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ORIGINAL EMPIRICAL RESEARCH

Bottom-up learning in marketing frontlines: conceptualization, processes, and consequences

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Abstract This study proposes a frontline learning process by which organizations capture new knowledge generated by frontline employees in addressing productivity-quality tradeoffs during customer interactions and transform it into updated knowledge for frontline use. Updated knowledge, in turn, is posited to influence customer satisfaction and financial outcomes (i.e., revenue, efficiency). Empirical testing with multi-source data reveals that: (1) knowledge articulation mediates the transformation of knowledge generated in the frontlines into updated knowledge, (2) updated frontline knowledge positively impacts customer and financial outcomes, and (3) frontline employee workload inhibits the transformational process unless it is at an intermediate level (inverted U-effect), while employee goal convergence bolsters it linearly.

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Research has acknowledged that new knowledge is routinely generated in service organizations as frontline employees interface with customers to customize or coproduce service solutions (Bohmer 2010; Roth and Jackson 1995). Dealing with heterogeneous customer needs and tackling productivity-quality tradeoffs often requires frontline employees to go beyond scripted routines (Singh 2000; Srivastava et al. 1998). When frontline employees interact with customers or exercise discretion to improvise solutions, their actions often entail new knowledge about evolving customer needs, persistent problems in service delivery, and ways of improving service quality and/or productivity. Such knowledge, if mobilized and captured, can be an inimitable source of competitive advantage (Grant 1996; Nonaka 1994). However, the process of frontline learning and capturing knowledge from customer interfaces has not been addressed in the literature.

Recognizing the potential of new knowledge at customer interfaces, service organizations are leading efforts to tap this potential (Parker et al. 2009). Starbucks recently assigned 48 frontline employees to interact with online bloggers and customers to capture knowledge and move it upward in the organization (Jarvis 2008). To develop original ideas for serving its customers, Vanguard relied on initiatives "conceived by frontline employees, not senior executives" (Gadiesh and Gilbert 2001, p. 78). Similarly, in reversing common mentoring practice, Best Buy tapped frontline employees as mentors for senior executives to bring frontline experiences to the top of the organization (Johnson 2005). Thus, Rayport and Jaworski (2004, p. 48) observe that frontline employees' "interactions with cus-

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tomers … are, for many businesses, the sole remaining frontier of competitive advantage."

Despite its potential, no study to date has developed a framework for understanding frontline learning or rigorously examining if it enhances organizational outcomes such as service revenue, efficiency of service operations, or customer satisfaction. This study takes a step toward addressing this gap by developing a multi-level model of frontline learning. First, to model how organizations harness frontline knowledge, we adopt a bottom-up learning perspective,[1] draw from existing theories of deliberate learning (e.g., Zollo and Winter 2002), and conceptualize the mechanisms by which knowledge is: (1) generated in individual frontline experiences, (2) captured by a group's articulation processes that triangulate, categorize, and analyze generated knowledge through collective efforts, and (3) updated by unit managers as they transform articulated knowledge into improved organizational routines. We also identify moderators that amplify or depress knowledge transformation processes by focusing on the impact of employee workload and goal convergence within organizational units.

Second, we focus on learning related to productivity-quality tradeoffs in frontline effectiveness (Mittal et al. 2005; Rust et al. 2002). We build on the idea that frontline learning related to productivity-quality tradeoffs is unique to customer interfaces (Singh, 2000), critical for organizational effectiveness (Mittal et al. 2005; Rust et al. 2002), and a leading indicator of long-term financial returns (Mittal et al. 2005). For example, in diagnosing Dell's customer service problems, Dick Hunter, head of customer services, observed that "to become very efficient, I think we became ineffective" (Jarvis 2007, p. 118) and subsequently increased service spending by 85% to train frontline employees to better manage productivity-quality tradeoffs. Evidence suggests that most service organizations find it difficult to harness knowledge related to productivity-quality tradeoffs but achieve superior long-term returns if they are successful (Marinova et al. 2008).

Finally, we examine the usefulness of frontline learning by assessing its impact on a unit's financial performance and customer satisfaction. Specifically, using primary data from 454 frontline employees and managers in 47 strategic business units as well as objective financial performance and customer satisfaction data, we examine the contribution of frontline learning to an SBU's customer satisfaction, efficiency in service delivery, and revenue per standard unit of work. We also test the frontline learning process by examining the influence of upstream processes of knowledge articulation and generation. Overall, our study provides initial insights into the mechanisms for transforming knowledge embedded in frontline activities and actions into updated organizational routines. It also casts light on the extent to which transformed frontline knowledge contributes to increased organizational effectiveness, thus substantiating its potential role in establishing a competitive advantage.

Frontline learning: theory and hypotheses

Organizational learning and market knowledge use have been topics of sustained interest in marketing as is evident from a review of the literature (see Table 1).[2] Past research has examined learning and knowledge related issues across diverse domains including marketing strategy development (Sinkula 1994), innovation management (Madhavan and Grover 1998; Marinova 2004; Moorman and Miner 1997), buyer-seller relationships (Johnson et al. 2004; Selnes and Sallis 2003), and sales and service management (Homburg et al. 2009; Sharma et al. 2000; Wang and Netemeyer 2002). Organizational learning is argued to be a key driver of competitive advantage (Sinkula 1994) by improving marketing effectiveness (e.g., Hanvanich et al. 2006; Hurley and Hult 1998), facilitating innovation processes, and enhancing new product performance (e.g., De Luca and Atuahene-Gima 2007; Homburg et al. 2009; Marinova 2004).

The literature review suggests that research in marketing on organizational learning is substantial and growing around coherent themes; however, it also reveals areas that have received less attention. For example, a common theme is the dissemination of market knowledge through a strategic goal-directed process (Maltz and Kohli 1996) initiated by top management, facilitated by a culture of learning orientation (Hurley and Hult 1998; Slater and Narver 1995), and implemented through cross-functional (De Luca and Atuahene-Gima 2007) and inter-organizational collaboration (Selnes and Sallis 2003). Most studies focus on top-down learning processes that involve codified knowledge and practices for guiding marketing

[1] Bottom-up learning is often distinguished from top-down learning by considering the processes that link explicit (codified/structured) knowledge and implicit (tacit/unstructured) knowledge (Nonaka 1994). Bottom-up learning generally involves processes that go from implicit to explicit knowledge, while top-down learning is associated with processes that go from explicit to implicit knowledge. Both processes are critical in market-oriented organizations (Day 1994). In this study, we focus on bottom-up learning processes.

[2] To keep the review focused, we included articles that: (1) used keywords of "organizational + learning" or "knowledge + management," (2) were published between 1990 and 2010, and (3) appeared in five marketing journals including *Journal of Marketing*, *Journal of Marketing Research*, *Marketing Science*, *Journal of the Academy of Marketing Science*, and *Journal of Retailing*. The articles are listed in chronological order.

Table 1 Summary of selected research on organizational learning[a]

Study[b]	Theoretical focus	Pathway of learning	Research approach	Key insights
Glazer (1991)	Information in marketing	Not specified	Conceptual	Information is an asset that needs to be managed carefully. The intensity of information of a firm has strategic and structural implications.
Menon and Varadarajan (1992)	Marketing knowledge utilization	Not specified	Conceptual	Knowledge utilization involves action-oriented use, knowledge enhancing use, and affective use. It is a function of the direct and indirect effects of both organizational factors, and informational factors.
Sinkula (1994)	Organizational learning	Not specified	Conceptual	Proposes a framework of market information processing and develops propositions that aim to advance our understanding of how organizations learn.
Slater and Narver (1995)	Organizational learning	Top-down	Conceptual	A culture of market orientation and entrepreneurship complemented by a climate of organic and facilitative leadership as well as decentralized planning produce organizational learning, which leads to a competitive advantage.
Moorman and Miner (1997)	Organizational Memory	Not specified	Empirical; survey data from 92 new product development projects	Higher organizational memory levels enhance the short-term financial performance of new products, whereas greater memory dispersion increases both the performance and creativity of new product.
Sinkula et al. (1997)	Market-based organizational learning	Top-down	Empirical; survey data from 125 executives	A learning orientation will result in increased market information generation and dissemination, which, in turn, directly affects the degree to which an organization makes changes in its marketing strategies.
Hurley and Hult (1998)	Innovation	Top-down	Empirical; survey data from 9648 employees from 56 organizations in a large governmental agency	Cultures emphasizing learning and market orientation encourage innovativeness, which in turn promotes capacity for adaptation and innovation.
Li and Calantone (1998)	Market knowledge competence	Not specified	Empirical; survey data from 236 executives from software industry	Three processes of market knowledge competence (customer knowledge process, marketing-R&D interface, competitor knowledge process) have positive influences on new product advantage, which, in turn, affects product market performance.
Madhavan and Grover (1998)	Knowledge management, distributed cognition	Not specified	Qualitative; interviews of members in five new product development teams	NPD management should emphasize cognitive team processes. Team members' and leaders' cognitive attributes and the team's process attributes affect the conversion of embedded to embodied knowledge.
Baker and Sinkula (1999)	Market orientation and learning orientation	Top-down	Empirical; survey data from 411 business executives from various industries	Market orientation and learning orientation have a synergistic effect on organizational performance.
Sharma et al. (2000)	Salespeople knowledge structures	Not specified	Both qualitative and quantitative data from 215 sales people from a major department store chain in the U.S.	Salespeople's knowledge structure elements (declarative knowledge and procedural knowledge) enhance their understanding of the antecedents of retail sales effectiveness.

