disappointing. A BetaTwo member described how the team "talked to them, but didn't get much traction," and toward the end they seemed to have stopped trying. Interestingly, what emerged from the data was a process by which this disappointing experience appeared to spread to BetaThree. One member of this team, for example, described how a BetaTwo member "told us how it was a waste of time to try to [learn] from what others have done." It is notable that the number of reported instances of vicarious learning was considerably smaller in BetaThree than in BetaTwo (see Table 4) and that several BetaThree members specifically pointed to the negative experience of BetaTwo as an influence. This dynamic then appeared to spill over to BetaFour. This study is not designed to assess causality. Still, what emerges from the rich qualitative data is a cyclical pattern in which the propensity to continue relying on vicarious group learning as a

means to change routines is determined in part by past experiences (this characteristic is indicated with a feedback loop in Figure 2).

DISCUSSION

Starting from the premise that understanding how groups change their routines is central to understanding organizational change and renewal, this research is an attempt to advance theories about how routine change occurs in groups by exploring the role of vicarious learning. Although prior research has suggested that such learning has significant performance benefits (Argote et al., 1990; Darr et al., 1995; Kane, Argote, & Levine, 2005), it has not investigated the question of *how* groups change their routines through vicarious learning, particularly in the dynamic environments facing many groups today. In seeking to fill this gap, I have investigated how drug development teams at Pharmaco, a large pharmaceutical firm, changed their routines by engaging in vicarious learning. The emergent model reveals a process that is more variegated than it has previously been understood to be. This model is a contribution to the growing discourse on how group-level routines change and spread through organizations (Becker, 2004; Edmondson et al., 2001; Feldman & Pentland, 2003; Greve, 2008; Parmigiani & Howard-Grenville, 2011; Rerup & Feldman, 2011; Zellmer-Bruhn, 2003). Specifically, the process view that emerges from the study has important implications for understanding of how groups alter their routines by relying on vicarious learning. It also sheds light on how routine change based on vicarious learning might relate to group outcomes. This study further contributes to the team learning literature by providing new insights about how the interaction between external and external learning is enacted, thus helping the interpretation of inconclusive past findings.

A Process View of Routine Change Based on Vicarious Group Learning

The process model encompasses four key subprocesses that help better explain how groups change their routines in response to the experiences of others. First, *identification*—the process by which a group identifies another group with prior related experiences—was found to often commence from day 1 as an important modus operandi in and of itself, regardless of circumstances, rather than in response to a particular problem. I refer to this search pattern as *anticipatory search* because it helps group members anticipate problems and opportunities without having a clear idea of what these may be ex ante. Counterintuitively, identifying an experienced source need not involve problemistic search; that is, anticipatory search is not motivated by a specific problem. Furthermore, my finding—in contrast with the classic definition of problemistic search (Cyert & March, 1963) and consistently with more recent work on search in the innovation literature (Jeppesen & Lakhani, 2010)—is that anticipatory search is not simpleminded; that is, it does not progress sequentially starting with sources that are closest and proceeding to more distal sources only when the initial sources fail to produce a solution. Recognition that the search for experienced others is often anticipatory then calls into question the common assumption that groups operating in environments without organizational slack only seek to learn from others when they have a good notion about what to look for, and it suggests that vicarious learning of routines in dynamic settings should be viewed as a less deliberate and focused effort than previously understood.

Second, the *translation* of knowledge from one group to another often involved an intense interaction between a seeker and a source, whereby the knowledge conveyed by the experienced source was translated into a vernacular of rules and conceptions that fit the seeker's own context. This process emerged as critical because, in the dynamic environment studied here, the context in which the source accumulated relevant experiences tended to differ from the context in which the seeker sought to apply those experiences. Through this process the seeker together with the source arrived at a judgment of the viability of the source's knowledge and how it might be molded to the new context. Established theory holds that the ability of a seeker to recognize the value of external knowledge, or absorptive capacity (Cohen & Levinthal, 1990), is a function of the seeker's prior related experience. Although the findings do not contradict this view, they add to researchers' understanding by suggesting that a seeker's ability to recognize the value of a source's knowledge is critically determined by the source's active involvement in assessing the value of its knowledge together with the seeker. The ability of the source to recognize the value of its knowledge for others is termed *transmission capacity* because without this recognition the value may not be transmitted to the knowledge-seeking group. The findings of the translation process relate to Carlile's (2004) research, which points to the importance of addressing the interpretive differences that emerge when knowledge crosses functional boundaries. The present research highlights the

central role of translation across boundaries even when teams work in the same function and on similar tasks but in contexts that are not identical. The emergence of the role of transmission capacity in the translation process, in addition to absorptive capacity, highlights the importance of focusing on collaboration as a linchpin of vicarious group learning.

