When problem solving prevents organizational learning

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Abstract We propose that research on problem-solving behavior can provide critical insight into mechanisms through which organizations resist learning and change. In this paper, we describe typical front-line responses to obstacles that hinder workers’ effectiveness and argue that this pattern of behavior creates an important and overlooked barrier to organizational change. Past research on quality improvement and problem solving has found that the type of approach used affects the results of problem-solving efforts but has not considered constraints that may limit the ability of front-line workers to use preferred approaches. To investigate actual problem-solving behavior of front-line workers, we conducted 197 hours of observation of hospital nurses, whose jobs present many problem-solving opportunities. We identify implicit heuristics that govern the problem-solving behaviors of these front-line workers, and suggest cognitive, social, and organisational factors that may reinforce these heuristics and thereby prevent organisational change and improvement.

The new mother, seated in a wheelchair and cradling her two-day-old infant in her arms, was ready to leave the hospital when Abby, the nurse on duty, noticed that the security tag that should encircle the baby’s ankle was missing. These reusable tags were expensive, costing over $100 each. Abby quickly searched for the tag and was able to locate it in the baby’s bassinet. Three hours later, a similar event occurred. This time, despite enlisting assistance from other nurses and spending eight minutes looking in the bassinet and the nursery, Abby was unable to find the tag and notified the nurse manager of its disappearance. It seemed likely that the distracting and potentially serious problem would happen again because investigation into underlying causes of the two incidences had not occurred.

The first author, observing both events, was struck not only by this seemingly unusual problem’s recurrence but also by Abby’s and the nurse manager’s lack of attention to seeking root causes for this annoyance. This inattention was surprising for two reasons. First, the nurse commented that the security tags had fallen off both of the babies she discharged that day, implying that she understood the significant and recurring nature of the problem. Second, the security tag system was less than a month old, which means that managers and nurses should have had a heightened sensitivity to the system’s shortcomings and have been more motivated to resolve breakdowns in the new technology (Tyre and Orlikowski, 1994). It is exactly

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under these conditions — when workers are sensitive of the existence of problems and motivated to make changes to improve the system — that one would expect root cause problem solving and ensuing organizational change to occur (Tyre and Orlikowski, 1994).

Furthermore, the manager and nurse’s actions made it more difficult to engage in root cause problem solving in the future. The nurse was able to discharge the patients without more than a few minutes of delay, reinforcing the validity of the nurse’s response to the missing tags and consequently her competence as a professional. This paper argues that problem-solving behaviors that focus solely on remedying or overcoming immediate obstacles prevent organizational learning, both because short-term success diminishes motivation to remove underlying causes of problems and because valuable data that can be used to justify and inform removal efforts are lost.

Problems occur frequently in organizations (Hackman and Wageman, 1995) and are often visible symptoms of faulty procedures or processes that, if changed, could result in organizational improvement (Sitkin, 1992). Problems that emerge repeatedly in the day-to-day operational activities through which an organization produces and delivers products and services to customers are especially important for signifying improvement opportunities. The above example is one of many problems we observed that did not receive further attention or trigger procedural or structural changes. Seeing a similar pattern across eight hospitals, we asked what might lead an organization to ignore these important signals for change. That organizations resist change is well documented (Argyris, 1993; Beer and Eisenstat, 1996; Beer et al., 1990; Bennis et al., 1961; Schein and Bennis, 1965; Turner and Crawford, 1998). At the same time, the need for change, learning, and improvement in organizations is intensifying (Garvin, 2000), and gaining a better understanding of sources of resistance to organizational change is important for theory and practice alike.

In this article, we propose that how employees respond to problems encountered on the job is a critical factor in enabling or preventing positive organizational change. In an inductive field study of hospital nurses, we observed a dominant pattern of problem-solving behavior, and we propose that this pattern — characterized by overcoming immediate obstacles and ignoring opportunities for change and learning — provides an unexplored source of resistance to organizational change. Our analysis of qualitative data suggests that problem-solving behavior of front-line workers may reduce an organization’s ability to detect underlying causes of recurring problems and thus to take corrective action. We explore organizational factors that may reinforce the tendency to engage in short-term fixes and thereby limit organizational learning from front-line failures (Argyris, 1990). Drawing from research on workplace errors (Osbourne et al., 1999), we also consider contextual factors and individual differences that might influence problem-solving behavior.
The role of problem solving in organizational learning

Recent literature has emphasized the notion that organizations can—and must—learn in a changing environment (Garvin, 2000; Senge, 1994). Organizational learning has been defined as a process of improving organizational actions through better knowledge and understanding (Fiol and Lyles, 1985). One can say that an organization has learned when it changes its activities in response to new knowledge or insight, typically resulting in improved performance (Garvin, 2000).