Table 1 (continued)

Study[b]	Theoretical focus	Pathway of learning	Research approach	Key insights
Bell et al. (2002)	Organizational Learning	Not specified	Conceptual; literature review	Organizational learning is embedded in four schools of thought: an economic school, a managerial school, a developmental school, and a process school. Theoretical plurality is beneficial for advancing knowledge about organizational learning.
Wang and Netemeyer (2002)	Salesperson learning and self-efficacy	Not specified	Empirical; survey data from 147 real estate agents in a regional brokerage firm and 173 billboard advertising salespeople in a national advertising company	Salespeople's learning effort affects self-efficacy, which in turn influences sales performance. Perceived job autonomy, customer demandingness and trait competitiveness shape salesperson learning effort and self-efficacy.
Selnes and Sallis (2003)	Learning in customer-supplier relationship	Not specified	Empirical; survey data from 315 dyads of customer-supplier	Relationship learning promotes relationship performance. Trust reduces the positive effect of relationship learning.
Jayachandran et al. (2004)	Customer knowledge process and customer response capability	Not specified	Empirical; survey data from 227 retail firms in B2C and B2B contexts	Customer response capability (expertise and speed) mediates the effect of customer knowledge process on firm performance. Customer knowledge process also diminishes the positive association between risk propensity and customer response capacity.
Johnson et al. (2004)	Relational knowledge	Not specified	Empirical; survey data from 176 informants from multiple industries who were involved and knowledgeable about supplier relationship	Interactional, functional, and environmental knowledge stores affect relationship quality and relationship portfolio differently and the effects vary by levels of industry turbulence.
Joshi and Sharma (2004)	Customer knowledge and new product development	Top-down	Empirical; survey data from 165 marketing managers participating in NPD projects	Organizational actions enable customer knowledge development, and the characteristics of NPD projects moderate the effects of these actions on customer knowledge development, which improves new product performance.
Marinova (2004)	Market Knowledge diffusion and innovation	Not specified	Empirical, longitudinal quasi field experiment based on Markstrat simulation exercises	Market knowledge (level, change, and extent of shared knowledge) influences innovation effort. Innovation effort, by itself, does not affect firm performance. Total shared market knowledge helps smaller firms actualize better returns from their innovation effort than larger firms.
Brockman and Morgan (2006)	Organizational cohesiveness, knowledge use and innovation	Not specified	Empirical; survey data from 323 NPD managers from multiple industry	Organizational cohesiveness has a moderating influence on both an organization's use of its existing knowledge to develop new products and the resulting performance of these products.
Eisenstein and Hutchinson (2006)	Action-based learning	Not specified	Empirical; three experiments involving 248 college students	Action-based learning (repeated decision-making with outcome feedback) can be either accurate and efficient or errorful and biased.
Hanvanich et al. (2006)	Organizational learning	Top-down	Empirical; survey data from 200 executives who supervised inbound logistics in manufacturing firms	Under low environmental turbulence, learning orientation and organizational memory are positively related with performance and innovativeness; however, under high environmental turbulence, only learning orientation is a useful predictor.

Table 1 (continued)

Study[b]	Theoretical focus	Pathway of learning	Research approach	Key insights
De Luca and Atuahene-Gima (2007)	Market knowledge and product innovation	Top-down	Empirical; survey data from 363 marketing managers in China	Marketing knowledge specificity and cross functional collaboration affect product innovation through knowledge integration mechanism (KIM). The effect of market knowledge depth is partially mediated by KIM, whereas knowledge breadth has a direct effect on product innovation performance.
Homburg et al. (2009)	Frontline employee customer need knowledge	Bottom-up	Empirical; triadic survey data from 215 service employees, 370 customers, and 92 managers in Germany	Frontline employees' customer need knowledge fully mediates the influence of employees' customer orientation and cognitive empathy on customer satisfaction and customer value.
Lam et al. (2010)	Diffusion of market orientation	Top-down	Empirical; survey data from 1856 sales people and objective sale performance data in a Fortune 500 company	Formal middle managers and work-group experts are two types of important envoys that diffuse the market orientation of top management to frontline employees.

[a] The following criteria guided paper selection for this summary review: (1) publication in *JM, JMR, MS, JAMS*, or *JR* in the period of 1990–2010 and (2) theoretical focus on organizational learning or knowledge management

[b] Papers are listed in chronological order

action and strategies (Li and Calantone 1998; Marinova 2004; Sinkula et al. 1997). By contrast, bottom-up learning processes are given less attention (see third column, Table 1). More recently, studies have addressed this lacuna by acknowledging the importance of implicit knowledge embedded in customer interfaces and by studying the impact of salespeople's or service employees' learning and knowledge on sales or customer outcomes (e.g., Homburg et al. 2009; Sharma et al. 2000; Wang and Netemeyer 2002). However, in these initial studies, the unit of analysis is invariably limited to an individual service employee or salesperson level. As such, these studies miss the critical idea that bottom-up learning is essentially a multi-level process that involves transformation from *individual* level, implicit knowledge to *unit* level, explicit knowledge so that knowledge generated in frontline actions at customer interfaces is codified for frontline unit use.

This paper addresses the preceding gap by drawing on market-driven organizational processes (Day 1994), deliberate learning theories (Nonaka 1994; Zollo and Winter 2002), and frontline management (Singh 2000) to: (1) conceptualize frontline learning as a bottom-up process rooted in ongoing customer interactions and (2) model frontline learning as a multi-level process involving individual, group, and SBU entities (Fig. 1). We develop each in turn.

The nature of frontline learning

Definition We conceptualize frontline learning as a process for capturing the implicit knowledge generated in ongoing customer interactions by frontline employees, and transforming it into explicit, updated routines for use in organizational frontlines. Capturing and transforming knowledge for use are common to most definitions of learning capabilities. Both require mindful engagement in action (Langer 1989; Levinthal and Rerup 2006; Weick and Roberts 1993). New knowledge cannot be captured unless it is created in action by attentiveness to one's context and openness to improvisation, experimentation, and innovation (Weick et al. 1999). Likewise, newly acquired knowledge cannot be deployed unless it is first integrated among individual employees (Grant 1996) and then integrated with available knowledge by renewal, revision, or replacement of action repertoires. The notions of capturing and transforming knowledge are further clarified by the distinction between ostensive and performative routines (Feldman and Pentland 2003; Levinthal and Rerup 2006). The performative aspect of organizational routines refers to the "inherently improvisational" enactment of action as employees mindfully construct an action from a repertoire of possibilities given the specifics of the context they face (e.g., type of customer, problem, history; Feldman and Pentland 2003,

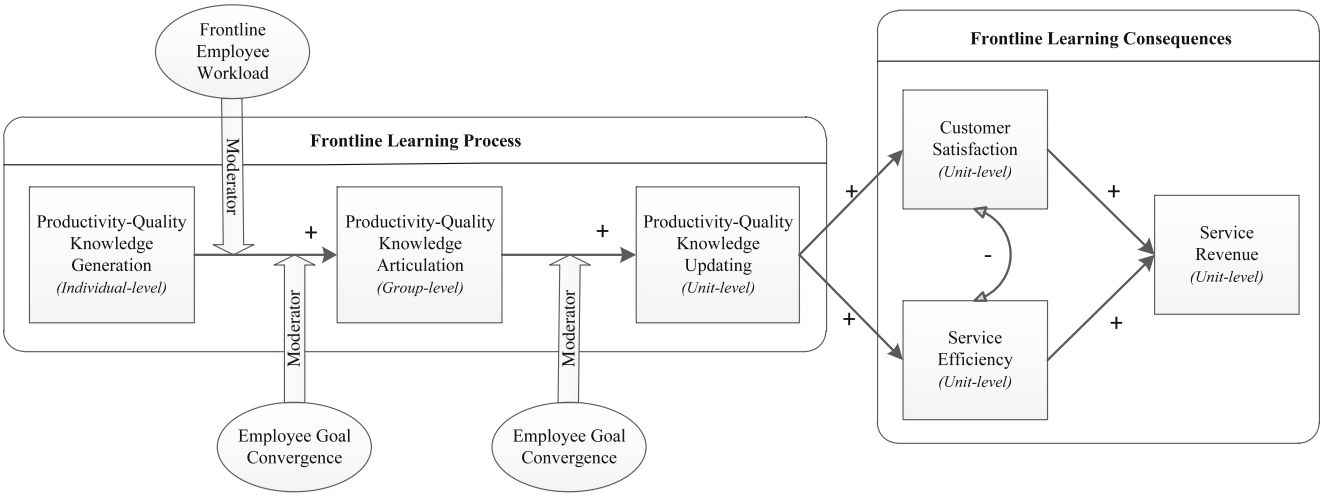

Fig. 1 Conceptual framework of frontline learning processes and its customer and financial consequences

p. 102). Such actions contain new knowledge depending on their degree of improvisation or novelty. The ostensive aspect of organizational routines refers to "standard operating procedures" that frontline employees are expected to comply with to accomplish organizational goals (e.g., customer satisfaction; Feldman and Pentland 2003, p. 101). In sum, while performative routines allow capturing of new knowledge, ostensive routines allow use of transformed knowledge by organizational members.

Distinctive characteristics Frontline learning has three distinctive characteristics comprising its complexity, tacitness, and fragility.

In terms of complexity, frontline performance often requires employees not simply to accomplish a specific goal (e.g., high-quality service) but to simultaneously balance competing goals (e.g., productivity and quality service). Typically, delivering high-quality service requires attending to the individual and dynamic needs of the customer and instantly adapting the service experience in response to these needs. In contrast, maintaining a high level of productivity requires placing boundaries on entertaining customer requests and limiting deviations from service scripts. As a result, discrepancies in achieving quality and productivity goals are ubiquitous in interactions with customers (Bateson 1985; Singh 2000). Past research and current practice consistently suggest that productivity and quality goals are in tension (Frei 2006; Singh 2000). When they overcome productivity-quality tradeoffs, frontline performances carry the seeds of new knowledge.

Further, new knowledge generated in frontline performances is uniquely tacit in nature, and an exemplar of knowing. The notion of *knowing* can be traced to the work of Dewey (1938) and James (1963) who viewed knowledge as inherent in individuals' actions as they interact with the world such that "knowledge [is conceptualized] less as an object and more as a dynamic phenomenon that manifests itself in the very act of knowing something" (Nag et al. 2007, p. 823). Likewise, Cook and Brown (1999) describe knowing as the epistemology of practice, while Kogut and Zander (1992) refer to it as "know-how" to assert its experiential qualities and not something that can be possessed as a set of hard and objective facts. Frontline knowing has characteristics of tacit knowledge in that it is unprocessed (e.g., low signal/noise ratio), unwieldy (e.g., high variability), unclear (e.g., ambiguous action-outcome linkages), and unusable in its original form (e.g., low generalizability).