Third, *adoption*—the process by which a group embeds knowledge developed by another group in its own routine—was found to have five distinct modalities. The modality of *exact imitation*, through which a routine was changed by embedding copies of vicariously learned knowledge, was contingent on easily codified knowledge. Interestingly, even in cases in which knowledge was copied exactly, the process tended to be preceded by an often arduous translation process. This notion contrasts with existing conceptions of vicarious learning as copying, possibly because they tend to be based on research on how routines are copied in full across identical contexts (e.g., Darr et al., 1995), and such settings impose fewer demands on translating the value of experiences from one context to another. Imitation by doing was used when the vicariously learned knowledge was relatively easy to understand but required trial and error to adopt (e.g., the adoption of certain lab equipment). This modality is comparable to one noted in the findings from a study of template use in the transfer of sales processes (Jensen & Szulanski, 2007), though here the transfer occurred across contexts that were not identical. *Imitation by not doing*, whereby a routine is changed by omitting certain parts of it, was sometimes used when the context in which the knowledge was developed was judged to be sufficiently similar to the context in which it was adopted. Groups relied on *conceptual imitation* when vicariously learned knowledge included useful rules and concepts but implementation necessitated fundamental adaptation because of significant differences between the contexts in which the knowledge was developed and adopted. Finally, *group process imitation* refers to the process by which decisions were made, roles were assigned, and so on, in a group. Interestingly, such routine change typically emerged serendipitously when sources and seekers engaged in interactions related to more technical topics.

What emerged from the study was thus an adoption process that blended learning by doing, extracting concepts, and copying when changing a routine, the specific configuration of which was contingent on the nature of the knowledge and the contexts across which knowledge was being transferred. These findings relate to Orlikowski's (2000) work on an organization's adoption of a new software package (Lotus Notes), which emphasized the importance of seeing adoption as a varied and contextually dependent process. From the present study, a view emerged of routine changes somewhere in the range between exact copying and improvised experimentation and involving an array of modalities representing different degrees of adaptation. One important implication is that vicarious learning occurs not only across contexts that are similar, as predicated by existing research, but also across different contexts, by different means, and for different ends. This opens up the potential importance of routine change based on vicarious learning in settings that may not previously have been considered.

Fourth, *continuation*—the process that determines whether a group continues to rely on a changed routine—is a function not only of the group's direct experience of outcomes (Feldman & Pentland, 2003; Greve, 2008), but also of others' experiences of outcomes. The reasons for continued reliance on a changed routine may thus themselves be vicariously learned. This notion suggests that indirect experiences continue to influence a group's use of a routine even after it has been adopted and incorporated to an extent that has been overlooked by prior research.

A theme common to all four subprocesses is the need to recognize that change of routines based on vicarious learning is a two-sided process that involves not only the seeker of vicarious experiences, but also the source. When identifying a source, the seeker depends on the source to help, particularly when the process involves anticipatory search. Further, when translating the experience of an identified source, the seeker depends on the source's transmission capacity. The adoption process commonly involves the seeker going back to the source to resolve implementation problems. Finally, the choice to continue relying on a changed routine is often shaped by the outcomes experienced by the source. The two-sided notion of vicarious learning is important because it questions the common assumption that vicarious learning occurs essentially at arm's length (e.g., Baum et al., 2000; Haunschild & Miner, 1997) and sees the relationship between seeker and source as an interpretive lens through which to understand the process.

In sum, this study identifies four distinct steps through which groups change their routines through vicarious learning: identification, translation, adoption, and continuation. From each step data emerged that were in some cases expected, and in others surprising. Together they comprise the first empirically grounded process model of the

behaviors that groups rely on to incorporate routine change based on the experience of others. The importance of the model is that it reveals a process that is both more precise and more varied than can be deduced from prior research. It therefore advances understanding of how routines change occurs in groups as a result of vicarious learning, particularly in dynamic environments.