One way that organizational learning can occur is through problem solving—identifying and resolving problems that occur in the execution of day-to-day work routines (Jones and McBride, 1990; Mukherjee et al., 1998). A problem is defined as an undesirable gap between an expected and observed state (Brightman, 1988; Kepner and Tregoe, 1976) that hinders a worker’s ability to complete his or her tasks. Problems encountered by front-line workers, who are responsible for producing the goods or services sold by organizations, can impact product quality or customer satisfaction. Removing recurring problems thus can contribute to improvements, especially when the changes made to remove problems lead to new systems and procedures. Front-line workers are frequently in the best position to identify operational problems, and so are critical to an organization's ability to improve. They are typically a large percentage of the workforce and can provide valuable leverage in both identifying and removing problems, as it is their work routines that are being disrupted by problems and they often have first-hand access to data about the causes or consequences of them (Roth, 1985). In sum, front-line workers are well situated to identify, analyze, and resolve daily problems that arise and, through this local improvement activity, to contribute to ongoing organizational learning.

Research on problem solving suggests that how problems are addressed affects the success of improvement efforts. More specifically, problem-solving responses can be categorized into one of two types, one that is likely to lead to organizational learning and one that is not. While many researchers (Boje and Murnighan, 1982; Mitroff et al., 1979; Taylor, 1975; Ulrich, 1977; White et al., 1980) and practitioners (Deming, 1986; Goldratt, 1997; Ishikawa, 1985; Juran et al., 1999; Kepner and Tregoe, 1976) have proposed problem-solving methods to improve quality in operations settings, few have examined how front-line workers actually approach problems. Analogous to the concepts of single and double loop learning identified by organizational learning researchers (Argyris and Schon, 1978), research on problem solving makes a distinction between fixing problems (first order solutions) and diagnosing and altering underlying causes to prevent recurrence (second order solutions). First-order problem solving allows work to continue but does nothing to prevent a similar problem from occurring. Workers exhibit first-order problem solving when they do not expend any more energy on a problem after obtaining the missing input needed to complete a task. Second-order problem solving, in contrast, investigates and seeks to change underlying causes.
Argyris and Schon (1978) found that in difficult interpersonal interactions, people see others as causally responsible for (and rarely learn about their own contribution to) the problematic interaction (single-loop versus double-loop learning). Although these authors focused on interpersonal rather than technical problems and did not investigate whether there is a similar tendency to prefer first-order to second-order problem solving, their research suggests the possibility. In short, second-order problem solving may be more difficult in practice than in theory. Consistent with this supposition, recent work highlights the fact that efforts to implement total quality management, a problem solving system aimed at continuous improvement at the front lines, often fail (Hackman and Wageman, 1995; Keating et al., 1999; Zbaracki, 1998).

Some researchers have investigated factors that might contribute to resistance to the specific practices advocated by quality improvement efforts (Carmen et al., 1996; Huq and Martin, 2000; Mukherjee et al., 1998; Shortell et al., 1995). For example, Mukherjee et al. (1998) found that workers' behaviors changed when the quality improvement projects included both operational "know how" and conceptual "know why" learning components.

In general, research on problem solving has focused on identifying preferable methods rather than on what happens when human beings confront problems in organizational contexts. Empirical research is thus needed to understand how organization members handle problems that arise in the day-to-day execution of work routines. Moreover, to develop a better understanding of this phenomenon than allowed by organization-level analyses of resistance to change (Beer et al., 1990; Turner and Crawford, 1998), it is important to observe actual behavior of organization employees as they encounter problems. Retrospective accounts gathered in interviews are likely to overstate an individual's tendency to engage in prescribed methods for problem solving (Argyris, 1990), and thus to fail to identify this important source of resistance to change.