Finally, frontline learning is fragile. In general, learning is not an explicit responsibility of the frontline employee (Sitkin et al. 1994). While performative routines may generate new knowledge, it remains localized to individuals, yielding little organizational payoffs. At worst, frontline employee knowing is lost as employees recreate performative routines every time without systematically learning from experience. Transforming everyday knowing into usable (explicit) knowledge is a deliberate process requiring time, energy, and resources. Moreover, frontline learning involves interpersonal risks (Edmondson 1999), and learning successes may invite higher performance standards, more work responsibility, or heavier workload.

Thus, frontline knowing generated in the process of customer interactions is likely to remain elusive and untapped despite its potential for significant payoffs (e.g., financial returns) and inimitable competitive advantages (e.g., capabilities for productivity-quality tradeoffs). We next identify organizational processes of productivity-quality knowledge articulation and knowledge updating that are central in capturing and transforming the tacit knowledge generated in the frontlines into explicit knowl-

edge. We also propose moderators that depress or amplify frontline learning processes.

The bottom-up process of frontline learning

We theorize that capturing and transforming frontline knowing into explicit, updated productivity-quality knowledge requires a mediating process involving knowledge articulation. Knowledge updating is defined as changes to explicit service routines and practices implemented in an organizational unit. In the context of bottom-up learning, we view knowledge updating as modifying and improving ostensive routines by unit managers to communicate desired unit practices to unit employees. To direct frontline work, unit managers develop materials such as manuals, protocols, scripts, and checklists. These resources specify linkages between frontline actions and performance outcomes, structure information around critical "what if" questions encountered in customer interactions, or simply provide recommended action routines (Zollo and Winter 2002). Once updated as a formal service routine, knowledge is easy to communicate and replicate, useful to train frontline employees, and effective in bringing some level of predictability and homogeneity to service experiences.

Knowledge updating requires investment of both resources and managerial attention to ensure that changes to organizational routines remain in step with organizational standards and priorities (Zollo and Winter 2002). Not all new knowledge generated and articulated in the frontlines need be codified. Yet, service protocols that worked well in the past can be improved, scripts that were thought to optimize quality and productivity actually induce downstream costs and have to be revised, or checklists could be abandoned in lieu of new scripts to prevent mindless execution of action steps. In these instances, unit managers may change unit practices and routines by codifying the new knowledge from bottom-up learning and integrating it into current service routines. In this sense, unit managers act as "anchors of knowledge management initiatives" by sifting, sorting, and synthesizing frontline knowledge and triangulating it with current organizational knowledge and priorities (Riege and Zulpo 2007, p. 297). Unit managers are positioned best to identify, develop, and refine the emergent productivity-quality knowledge spawned by bottom-up processes into updated routines and practices that align with organizational priorities, values, and mission (Blumentritt and Hardie 2000). Thus, a unit manager's discretion is needed for knowledge updating.

Articulation is a mechanism for developing collective competence in processing the frontline employee knowledge-in-action to gain insights for identifying productivity-quality tradeoffs in current solutions, or new solutions to productivity-quality dilemmas (Singh 2000). Collective competence develops when frontline employees organize communities of practice to share their experiences and beliefs, engage in constructive confrontations, and challenge each other's viewpoints (Hinsz et al. 1997). Moreover, by sharing and constructively challenging distributed viewpoints, communities can achieve an improved "understanding of the causal mechanisms intervening between the actions required to execute a certain task and performance outcomes produced" (Zollo and Winter 2002, p. 342). In the process of developing collective competence, frontline employees express to others their preconceptions, assumptions, and perspectives, thereby opening up interpretive schemes for mutual scrutiny and construction (Faraj and Xiao 2006). To build consensus and resolve productivity-quality tradeoffs, frontline employees can engage in mutual perspective taking, continuing conversation and adjustment, and the negotiated actions (Brown and Duguid 1991; Simon 1991; Weick and Roberts 1993). Thus, we posit that knowledge articulation is a critical process for transforming unprocessed, unwieldy, unclear, and unusable knowledge into kernels of relatively explicit knowledge that can be further processed for possible knowledge updating.

H1: Productivity-quality knowledge articulation mediates the effect of productivity-quality knowledge generation on productivity-quality knowledge updating, such that: (a) knowledge generation is positively associated with knowledge articulation and (b) knowledge articulation is positively associated with knowledge updating.

Customer and financial consequences of frontline learning

We examine three unit-level outcomes of frontline learning, including (1) customer satisfaction, or the degree to which customers are satisfied with the service provided by unit employees, (2) service efficiency, or the labor costs per capita for service performed by unit employees, and (3) service revenue, or the revenue per capita generated by unit employees through service performance. Customer satisfaction is indicative of quality, service efficiency reflects productivity, and service revenue represents the downstream financial outcome of frontline learning.

Although the productivity-quality insights gained from individual knowledge generation and group articulation might filter into behavior changes, they cannot be transferred directly into unit-wide productivity and quality benefits because such insights are mostly localized to individual agents (Goodman and Rousseau 2004). Knowledge updating is necessary to ensure that new knowledge generated and articulated during frontline learning is integrated with existing service routines and that unit-wide

performance benefit is realized. Without knowledge updating, the knowledge generated in the frontlines and collectively processed through articulation is likely to be lost, regardless of its novelty or usefulness (March and Simon 1958; Stinchcombe 1959).

The explicit representation of knowledge through updating service routines has two fundamental roles: interpretation and action guidance (Moorman and Miner 1997). The interpretative role filters the way that information and experience are categorized and sorted. Accordingly, service routines structure information around critical "what if" questions encountered in service delivery and specify the linkage between frontline action and performance outcomes. The action-guidance role dictates or influences individual and group action. Service routines, once established, have normative power to legitimize the necessary changes in frontline service processes, ensure frontline compliance (Feldman and Pentland 2003), and drive frontline employees' service behaviors and operating decisions (Cyert and March 1963; Nelson and Winter 1982).

As service organizations are facing fast-changing environments, service routines and scripts that worked well in the past may need to be revised and updated. Knowledge updating is necessary to adapt service routines to the internal and external environment and thus sustain their roles of interpretation and action guidance. Knowledge updating is expected to help frontline employees be more effective by updating employees' understanding of the linkage between frontline action and performance outcomes, and as a result, it better dictates or influences frontline behaviors. Therefore, knowledge updating is a critical intervening process ensuring that bottom-up frontline learning generates positive service and financial outcomes. Because we focus on productivity-quality knowledge, we expect that frontline learning would not induce tradeoffs such that increments in satisfaction entail decrements in efficiency, or vice versa. Rather, our expectation is that productivity-quality knowledge updating will enhance the quality of service provided to customers thereby increasing customer satisfaction, as well as streamlining the processes for service delivery thereby increasing service efficiency.

H2a: Productivity-quality knowledge updating is positively associated with customer satisfaction.
H2b: Productivity-quality knowledge updating is positively associated with service efficiency.

Consistent with the extant literature, we also hypothesize that both customer satisfaction and service efficiency drive service revenue. The academic literature provides substantial conceptual, logical, and empirical evidence that customer satisfaction induces repeat business, usage level, and positive word of mouth, resulting in increased customer retention and acquisition, thereby yielding higher market share and revenue growth (e.g., Bolton 1998; Rust et al. 1995; Rust et al. 2002). As such, customer satisfaction is hypothesized to influence service revenue. Likewise, lowering costs enables companies to price more competitively, thereby enlarging market share and increasing revenue. In services, efficient service operation can lower costs, free up resources to serve more customers, and/or increase the speed and quantity of service operations, which leads to increased revenue (e.g., Grönroos and Ojasalo 2004; Roth and Jackson 1995). This supports the relationship between service efficiency and revenue. Thus, we hypothesize:

H3a: Customer satisfaction is positively associated with service revenue.
H3b: Service efficiency is positively associated with service revenue.

Moderators of frontline learning

Although knowledge generation-articulation-updating represents the key mechanism of frontline learning, we anticipate unit and individual characteristics to act as moderators that amplify or depress the learning mechanisms. If these moderating variables are open to managerial control and intervention, they provide opportunities for facilitating frontline learning mechanisms. Below, we conceptualize the moderating effect of frontline employee workload and goal convergence for empirical testing.

Moderate workload facilitates the link between knowledge generation and articulation Increasing frontline employee workloads and having fewer employees serving customers are frequently used by service organizations as strategic initiatives to cut operating costs and improve efficiency. This may increase short-term productivity but may harm long-term service quality and satisfaction (Oliva and Sterman 2001). We propose that frontline employee workload is also relevant to frontline learning, specifically the transition from knowledge generation to knowledge articulation. We define workload as the level of cumulative demands relative to the available resources perceived by a frontline employee in his or her job. Because different frontline employees may perceive differences in both stressors and available resources even in identical jobs, the level of workload is not an objective but a subjective assessment by an individual frontline employee.

Rooted in notions of eustress (i.e., healthy, fulfilling stress) and distress, activation theory suggests that an individual's performance is at a suboptimal level, or in distress, for both low and high levels of stress because

performance is undermined by a lack of alertness or activation in the low-stress condition, and by over activation in the high-stress condition (Dienstbier 1989; Scott 1966). Both conditions promote a passive orientation to work where the individual is either too burdened by excessive work demands or too distracted by a lack of work challenge. This results in an individual's limited ability to adapt and respond to environmental demands, thereby undermining performance (Schaubroeck and Ganster 1993). Eustress, by contrast, lies at the intermediate workload condition, where the individual is energized to respond actively to environmental demands resulting in greater work engagement and higher performance. Empirical evidence supporting the inverted U-effect of workload on employee outcomes is robust across studies (e.g., Wicker and August 1995; Xie and Johns 1995).