Rethinking the Link between Vicarious Learning and Group Outcomes

The process view introduced here has important implications for scholars and managers interested in the effectiveness and efficiency of groups. As noted, routine change based on vicarious learning has been shown to have positive performance effects (e.g., Argote et al., 1990; Darr et al., 1995), but existing research has focused on performance changes, leaving the process largely unexamined. Although this has been an important and fruitful avenue of inquiry, it has allowed a somewhat simplistic conception of vicarious learning as essentially a matter of finding and copying proven routines to persist. This study raises the possibility that a reliance on this conception may have caused existing studies to overlook instances of routine change via vicarious learning because the source may not have been a group doing the exact same work as the seeker, or because the routine ultimately enacted by the seeker may have been very different from that of the source. Moreover, as a basis for prescriptive recommendation, this conception is likely to be unhelpful in some instances, and it may even hurt. If copying is the assumed mechanism, then it risks being applied in situations where it should not. For example, if a group copies a proven routine developed in one context and applies it in a different context, it might create problematic outcomes. Therefore it is important to recognize that vicarious learning should not only be seen as find and copy, but also as a process by which a routine is adapted, sometimes heavily, to specific circumstances. Showing how this happens is a key contribution of the model introduced here.

The model provides several specific clues about how the process works that have important implications for groups trying to make it work. First, the process view presented here suggests that to develop the ability to learn vicariously (which, as this research shows, is not a discrete skill), groups need to acquire distinct subskills in managing the processes of identification, translation, adoption, and continuation. Second, the study underlines a number of key preconditions that may need to exist for groups to realize gains from vicarious learning. For example, not only must experienced groups be willing to share their experiences—they may also have to be willing to spend significant time with less experienced group members to help them make sense of those experiences. Third, routine change based on vicarious learning may sometimes help groups perform faster (by skipping unneeded steps), and sometimes better (by adding subroutines to an existing routine), but not necessarily both. Different routine changes have different benefits and costs, and their value may be contingent on the needs and priorities of a specific group. If the priority is to work faster, then a vicarious learning process that involves time-consuming interactions with an experienced group might not be worth the effort. This implies that the potential gains from routine change based on vicarious learning are more ambiguous than previously articulated and that groups may have different reasons to learn (or not to learn) vicariously. Although this study is not designed to explain variance in group outcomes, it does provide some important reasons and clear directions for future research that reconsiders the link between vicarious learning and the effectiveness and efficiency of groups.

Team Learning: Understanding How External and Internal Learning Activities Interact

The central contribution of this study is to the literature on how changes in routines occur in organizational groups, yet it also contributes to the fledgling team learning literature. Students of individual-level learning have long recognized the importance of looking beyond trial and error toward vicarious learning. As Bandura (1977) noted, we do not teach children how to swim using only their own experiences of success or failure—we also provide them with external models to learn from. By contrast, until recently students of team learning have tended to focus on internal experiential learning. This lack of attention to how externally oriented learning activities complement internal ones is, at least in part, a function of the relative youth of team learning as a field of study (Bresman & Zellmer-Bruhn, in press; Edmondson, Dillon, & Roloff, 2007). More recently, some important advances have been made in understanding of how external and internal learning processes interact, but as Argote and Miron-Spektor (2011) pointed out in a review, findings are inconclusive. Some studies have shown a negative interaction between external and internal learning activities (Wong, 2004), but others have shown a positive relationship (Bresman, 2010). The authors proceed to argue that understanding the causes of these apparently

contradictory findings is an important question for future research (Argote & Miron-Spektor, 2001: 1127).

This study provides some possible answers. Specifically, it suggests that the direction of the interaction between external (vicarious) learning and internal (experiential) learning activities is contingent on the task environment in which a team operates as well as the outcome that it seeks. In the dynamic environment in focus here, teams run the risk of doing harm to their task if they do not spend enough time learning experientially how to translate and adopt lessons that have been vicariously learned from another team's context. This risk is less salient in a stable environment in which the context of the seeker is similar to that of the source. Hence, a lesser amount of experiential learning is likely to be required in a stable environment to complement the vicarious learning—it may even amount to wasting valuable time. Relatedly, the interaction between vicarious and experiential learning is likely to depend on whether the prioritized outcome is quality or efficiency. As noted, some routine changes emerging from this study helped teams perform better, but not necessarily faster. If efficiency is the prioritized outcome, therefore, the interaction between vicarious and experiential learning may turn out to be negative. Indeed, Wong (2004), a study cited by Argote and Miron-Spektor (2011), was largely conducted in a stable hospital environment and focused on efficiency-related outcomes, but my (Bresman, 2010) study in the dynamic pharmaceutical industry also included quality-related outcomes. In sum, by exploring how vicarious learning happens at the team level, this study helps researchers better understand how the interaction between external and internal learning is enacted and when the interaction can result in positive versus negative outcomes.

Future Directions

The groups studied here were time-limited teams operating in dynamic environments. They share features with many other strategically important groups, as noted earlier, yet they are not representative of all groups. The findings may not apply to groups that work in stable environments on simple tasks, ongoing groups that work without deadlines, or knowledge communities, such as communities of practice (Cohendet & Llerena, 2008), with no predefined tasks. For example, resistance to change (Gersick & Hackman, 1990) and resistance to learning from others (Katz & Allen, 1982) are well-known issues in organizational learning, but neither is salient in the context studied here. Specifically, change leadership was a defining characteristic of the tasks conducted by the teams, and members had elected to join, so it was not surprising that I was unable to identify "resistors." Furthermore, the need for external expertise was self-evident; hence the "not-invented-here" syndrome—an aversion to the ideas of others—was unlikely to find fertile ground (Katz & Allen, 1982). In other organizational groups, however, these are likely to be prominent issues. By articulating the key characteristics of the focal groups using rich qualitative data, I seek to contribute to the ongoing discussion about how vicarious learning processes related to routine change may differ across contexts. More generally, the process model proposed here makes no claim to perfection or completeness. The inductive insights presented should be rigorously tested empirically in the hope that they will move research toward more robust models of how organizational routines change through vicarious group learning.

The focus here is on how organizations learn by way of the groups that are embedded in them. But organizations also forget (Argote, 1999), and there is strong evidence that vicariously learned knowledge depreciates more easily than knowledge that is experientially learned (Madsen & Desai, 2010). The research design used here is not suited for exploring questions about knowledge depreciation, such as whether some kinds of vicariously learned routines are more resistant to knowledge depreciation than others, but it is an area for future research of central importance.

This research focuses on group-level processes rather than the work of individual group members. Research on boundary spanners (Allen, 1977) and knowledge brokers (Hargadon & Sutton, 1997) has demonstrated the critical importance of key individuals in processes involving knowledge flows across boundaries. The role of specific individuals in the process of how group routines change through vicarious learning is therefore a promising avenue for future work. For example, having a "star" scientist on a team is likely to have an impact on the networks that the team can rely on in the process (Girvan & Newman, 2002).

Finally, studying routines empirically in the field "forces us to take a particular point of view" (Pentland & Feldman, 2008: 287). The definition of routines used here is designed to be consistent with common conceptions (Parmigiani & Howard-Grenville, 2011), but it is important to acknowledge alternative definitions presented in the literature. In his review, Becker (2008) found that through the years scholars had used three broad conceptual categories when defining routines: rules, disposi-

tions, and repeated behaviors. He encouraged scholars to investigate the distinct contribution of each of these schools of thought. Others have argued that a better way forward is to agree on one definition and build on that. For example, Hodgson (2008) made a compelling case that routines should be conceptualized as dispositions, not behaviors. Pentland and his colleagues (Pentland, Haerem, & Hillison, 2010) countered with the argument that behaviors are the most appropriate foundation for empirical field work, since without observable behaviors one cannot know whether a routine exists. This debate seems to reflect a general pattern whereby conceptually oriented scholars tend to favor conceptualizations of routines as rules or dispositions, whereas empirical researchers more often view routines as actions or behaviors. My own perspective is that because routines are context-specific, and because the number of empirical studies to have investigated the content and change of routines in depth remains small, it is too early to agree on one narrow definition, particularly in empirical research. Rather, field research designed to explore the full range and nature of routines in organizations, taking the specific context on board, would seem to offer the most productive way forward (cf. Parmigiani & Howard-Grenville, 2011). In this pursuit, however, researchers should be explicit about our own definitions, boundary conditions, and empirical findings so that the discourse can continue unhindered.

Conclusions

Prior research has emphasized the importance of routine change within groups that is based on the experience of others. This research on drug development teams in pharmaceutical R&D—the first empirical study focused on how such change happens—demonstrates that the process by which groups change routines through vicarious learning is a more varied phenomenon than previously assumed. When analyzed in terms of subprocesses, changing routines through vicarious group learning is clearly revealed as rarely a matter of simply finding and copying best practice routines exactly and in full, but instead as better seen as a set of distinct interlinked activities unfolding over time, each with its own unique demands. This theory and these results advance understanding of how groups change their routines, particularly in dynamic organizational environments characterized by constant change and scarce resources.

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