Thus, we posit that employees who work in eustress conditions will be more prone to deliberately engage in transforming their individually generated knowledge into articulated knowledge. As noted, deliberate engagement involves mutual perspective taking, constructive scrutiny and negotiated sense making to open up interpretive schemas of tacit knowledge for resolving productivity-quality tradeoffs. Such deliberate engagement is diminished, if not entirely unlikely, when frontline employees have a passive orientation toward work and operate at a suboptimal activation level. Deliberate processes are crowded out by the pressure of overwhelming work demands in the high-workload condition or undermined by the lack of focus and attention typical of unchallenging work in the low-workload condition. By contrast, the active work orientation associated with the intermediate workload condition is thought to be conducive to deliberate processes for transforming generated knowledge into articulated knowledge. Accordingly, we hypothesize:

H4: The positive association between productivity-quality knowledge generation and productivity-quality knowledge articulation is stronger when frontline employee workload is moderate than when workload is low or high.

Employee goal convergence amplifies the knowledge generation-articulation link and the knowledge articulation-updating link Goal convergence is the degree to which a frontline unit's employees perceive productivity and quality goals as equally important. When unit employees collectively give equal importance to productivity and quality goals, goal convergence is high. Goal convergence is expected to diminish in proportion to the deviation between the importance accorded to productivity and quality goals. As discussed earlier, delivering services in a manner that satisfies both quality and productivity goals (Bateson 1985) while avoiding their potential tradeoffs (Anderson et al. 1997; Singh 2000) is critical in frontline tasks. Past research suggests that, in face-to-face service settings, frontline workers tend to emphasize quality goals (e.g., patient satisfaction) but are relatively less motivated for productivity goals (e.g., patient load; Marinova et al. 2008). These tendencies may reflect frontline employees' intrinsic characteristics that promote self-selection for service work (e.g., nursing) or a socialized professional norm of placing customer care above other priorities (Donovan et al. 2004; Weinberg 2003). Increasingly, service organizations are urging frontline employees to keep the productivity of their efforts in mind while pursuing service quality (Singh 2000). Thus, employee goal convergence is likely to vary across units rather than being uniformly high.

We propose that goal convergence of a unit's employees will boost the transformation of generated knowledge into articulated knowledge. Frontline employees with convergent belief in the importance of productivity and quality goals are likely to perceive productivity-quality knowledge as relevant. Accordingly, individually generated knowledge that is more beneficial for improving productivity performance without sacrificing quality performance or vice versa is more likely to be recalled, shared, discussed, and integrated among frontline employees. Moreover, research suggests that members with similar values, preferences, and orientations tend to communicate more easily and to share and exchange information more effectively (Gibson 2001). Thus, goal convergence for unit frontline employees is likely to boost the transformation of knowledge generation to knowledge articulation. Based on the proceedings, we hypothesize:

H5a: The higher the frontline employees' goal convergence, the greater the positive association between productivity-quality knowledge generation and productivity-quality knowledge articulation.

Goal convergence of a unit's employees will also enhance the transformation of articulated knowledge into updated knowledge because goal convergence promotes and legitimizes managerial intervention for updating productivity-quality knowledge. Balanced pursuit of productivity and quality goals is a priority and a challenge for most service organizations (Mittal et al. 2005; Rust et al. 2002; Singh 2000). As such, managers are positively disposed toward ideas and suggestions that reflect a balanced consideration of productivity and quality objectives. Goal convergence for unit frontline employees is likely to favor articulated knowledge that is more instrumental for maximizing performance outcomes related to productivity and quality goals. This increases the availability of articulated productivity-quality knowledge that is consistent with managerial objectives for knowledge updat-

ing. Although unit managers are empowered to institute new practices or routines without acquiring employee support, a poorly supported knowledge updating tends to receive strong resistance from employees and is hard to implement successfully. Convergence in importance of productivity and quality goals among frontline employees aligns with the manager's strategic objectives to maximize quality and productivity outcomes and legitimizes encoding of articulated productivity-quality knowledge.

H5b: The higher the frontline employees' goal convergence, the greater the positive association between productivity-quality knowledge articulation and productivity-quality knowledge updating.

Method

Research setting, data sources and sampling

We selected a health care organization as the setting for this research. Health care organizations evidence wide variations in the use of resources, services, and practices, despite regulatory standards for care and specific clinical pathways. These wide variations have persisted because of uncertainty in the effectiveness of care and differences in knowledge and learning across units (Wennberg and Gittelsohn 1973). Research has shown that there are ample opportunities for frontline employees to engage in learning and problem-solving in the health care industry (Bohmer 2009; Edmondson 2004). In addition, testing the conceptual framework requires multi-level, multi-source data, including customer outcomes (satisfaction), financial performance from archival sources at the unit (SBU) level, knowledge updating from managers at the unit level, knowledge articulation from unit frontline employees at the work-group level, and knowledge generation from frontline employees at the individual level. Securing cooperation from organizations for such comprehensive data collection and matching data sources and levels poses substantial challenges. To effectively tackle the preceding challenges, we focused our efforts on a single health care organization in the northeastern United States with a sufficiently large and diverse number of frontline employees and units (SBUs) that function as independent profit centers and utilize a common financial reporting system thereby providing uniformity in performance measurement.

Accordingly, our research design involved: (1) self-report data from frontline employees regarding productivity-quality knowledge generation, (2) key informant data from frontline employees on productivity-quality knowledge articulation, workload, and perceived goal importance (used to compute goal convergence index), (3) key informant data from frontline unit managers on productivity-quality knowledge updating, (4) longitudinal archival financial data for frontline unit service revenue and service efficiency, and (5) customer satisfaction data based on hospital patient surveys.

Survey data Fifty SBUs, 85 managers, and 1,213 frontline employees from these units (e.g., ICU, surgery, pediatrics, and telemetry) who had direct interaction with consumers (patients) were selected for participation in the study. We sent participants a questionnaire packet including: (1) a letter from the researchers describing the purpose of the study, (2) a six-page questionnaire, (3) a letter of support from the top management of the hospital, (4) a return postage-paid envelope, and (5) a lottery-card based incentive. Although the survey lengths were similar, the unit managers and frontline employees received different survey instruments based on the constructs of interest for that source. We ensured participants that their responses would remain confidential. Three weeks after the original mail-out, we sent a follow-up package to all non-respondents and included a lottery with several prizes to motivate responses.

Unit performance data The financial data, including revenue, cost, and productivity measures, came from the hospital's financial database. Unit customer satisfaction data were acquired from an external agent-sponsored patient satisfaction survey database, which is continually updated. The time frames for the survey and unit performance data were specified as follows. First, survey participants were asked about frontline learning activities, workload, and perceived goal importance in the past 12 months (see Appendix A for details). Second, we collected financial and satisfaction data covering the same 12 months as well as the subsequent 12 months.

In total, 420 frontline employee and 58 unit manager surveys were returned, with a response rate of 34.6% for employees and 68.2% for managers. However, 22 frontline employee and 2 manager responses were not usable because of: (1) more than 10 omitted items in the returned survey and/or (2) lack of variation in the response to survey questions. The remaining usable 454 responses (398 employee responses and 56 manager responses) were from 47 inpatient and outpatient clinical units. Unit financial data covers 51 hospital units, and unit customer satisfaction data covers 21 hospital units. After matching survey with financial data and excluding observations with missing values, we obtained usable data for 41 units with 411 responses (362 employee responses and 49 manager responses). Due to the limited coverage of patient satisfaction data, the usable data for testing the impact of the proposed mechanism on customer satisfaction outcomes comprised 21 units with 227 individual responses (202 employee responses and 25 manager responses).

Measurement and operationalization

Frontline learning constructs We used a four-step approach to develop the measurement scales for the frontline learning constructs (Spector 1992): (1) construct definition based on the literature, (2) construct interpretation and item generation, (3) item pretest and refinement using think aloud exercises, and (4) psychometric analysis based on large scale quantitative work. In the first step, we identified and defined the three core constructs including knowledge generation, knowledge articulation, and knowledge updating based on a thorough review of the existing theory and research about learning process in the organizational learning literature (e.g., Crossan et al. 1999; Nonaka 1994; Zollo and Winter 2002). Drawing from services marketing and frontline management, we focused on improving quality, productivity, and managing the tradeoffs as the specific content of learning in the frontline context (e.g., Anderson et al. 1997; Rust et al. 2002, Singh 2000).

In the second step, we generated items based on the specified conceptual domain of the focal learning constructs. Content validity was our primary concern at this stage. We ensured that the generated items, when examined together, adequately capture the specific domain of interest yet contain no extraneous content (Hinkin 1995). Specifically, items related to knowledge generation capture the individual process of intuiting including breaking out of traditional mind-sets to see things in new and different ways, taking the time to think, experimenting, and being aware of the critical issues affecting one's work. Knowledge articulation items capture work-group process of sharing individual knowledge with other frontline employees, discussing collectively, resolving conflicting opinions, and reaching common understanding. Finally, knowledge updating items capture the unit process of integrating newly acquired knowledge into existing job practices, procedures, and routines, with unit managers as key informants.

In the third step, we employed think aloud exercises in one-on-one interviews with 20 nurses and clinical managers to pretest the scales. The participants were asked to respond to the items as if they had received them as part of a survey, and to verbalize their thoughts aloud as they read the items and developed a response. The purpose was to understand how target respondents interpret the items and the nature and scope of experiences they draw upon for developing their responses. Participants also helped us identify alternative wordings and terms to make the items more relevant to their colleagues. The items were iteratively refined after every five think aloud exercises to account for feedback provided until only marginal changes were identified. The final instrument contained 12 items with 4 items measuring each learning construct. The 12 items are scaled on a 5-point never-very frequently Likert scale (see Appendix A).

In the last step, we employed various statistical procedures including the Cronbach's alpha, exploratory factor analysis, and confirmatory factor analysis to assess the psychometric properties of the refined items. Our sample size (454 observations) met the suggested criteria for both exploratory and confirmatory factor analysis (Guadagnoli and Velicer 1988; Hoelter 1983), and was large enough to ensure accurate and confident statistical estimates. The Cronbach's alpha is .91 for knowledge generation (employee self-report), .96 for knowledge articulation (employee self-report), and .95 for knowledge updating (manager key-informant), indicating high internal consistency. The exploratory factor analysis using principal component approach showed that items load on their theoretical constructs, and the cross-loadings on other constructs are small and nonsignificant, indicating high stability of the factor structure. We further conducted confirmatory factor analysis (CFA) to assess the convergent and discriminant validity of the new scales. The details of the CFA are given in the following sections.

Workload and employee goal convergence The measures of workload were adopted from the role overload scale developed by Beehr et al. (1976). The construct was measured on a 5-point scale ranging from "strongly disagree" to "strongly agree." The Cronbach's alpha is .89. Goal convergence was operationalized as the relative difference between the importance of quality and productivity goals, averaged across a given unit's frontline employees (see Appendix A). The Cronbach's alpha is .73 for the quality dimension and .82 for the productivity dimension.

Unit financial performance We utilized two measures of unit financial performance—service revenue (*REVE*) and service efficiency (*EFFI*)—based on longitudinal unit-level quarterly archival data. We extracted the revenue and efficiency measures by adopting the procedures used by Marinova et al. (2008). Specifically,

$$REVE_t = Unit\ Gross\ Revenue_t / Unit\ Equivalent\ Patient\ Day_t \quad (1)$$

where t denotes quarter. Unit equivalent patient day is computed by estimating the proportion: unit total gross patient revenue/hospital gross revenue per equivalent patient day. The hospital gross revenue per equivalent patient day is given by: {total gross inpatient revenue/(number of inpatients × length of average inpatient stay)}. Hospitals routinely use the measure to assess performance across inpatient and outpatient units. Adjusting the revenue by equivalent patient days for a given unit takes into account variations due to unit-specific factors

such as unit size, labor intensity, nature of services, and patient mix.

Service efficiency (*EFFI*) was computed as a ratio of the labor cost (which is the most significant and critical expense in a typical service organization) relative to an equivalent patient day of the unit. Similarly, adjusting labor cost by equivalent patient days takes into account the differences in unit characteristics. To make it easier to interpret, we reversed the sign of the ratio to obtain a positively increasing scale for efficiency.

$$EFFI_t = -(Total\ Labor\ Cost_t\ /\ Unit\ Equivalent\ Patient\ Day_t) \tag{2}$$

We then performed additional analyses to further rule out the potentially confounding effects of unobservable variables. Specifically, starting with the adjusted quarterly time-series data for $REVE_t$ and $EFFI_t$ for each unit, we modeled a first-order autocorrelation (e.g., Boulding and Staelin 1995; Jacobson 1990) and also included a fourth-difference term for seasonality effects to extract the variability arising from autocorrelation and seasonality effects. Thus, we estimated the following time-series cross-sectional models for each unit:

$$REVE_t = \beta_0 + \beta_1 REVE_{t-1} + \beta_2 REVE_{t-4} + \varepsilon_t \tag{3}$$

$$EFFI_t = \lambda_0 + \lambda_1 EFFI_{t-1} + \lambda_2 EFFI_{t-4} + \xi_t \tag{4}$$

where t denotes the quarter ranging from 1 to 8. Consistent with prior research (Bayus et al. 2003), we retained β_0 and λ_0 as the corrected estimates of service revenue and efficiency for use in testing the hypotheses, as follows:

$$REVE = \beta_0 \tag{5}$$

$$EFFI = \lambda_0 \tag{6}$$

Customer satisfaction Customer satisfaction (*CS*) for each unit was derived from the unit-level quarterly satisfaction data for the same two-year period as the financial data by following the procedures used by Marinova et al. (2008). The customer satisfaction index was based on patients' responses to the question "Overall, how would you rate the care you received at the unit?"[3] using a five-point Likert scale ranging from "poor" to "excellent." Basically, our approach involves two steps of averaging given the unit-level customer satisfaction data available to us: (1) frequency distribution of customer responses in each category of the 5-point scale (the hospital would not give us individual patient response data, citing HIPAA privacy laws), and (2) separate frequency distributions for each of the 8 quarters of interest. For each quarter t, a mean score $Satisfaction_t$ was computed based on the patients' rating of the overall quality they received in the unit, as follows:

$$Satisfaction_t = \frac{1 \times X_{1t} + 2 \times X_{2t} + 3 \times X_{3t} + 4 \times X_{4t} + 5 \times X_{5t}}{X_{1t} + X_{2t} + X_{3t} + X_{4t} + X_{5t}} \tag{7}$$

where t represents quarter and ranges from 1 to 8; 1, 2, 3, 4, and 5 represent the categories "poor," "fair," "good," "very good," and "excellent," respectively; and X_{1t}, X_{2t}, X_{3t}, X_{4t}, *and* X_{5t} represent the frequency counts of the category indicated in the subscript at time t, respectively. The *CS* indicator for each unit was derived by averaging the quality rating for the eight quarters:

$$CS = \frac{1}{8}\sum_{t=1}^{8} Satisfaction_t \tag{8}$$

Method of analysis

The analytical approach involved measurement assessment for the key constructs and a test of the hypothesized model. Table 2 summarizes the relevant descriptive statistics.

Measurement model analysis Separate analyses were conducted for the perceptual constructs at the individual level (i.e., knowledge generation, articulation, workload, quality dimension of goal convergence, and productivity dimension of goal convergence) and unit level (knowledge updating). For the individual-level measures, a combination of exploratory and confirmatory factor analysis was utilized to assess the psychometric properties. For the unit-level knowledge updating, we conducted a one-factor CFA to assess its convergent validity. Additionally, we assessed the association between knowledge updating and other unit-level constructs for evidence of discrimination (i.e., employee goal convergence, service revenue, service efficiency, and customer satisfaction). To assess the reliability of goal convergence, we followed the procedure of Peter et al. (1993) and examined the reliability of the components (quality and productivity) and their correlation.

Hypothesized model analysis The hypothesized model involves constructs at three conceptual levels—individual frontline employees, work groups, and frontline units (recall

[3] This measure is widely used in the health care industry for measuring patients' overall satisfaction and computing patient satisfaction scores. To be consistent with industry practice, we labeled this measure as customer satisfaction. An alternative label of "service quality" is reasonable given the academic literature.

Table 2 Descriptive statistics and correlations of studied constructs

	n	Mean	s.d.	1	2	3	4
Variables measured at the individual level							
1. PQ[a] Knowledge Generation	398	3.44	0.81				
2. PQ Knowledge Articulation	398	3.12	1.02	0.42**			
3. Workload	398	3.25	1.04	−0.09	−0.29**		
4. Education	396	3.56	1.27	−0.09	−0.18**	0.05	
5. Income	372	2.88	0.99	−0.05	−0.21**	0.11*	0.13*
Variables measured at the unit level							
1. PQ Knowledge Updating	47	3.90	0.67				
2. Employee Goal Convergence	47	1.71	0.97	0.15			
3. Customer Satisfaction	21	0.14	0.91	0.44*	0.03		
4. Service Efficiency	41	0.29	0.70	0.08	−0.04	0.01	
5. Service Revenue	41	0.18	0.37	0.02	0.07	0.06	0.35*

*$p<0.05$ (two tailed)

**$p<0.01$ (two tailed)

[a]PQ refers to productivity-quality

that group knowledge articulation is a unit-level variable). To account for the multi-level structure of the data (frontline employees nested within units), we utilized a random-parameters model (Greene 2008). This analytical approach provides the statistical benefits of pooling individuals and units together without sacrificing the ability to model individual unobserved heterogeneity. Individual unobserved heterogeneity implies that the differences in employee learning behaviors may be due to the characteristics of individual employees that are not measured, and therefore unobservable, in the study. A random-parameters model accounts for this individual unobserved heterogeneity and allows for between- and within-unit effects. Thus, we modeled the hypothesized knowledge effects on outcomes by estimating the following equations.

$$KA_j = \delta_0 + \delta_{1j}KG_j + \delta_{2j}WL_j + \delta_{3j}WL_j \times KG_j + \delta_{4j}WL_j^2 + \delta_{5j}WL_j^2 \times KG_j + \delta_6 EGC_j + \delta_{7j}EGC_j \times KG_j + \delta_{8j}EDU_j + \delta_{9j}INC_j + \iota_j \quad (9)$$

$$KU_j = \eta_0 + \eta_{1j}KA_j + \eta_2 EGC_j + \eta_{3j}EGC_j \times KA_j + \eta_{4j}EDU_j + \eta_{5j}INC_j + \eta_6 MGC_j + \vartheta_j \quad (10)$$

$$EFFI_j = \rho_0 + \rho_1 KU_j + \rho_{2j}EDU_j + \rho_{3j}INC_j + \varepsilon_j \quad (11)$$

$$CS_j = \kappa_0 + \kappa_1 KU_j + \kappa_{2j}EDU_j + \kappa_{3j}INC_j + \varpi_j \quad (12)$$

$$REVE_j = \beta_0 + \beta_1 KU_j + \beta_2 EFFI_j + \beta_3 CS_j + \beta_{4j}EDU_j + \beta_{5j}INC_j + \varepsilon_j \quad (13)$$

where j denotes unit (subscript for individual is implied but omitted for readability), *KG* denotes productivity-quality knowledge generation, *KA* denotes productivity-quality knowledge articulation, *KU* denotes productivity-quality knowledge updating, *WL* denotes workload, *EGC* denotes employee goal convergence, *CS* denotes customer satisfaction, *EFFI* denotes service efficiency, *REVE* denotes service revenue, *MGC* denotes manager goal convergence, *EDU* denotes level of education, and *INC* denotes income.

Moreover, to account for individual unobserved heterogeneity within units, additional equations were estimated with the coefficients in the preceding equations as dependent variables, in accord with the random-parameters model:

$$\delta_{nj} = \theta_n + \mu_{nj} \quad (14)$$

$$\eta_{nj} = \pi_n + \mu_{nj} \quad (15)$$

$$\rho_{nj} = \lambda_n + \mu_{nj} \quad (16)$$

$$\kappa_{nj} = \tau_n + \mu_{nj} \quad (17)$$

$$\beta_{nj} = \gamma_n + \mu_{nj} \quad (18)$$

where μ_{nj} are ~N(0,σ^2) and denote unit-specific variances; the coefficients δ_{nj}, η_{nj}, ρ_{nj}, κ_{nj}, and β_{nj} are allowed to change randomly due to unobserved within-unit heterogeneity. In turn, θ_n, π_n, λ_n, τ_n, and γ_n capture between-unit effects (reported in Table 3), which account for unit-specific variances (μ_{nj}). We used the same notation μ_{nj} for the sake of convenience.

Table 3 Confirmatory factor analysis of constructs measured at the individual level

	Loading[a]	*t*-value	Construct reliability	Variance extracted	Highest R^2
PQ[b] Knowledge Generation			0.91	0.71	0.24
PQ knowledge generation 1	0.78	18.02			
PQ knowledge generation 2	0.83	19.64			
PQ knowledge generation 3	0.85	20.34			
PQ knowledge generation 4	0.90	22.65			
PQ Knowledge Articulation			0.96	0.87	0.20
PQ knowledge articulation 1	0.91	23.61			
PQ knowledge articulation 2	0.95	25.30			
PQ knowledge articulation 3	0.91	23.44			
PQ knowledge articulation 4	0.97	26.32			
Workload			0.89	0.67	0.10
Workload 1	0.89	21.74			
Workload 2	0.89	21.84			
Workload 4	0.75	17.06			
Workload 5	0.77	17.67			
Goal Convergence (Quality)			0.74	0.65	0.20
Quality 1	0.71	14.50			
Quality 2	0.84	20.01			
Goal Convergence (Productivity)			0.84	0.73	0.20
Productivity1	0.79	16.33			
Productivity 2	0.90	18.97			

Model fit index: Chi-square= 285.81 (95df), $P<.0001$; NFI=.95; NNFI=.96; CFI=.97; SRMR=.044; RMSEA=.071; 90% C.I. OF RMSEA (.062–.081)

[a]The estimates are standardized coefficients (all $p<.01$) and *t*-values from maximum likelihood solution using EQS

[b]PQ refers to productivity-quality

We controlled for measurement error in the multi-item constructs including knowledge generation, knowledge articulation, knowledge updating, and workload by using latent factor scores in estimating the hypothesized models. Latent factor scores were estimated based on a procedure proposed by Joreskog (2000). In addition, past studies have consistently evidenced tradeoffs between service efficiency and customer satisfaction (Anderson et al. 1997; Oliva and Sterman 2001; Singh 2000). To control for the reciprocal relationship between customer satisfaction and service efficiency, we employed an instrumental variable that accounts for the common variance between customer satisfaction and service efficiency in the estimation. We also considered the possibility that employee characteristics may influence the modeled relationships. For example, employees with higher education and work experience tend to exhibit different learning behaviors from those with lower education and work experience. To rule out such alternative explanations, we included two control variables—income and education level—based on prior research that identified those characteristics as influential in group processes and performance outcomes (Campion et al. 1993; Gladstein 1984). To the extent that we obtain empirical support for the focal hypotheses after controlling for alternative explanations and unobserved heterogeneity, we expect the proposed theory to be relatively robust. To minimize the issue of multicollinearity caused by squared and interaction terms in the models, we created instrumental variables orthogonal to the rest of the variables in each model (Greene 2008; Marinova 2004).

Results

Measurement model analysis

Table 3 summarizes confirmatory factor analysis results for the individual-level constructs. The CFA yields model fit statistics and indexes as follows: $\chi^2=285.81$, $df=95$, $p<.01$; NFI=.95, NNFI=.96, CFI=.97, SRMR=.044, and RMSEA=.071 (90% CI: .062–.081). While the hypothesized model is a statistically inadequate representation of observed covariance ($p<.01$), the indicators of absolute (e.g., RMSEA, SRMR) and relative fit (e.g., NFI, CFI) suggest that the measurement model is a reasonable fit to the data revealed by trivial residuals (<.05) and significant improvements over the null model (> .95). Table 3 provides further support for the convergent and discriminant validity of the constructs. The estimated loadings of individual indicators on their underlying construct are, without exception, large and significant (*t*-values >14.0, $p<.01$). Additionally, the construct reliability estimates are robust,

ranging from .74 to .96, exceeding the conventional .70 criterion. In terms of discriminant validity, the epistemic correlations among the study constructs range from −.09 to .42, with none approaching unity. The 95% confidence intervals for construct correlations do not include unity. Also, in accord with Fornell and Larcker's (1981) criterion for discriminant validity, the variance extracted exceeds the highest variance shared for each construct.

For the unit-level knowledge updating construct, the factor loadings are large and significant (t-value >7.00, $p<.01$), and the construct reliability is .96, supporting convergent validity (Table 4). The correlations between knowledge updating and other unit-level variables range from .02 to .44 (less than 20% variance shared), supporting discriminant validity.

The reliability of the goal convergence construct is dependent on the individual reliabilities of the quality and productivity components and the intercorrelation between them (Peter et al. 1993). The estimated construct reliability is .74 and .84 for quality and productivity components respectively. The correlation between the two components is .35. Thus, the reliability of goal convergence is estimated to be in the range of .65 to .70.

Test of hypothesized frontline learning mechanisms

Table 5 shows the results of model fit tests and coefficient estimates. The estimation involved a random-parameters model to account for individual-specific heterogeneity and modeled both between- and within-unit effects. Compared with the null model (control variables only), the hypothesized model is a significant improvement in fit for knowledge articulation ($\chi^2_{7\text{d.f.}} = 120.40$), knowledge updating ($\chi^2_{3\text{d.f.}} = 39.96$), efficiency ($\chi^2_{2\text{d.f.}} = 237.78$), customer satisfaction ($\chi^2_{2\text{d.f.}} = 432.02$), and revenue ($\chi^2_{3\text{d.f.}} = 152.80$) at a 99% significance level (all $p<.01$).

Table 5 summarizes the results of the hypothesized frontline learning mechanisms. The mediation hypothesis was tested in accord with Mathieu and Taylor (2006). This approach amends the conventional Baron and Kenny (1986) approach and distinguishes among indirect effects, partial mediation, and full mediation, outlining decision points for drawing inference of each type. We first tested the direct effect of knowledge generation on knowledge updating without including the mediating variable of knowledge articulation. Our tests indicated that this direct effect is nonsignificant ($b=.02$, $p>.10$).

Next, we tested the effect of knowledge generation on knowledge articulation and knowledge articulation on knowledge updating. Knowledge generation positively affects knowledge articulation ($\theta_1=.69$, $p<.01$) and, in turn, knowledge articulation has a positive effect on knowledge updating ($\pi_1=.29$, $p<.01$). This confirms H1a and H1b.

Since the two paths in the mediation mechanism are significant, we tested the significance of the indirect effect, $\theta_{1*}\ \pi_1$, which is a necessary condition to determine if knowledge generation has a significant effect on knowledge updating through articulation, as per Mathieu and Taylor (2006). Sobel's (1982) test indicated that $\theta_{1*}\ \pi_1$ is significant (S=2.45, $p<.05$). These results suggest that knowledge generation exerts an indirect effect on knowledge updating through knowledge articulation. The knowledge generation-articulation-updating relationship is neither fully nor partially mediated because both require a significant direct relationship between knowledge generation and updating (Mathieu and Taylor 2006).

Customer and financial consequences of frontline learning Table 5 summarizes the results of hypotheses for the influence of knowledge updating on unit outcomes. Knowledge updating positively and significantly affects customer satisfaction ($\kappa_1=.12$, $p<.01$), and service effi-

Table 4 Confirmatory factor analysis of constructs measured at the unit level

	Loading[a]	t-value	Construct reliability	Variance extracted	Highest R^2
PQ[b] Knowledge Updating			0.96	0.85	–
PQ knowledge updating 1	0.95	9.38			
PQ knowledge updating 2	0.99	10.23			
PQ knowledge updating 3	0.81	7.27			
PQ knowledge updating 4	0.90	8.65			

Model fit index: Chi-square=17.02 (2 df), $P=.0002$; NFI=.94; NNFI=.83; CFI=.94; SRMR=.041; RMSEA=.37; 90% C.I. OF RMSEA (.219–.535)

[a] The estimates are standardized coefficients (all $p<.01$) and t-values from maximum likelihood solution using EQS

[b] PQ refers to productivity-quality

Table 5 Estimated coefficients from the hypothesized model

Independent variable	Dependent variable									
	PQ knowledge articulation		PQ knowledge updating		Service efficiency		Customer satisfaction		Service revenue	
	b	*t*	*b*	*t*	*b*	*t*	*b*	*t*	*b*	*t*
PQ[c] Knowledge Generation	0.69**[a]	4.55[a]								
PQ Knowledge Articulation			0.29**	3.01						
PQ Knowledge Updating					0.13**	10.55	0.12**	5.61	0.03**	3.96
Workload	−0.19**	−3.59								
Workload×Knowledge Generation	−0.03	−0.76								
Workload^2	−0.01	−0.21								
Workload^2× Knowledge Generation	−0.07*	−1.65								
Employee Goal Convergence	0.09	1.50	0.13**	5.28						
Employee Goal Convergence× Knowledge Generation	0.11*	1.72								
Employee Goal Convergence× Knowledge Articulation			0.09*	1.79						
Customer Satisfaction									0.07**	2.92
Service Efficiency									0.15**	24.85
Education	−0.10*[b]	−2.38[b]	−0.01	−0.20	0.02	1.89	0.10**	6.87	−0.02**	−6.34
Income	−0.13**	−3.07	−0.03	−0.83	0.05**	4.33	0.02	1.68	−0.05**	−2.93
Manager Goal Convergence			0.43**	9.42						
Log Likelihood (hypothesized model)	−462.34		−388.89	−50.61	−54.53	−52.40				
Log Likelihood (null model—control variables only)	−522.54		−408.87	−169.50	−270.54	−128.80				
Likelihood Ratio Test (d.f.)	120.40 (7) $p<0.01$			39.96 (3) $p<0.01$		237.78 (2) $p<0.01$		432.02 (2) $p<0.01$		152.80 (3) $p<0.01$

*$p<0.05$, **$p<0.01$

[a] For all the hypothesized relationships, the p-value is based on one-tailed tests

[b] For all the control variables, the p value is based on two-tailed tests

[c] PQ refers to productivity-quality

ciency (ρ_1=.13, p<.01). This confirms H2a and H2b. Our results provide support for H3a and H3b regarding the relationship among the three unit outcomes. Both service efficiency and customer satisfaction are positively associated with service revenue (β_2=.15, and β_3=.07, p<.01). Moreover, we found a small but significant direct effect of knowledge updating on service revenue (β_1=.03, p<.01) after controlling for the effects of customer satisfaction and service efficiency. This result indicates that the effect of knowledge updating on service revenue is mostly mediated by customer satisfaction and service efficiency.

Moderators of frontline learning process Consistent with H4, workload has a curvilinear moderating effect (θ_5=−.07, p<.05) on the relationship between knowledge generation and knowledge articulation. Figure 2 shows the partial derivative of knowledge articulation with respect to knowledge generation as a function of workload. It

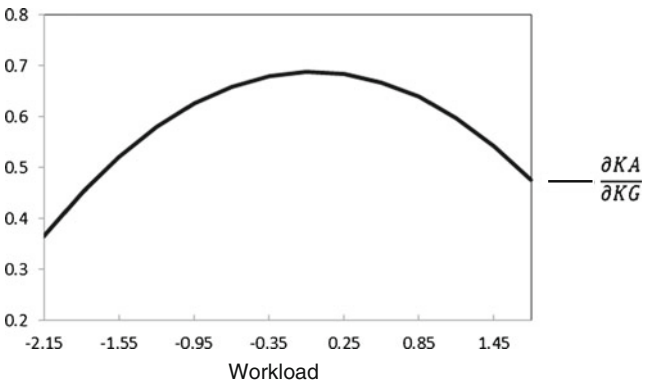

Fig. 2 Moderating effect of workload on the transformation of generated knowledge into articulated knowledge. The equation plotted is: $\frac{\partial KA}{\partial KG} = 0.69 - 0.07\text{Workload}^2$. The rate of transformation of knowledge generation (KG) into knowledge articulation (KA) is greater when workload is at moderate level (≈0) than when workload is low or high (>|±1.5sd|)

indicates that when workload is perceived to be low or high (>|±1.5sd|), the rate of transformation of knowledge generation to knowledge articulation is about 1.5 times lower than in the case of moderate workload (workload ≈0). Thus, when moving away from an optimal point, which occurs around the mean workload value, the transformation of knowledge generation to knowledge articulation shows a decreasing trend.

As per H5, we found that employee goal convergence has a positive moderating effect on the knowledge generation-articulation transformation (θ_7=.11, p<.05), as well as on the knowledge articulation-updating transformation (π_3=.09, p<.05). Figure 3 displays the partial derivative of knowledge articulation to knowledge generation as well as the partial derivative of knowledge updating to knowledge articulation as a function of goal convergence. As depicted, the transformation rate of knowledge generation-articulation and knowledge articulation-updating increases as productivity and quality goals converge. These findings support H5a and H5b.

Discussion

This study develops and empirically tests a frontline learning process model that explains how service organizations capture and transform knowledge embedded in customer interfaces. We focus on the knowledge that relates to productivity-quality tradeoffs in service delivery and examine its consequences for customer satisfaction, service efficiency, and service revenue. We also investigate the moderating effects of employee workload and goal convergence on knowledge transformation processes. Researchers have long recognized the importance of bottom-up learning from frontline actions at customer interfaces (Day 1994; Srivastava et al. 1998), but empirical work in this area has been spotty at best. The few studies that exist are limited to an individual-level analysis of frontline learning (e.g., Homburg et al. 2009; Sharma et al. 2000; Wang and Netemeyer 2002); none of the studies to date have examined the multi-level organizational processes central to frontline learning.

Our results support a frontline learning process comprising three distinct elements—knowledge generation, articulation, and updating—that are involved in transforming tacit productivity-quality knowledge generated in the frontlines into explicit routine updating for unit use. Units that are more effective at this transformation are associated with higher levels of customer satisfaction, service efficiency, and revenue. We also find that the transformation process is susceptible to contextual threats, such that only intermediate workloads and greater levels of employee goal convergence promote knowledge transformation. We discuss each of the preceding contributions next, following an outline of the study's limitations.

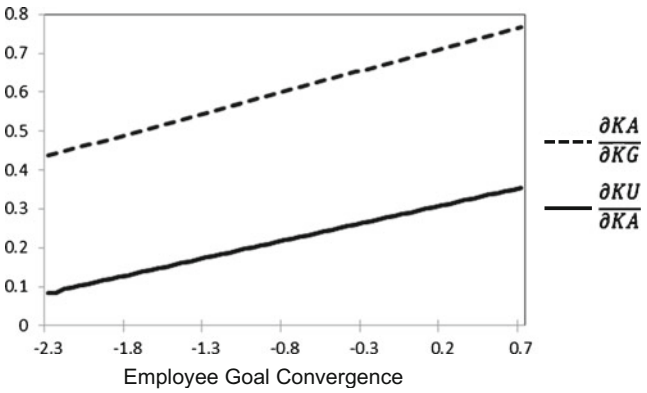

Fig. 3 Moderating effect of employee goal convergence on the knowledge generation–knowledge articulation link and knowledge articulation–knowledge updating link. The equations plotted are: $\frac{\partial KA}{\partial KG} = 0.69 + 0.11$Employee Goal Convergence. $\frac{\partial KU}{\partial KA} = 0.29 + 0.09$Employee Goal Convergence. The rate of transformation of knowledge generation (KG) to knowledge articulation (KA) and knowledge articulation (KA) to knowledge updating (KU) increases linearly with convergence of productivity and quality goals of unit employees

Limitations

Several limitations of this research warrant consideration. First, this study models and tests the impact of frontline learning only on unit-level outcomes. We do not examine the organization-level impact of frontline learning because our data allow for testing only the unit-level effects. Organization-level impacts of frontline bottom-up learning such as knowledge transfer and dissemination between units and organizational level outcomes warrant future research. Second, we recognize that knowledge use is an omitted mediating variable between knowledge updating and outcomes. Although omitted mediating variables rarely bias the total effect, future studies should explicitly model the mediating mechanisms of knowledge use.

Third, the cross-sectional data pose challenges for cause-effect inferences. While our results support a generation-articulation-updating mechanism of frontline learning, caution is advised in imputing temporal dynamics. Admittedly, the learning processes are likely to involve reciprocal and iterative linkages. For exam-

ple, following group articulation, a frontline unit could either move forward into knowledge updating or backward into a second iteration of knowledge generation. The knowledge might not be clearly articulated and casual ambiguity might not be resolved during knowledge articulation, thus prompting more individual reflection and experimentation. The current design does not allow modeling of such dynamic mechanisms.

Fourth, the study may have limited generalizability. The frontlines of health care organizations share many commonalities with those in other service settings, but they also have some unique characteristics. Frontline employees in hospitals are typically professionally certified, well trained, reasonably paid, and highly respected. Though the proposed model is not health care specific, replication studies in different service contexts are warranted.

Finally, admittedly, the small sample size increases risks of reduced statistical power and inflated type II errors. To mitigate this, we initially analyzed performance variations across time and within units to derive performance indexes that increase the ability to detect a signal in the subsequent structural estimations. As a result, we obtained strong statistical support for the hypotheses, alleviating some of the concerns of inadequate power. Nevertheless, the small sample size warrants future studies.

Key elements of frontline learning

Although it is recognized that the role of frontline employees in service delivery is a critical source of market-driven capability (Day 1994) and market-based relational and intellectual assets (Srivastava et al. 1998), past research has not explicitly theorized or examined a bottom-up learning process for capturing and transforming knowledge embedded in the organization's customer interfaces. This study advances research by theorizing a frontline learning process and empirically demonstrating the translation of frontline learning into bottom-line advantages.

Specifically, the results support the idea that frontline learning is composed of three distinct elements, each performing a vital role at different organizational levels—knowledge generation at the individual employee level, knowledge articulation at the employee group level, and knowledge updating at the unit level. Individual frontline employees' actions in customer interactions fuel the bottom-up learning process by generating new knowledge. The heterogeneity of customer needs and requests increases the opportunity for new knowledge generation by individual frontline agents. Although past research has noted that organizational learning is more likely when experiential learning involves complex and heterogeneous rather than homogenous and repetitive experiences (Haunschild and Sullivan 2002), limited empirical evidence exists in the context of frontline learning.

Further, frontline knowledge articulation is a key mediator in the frontline learning mechanisms. Articulation by employee groups converts the largely tacit, fragile, and distributed knowledge embedded in the frontline actions into collectively shared and processed knowledge that is suitable for organization-wide use. In accord with our theoretical expectation, the results show that knowledge generation does not significantly influence knowledge updating directly; rather, the former significantly influences the latter indirectly through knowledge articulation. Thus, it appears that, without knowledge articulation, new productivity-quality knowledge generated in the organizational frontlines is likely to be lost.

Finally, knowledge updating is essential for realizing frontline learning payoffs. The results demonstrate that while knowledge generation and articulation do not directly affect unit outcomes, knowledge updating has a significant positive impact on customer satisfaction, service efficiency, and service revenue. Our results affirm that knowledge updating is the crucial link that completes a multi-level learning cycle by consolidating the local benefits gained from individual and group learning into unit-wide benefits. Thus, knowledge updating enables frontline units to warehouse the kernels of knowledge originating from customer interactions and enjoy the potential payoffs for a broad range of unit outcomes.

Frontline learning focused on productivity-quality tradeoffs pays off

There is wide belief that service organizations should pursue superior performance in both productivity and quality to maintain a competitive advantage (Mittal et al. 2005; Rust et al. 2002). However, past research suggests that service firms are especially challenged in adopting and successfully implementing processes that enhance both the productivity (e.g., efficiency) and quality (e.g., customer satisfaction) of organizational outcomes (Anderson et al. 1997; Marinova et al. 2008; Mittal et al. 2005). This study provides unequivocal evidence that frontline learning focused on minimizing productivity-quality tradeoffs pays off for customers (customer satisfaction), processes of

service delivery (efficiency), and top line outcomes (service revenue).

Our results indicate that productivity-quality knowledge updating has a direct positive effect on both customer satisfaction and service efficiency, and a partially mediated positive effect on service revenue through customer satisfaction and service efficiency. Moreover, to the extent that customer satisfaction is a forward-looking indicator of sales growth and cash flow, our results suggest additional downstream payoffs from frontline productivity-quality knowledge updating. For instance, Morgan and Rego (2006) report that a unit increase in satisfaction scores returns a .19 unit increase in sales growth and a .10 unit increase in net cash flow (both significant, $p<.05$). Thus, productivity-quality focused frontline learning enables units not only to improve performance in both productivity and quality but also to enjoy the potential payoffs for a broad range of unit outcomes.

Taken together, this study's insights have important implications for developing market-driven capabilities that yield a sustainable competitive advantage (Dickson 1992; Hunt and Morgan 1995). Because the proposed frontline learning process is grounded in the productivity-quality tradeoffs that are often elusive and difficult to observe, our results pinpoint learning processes that are essential to the stock and flow of difficult-to-trade knowledge assets. These knowledge assets serve as the building blocks of competitive advantage over time because of their impact on customer satisfaction, service efficiency, and revenue (Teece et al. 1997). To the extent that these learning processes represent the capabilities of the employees and managers who populate frontline units, organizations are advised to develop procedures, interventions, and incentives to foster such capabilities. Our study establishes that payoffs from such capabilities are important and systemic.

Enabling the frontline learning process

Our study affirms that frontline learning is vulnerable to contextual factors and requires planned managerial intervention and facilitation. In this study, we examine two contextual factors, employee workload and employee goal convergence. We find that both heavy and light frontline workloads can effectively shut down the frontline learning mechanisms. A heavy workload hinders an employee's engagement in converting generated knowledge into articulated knowledge. Some flexibility that comes from an intermediate level of workload is necessary to foster frontline learning and benefit from its payoffs. While increasing workload might yield short-term gains, it is likely to harm an organization's long-term effectiveness.

Finally, our study suggests that a imbalanced view on the importance of productivity and quality goals may harm the frontline learning process. We find that frontline employees' perceived importance of quality relative to productivity goals not only affects the transformation of knowledge generation to knowledge articulation but also affects the transformation of knowledge articulation to knowledge updating. When employees' quality and productivity goals do not converge, it threatens the generation-articulation and articulation-updating process. As such, the fragility of frontline learning is exposed unless the organization can maintain a balance as it pursues quality goals without diminishing productivity. After all, organizations that deliver high levels of quality at an unduly high cost to the customer (due to poor productivity) are unlikely to maintain a sustainable market performance.

Managerial implications

This study offers several important managerial implications on how organizations can improve both productivity and quality simultaneously by effective management of the knowledge at customer interfaces. First, practitioners may need to balance their efforts for developing frontline learning capacity across organizational levels. Developing individual and group learning through additional training may be counter-productive if the organization does not have the mechanisms to absorb and warehouse the knowledge obtained through individual knowledge generation and group knowledge articulation. Likewise, ignoring the collective mechanism of sharing and articulating knowledge at the group level may make it difficult for organizations to capitalize on the marketing knowledge embedded in customer interfaces.

Second, learning is not an explicit responsibility of the frontline employee in general, and frontline learning does not happen automatically. Accordingly, managers must direct the resource allocation toward the promotion of frontline learning activities across organizational levels. Performance-monitoring systems need to be developed to allow the detection of performance gap signals and to provide performance feedback. Reward systems need to be tailored toward encouraging individual and group learning activities. Transforming everyday knowing into usable (explicit) knowledge is a deliberate process requiring time, energy, and resources. Thereby, management should invest resources to facilitate knowledge exchange such as internal workshop/seminars and periodic group meetings to identify and diffuse best practices. Finally,

developing an open communication climate for collective articulation is necessary for honest disclosure, criticism, and conflict resolution, which are psychologically threatening.

Third, cutting service capacity and having fewer employees to serve customers is not necessarily instrumental to an organization's long-term success. Many service firms are tempted to reduce service staffing level and increase employee workload to maximize output per employee (Oliva and Sterman 2001). For instance, in the health care industry, the number of patient visits per employee has increased from 182 in 2006 to 200 in 2010 according to IBIS World Industry Report. Similarly, the passenger count per flight attendant has increased from 4,458 in 2000 to 5,705 in 2009 for American Airlines and from 3,568 to 4,322 for United Airlines, per AirlineFinancials.com. Psychological burnout has been widely documented among service employees (e.g., Crawford et al. 2010; Singh 2000). While putting heavy workload on frontline employees might yield short-term gains, it has a downside effect on employees' engagement in frontline learning, which ultimately benefits organizations' performance. We urge managers to carefully weigh the pros and cons of increasing employees' workload.

Lastly, managers must do a better job of communicating with frontline employees about the importance of productivity goals. Frontline employees tend to place greater importance on quality than on productivity goals because of their physical and psychological proximity to customers (e.g., Donovan et al. 2004; Schneider and Bowen 1984). Our data confirmed this pattern (the mean value of frontline employees' perceived importance of quality goals (4.82) is significantly greater than that of productivity goals (3.80), $t_{397\text{d.f.}}=22.67$, $p<.01$). However, such imbalanced view of the importance of productivity and quality impairs frontline learning processes. Management must effectively convey to frontline employees the necessity of maintaining an efficient operation as well as quality service for the organization's survival. The productivity and quality benefits of frontline learning process appear more conducive when a convergent goal system is achieved among frontline employees.

Implications for future research

This study opens avenues for future theorizing of frontline learning. Much existing research in marketing focuses on top-down learning processes such that current understanding of the bottom-up learning triggered by frontline improvisation is rather limited. In face-to-face service contexts, service routines cannot be completely scripted because customer needs are ever changing and unpredictable. Despite the best efforts of organizations, contextual demands remain open to unanticipated customer heterogeneity (Feldman and Pentland 2003). To address these contextual needs, organizations need to design frontlines to go beyond ostensive routines and improvise customized or individualized solutions. Future research should investigate the types of frontline improvisation, the impact of the performative aspect of frontline learning on productivity and quality outcomes, and customers' participation in frontline improvisation.

More importantly, we urge future research to take a more integrative view of ostensive and performative learning. The performative and ostensive aspects of learning are two sides of the same coin. They are embodied in a duality of organizational learning and together contribute to frontline effectiveness. Ostensive learning creates stability and cognitive efficiency, and performative learning generates endogenous change and improvement (Feldman and Pentland 2003; Levinthal and Rerup 2006). This study examines the process through which knowledge generated in frontline performative actions is captured and transformed into the updating of ostensive service routines. More studies with an integrative perspective of ostensive and performative learning are warranted in the future.

Another under-explored area is managerial interventions that motivate employees to engage in frontline learning, and facilitate the transformation process of frontline learning. Frontline learning is costly, and these learning behaviors may not occur automatically. Opportunity costs include sacrificing time, energy, and resources dedicated to learning processes, and they could negatively affect short-term operational targets. Frontline learning also involves interpersonal risks (e.g., Edmondson 1999), and it will be necessary to identify organizational mechanisms that can alleviate risks and motivate employees to engage in frontline learning behaviors. Without employee engagement, frontline learning is a nonstarter. Future research should investigate other, managerially controllable interventions that influence the transformation process of frontline learning.

Finally, future research should explicitly consider knowledge use and knowledge integration in an effort to better understand how frontline learning contributes to organizational outcomes. Overall, a balanced and systematic approach is needed to develop a theory of frontline learning that is functional for organizations, employees, and customers. We hope our work provides impetus for such development.

Appendix A

Table 6 Measures and operationalization of studied constructs

Productivity-quality Knowledge Generation[a]	New Scale
In the past 12 months, how often did the following happen in your work?	
1. I thought of ways to improve both productivity and quality of patient care	
2. I tried different ways to improve quality of patient care without affecting productivity	
3. I learned to deliver high level of productivity and patient care quality	
4. I tried different ways to improve productivity without sacrificing quality of patient care	
Productivity-quality Knowledge Articulation[a]	New Scale
In the last 12 months, how often did the following occur in the unit meetings in your unit?	
1. We discussed different ways that improve both productivity and quality care	
2. We shared ideas to improve quality care without sacrificing productivity	
3. We reached consensus on how to increase both productivity and quality	
4. We shared ideas to improve productivity without affecting quality	
Productivity-quality Knowledge Updating[a]	New Scale
In the past 12 months, how often has your unit…	
1. Developed alternative practices to improve both productivity and quality care	
2. Changed work practices to enhance productivity without affecting quality care	
3. Adopted different ways to improve quality care without affecting unit productivity	
4. Launched new practices to improve both quality care and unit productivity	
Workload[b]	Beehr et al. (1976)
Please indicate the degree to which you agree with the following:	
1. I have too much work to do and too little time to do it	
2. The amount of work I have to do interferes with the quality I want to maintain	
3. I often have to do assignment without adequate training[c]	
4. I don't have enough help and equipment to get the job done well	
5. I often feel exhausted in my work role	
Employee Goal Convergence	
Step 1: Respondents rated their perceived importance of two quality goals and two productivity goals. The goals were selected based on a review of the health care literature and interview with the hospital management as follows:	
(a) delivering highest quality of patient care, (b) maintaining highest levels of customer satisfaction,	
(c) delivering patient care in a cost efficient manner, and (d) meeting productivity targets.	
Step 2: We estimated each frontline employee's perceived importance of quality ($Q = (goal_a + goal_b)/2$) and productivity goals ($P = (goal_c + goal_d)/2$). Subsequently, we calculated a distance, D_{ie}, as the indicator of productivity and quality goal convergence of each employee: $D_{ie} = \sqrt{(P_{ie} - Q_{ie})^2}$ where P_{ie} and Q_{ie} represent the i_{th} employee's perceived importance of productivity goals and quality goals.	
Step 3: The mean of the D_{ie} within each unit was calculated and the sign was reversed to represent the employee goal convergence in each frontline unit: $D_e = -\frac{1}{n}\sum_i D_{ie}$ where n is the number of employee respondents within each unit.	

[a] 5-point Likert scale ranging from "Never" to "Very Frequently."

[b] 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree."

[c] The item was dropped due to poor factor loading

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