**Methodology**

To investigate problem-solving responses of front-line workers, we relied upon qualitative observational methods (see Spear, 1999). Because little is known about actual rather than prescribed behavior in response to problems, it was essential to observe this behavior directly to learn from it. We gathered data on the actual problem situation and response of front-line workers through observation, enabling a better understanding of the nature and contextual triggers of different kinds of problem-solving actions than would be possible with interviews or a survey. Our aim was to use observational data as a foundation for developing new descriptive and theoretical propositions about this phenomenon.

The health care delivery context is particularly conducive for a study of problem-solving behavior because organizational-system problems occur relatively frequently (Leape et al., 1995). Moreover, we predicted that in this setting we would be likely to observe efforts to solve problems, as they often
have consequences for human life. In particular, hospital nurses are appropriate subjects for this research because their central position in complex organizations increases the likelihood that they will encounter obstacles, which happens when aspects of the work system prevent them from completing patient-care tasks.

The first author observed 22 nurses in eight different hospitals for a total of 197 hours. She made observations on all three shifts and on all days of the week to ensure an accurate representation of cycles of nursing work and support systems available to nurses. She closely followed nurses, including times when they were in the patients' rooms (contingent upon patients' consent), but did not observe bathing, toileting, or other care that compromised patients' privacy. The first 12 nurses were observed for only part of their shift and notes were recorded on an event driven basis. The remaining ten nurses, from five different hospitals, were shadowed for an entire shift, and notes were recorded on a minute-by-minute basis. Following each site visit, the first author wrote a detailed narrative version of the day in a journal. The data from the journal and the notebook were combined for analysis.

Results
In 197 hours of observation of 22 nurses, we documented 120 problems (or, approximately one every 1.6 hours of observation). Examples include the following (in descending order of cumulative time spent):

1. missing or incorrect information;
2. missing or broken equipment;
3. waiting for a resource; and
4. missing or incorrect medication.

To compute interrater reliability, a random sample of ten observation days was evaluated independently by two non-nurse reviewers. The kappa statistic, which adjusts the rating downward to compensate for the probability that raters could assign items to the same category by chance, was appropriate to use in this situation. The kappa value was 0.88 for judgments about problem type, which is considered almost perfect by Landis and Koch (1977).

Missing or incorrect information, the most time consuming type of problem, included not having a Tylenol order to treat a patient's fever, looking for test results and not being told about a patient's nausea during a change-of-shift report. Missing infant security tags, broken suction gauges, and missing thermometers were instances of missing or broken equipment. An example of a "waiting for resource" problem was waiting for a medication-dispensing machine that was being used by another nurse to become available. Finally, missing or wrong medication occurred when the patient's medication was not in the patient's medication drawer, or was in the drawer but was the wrong dosage.
In this section, we characterize the problem-solving behavior of the nurses, and speculate about the effects of nurses’ responses on the organization’s ability to learn and change. First, we note that first-order problem-solving behavior characterized the great majority of these responses. Second, we identify two distinct heuristics that capture nurses’ first-order problem-solving behavior. Third, we draw from additional observational data to suggest antecedents and consequences of the observed preference for first-order over second-order approaches when an exception arises.

**Predominance of first-order problem solving**

The nurses we observed appeared virtually unable to engage in the kinds of second-order problem-solving behaviors prescribed in the literature. Instead, the most common response was to use first order techniques that allowed the nurse to continue caring for the patient and ignored the possibility of investigating or changing causes of the problem. In addition, we found that nurses refrained from sharing information that could have been used to aid their own and the organization’s learning and improvement. Finally, nurses engaged in second-order problem solving for only a handful of the problems, but even then it was usually only in a minimal fashion, such as using an opportune moment to relay information.

Through qualitative analysis of 120 problems, we discerned two distinct heuristics, or rules of thumb, that characterized the majority (92 percent) of nurses’ responses when confronted with problems. The kappa statistic for problem solving response was 0.53, which reflects a moderate degree of agreement (Landis and Koch, 1977). The two dominant heuristics are:

1. do what it takes to continue the care of the patient; and
2. involve people with whom you are most comfortable, rather than the ones who are best able to solve the problem.

Each of these is explained below and illustrated in Table I and both can be characterized as first-order problem solving.

**Two problem-solving heuristics**

The first heuristic, doing (only) what it takes to continue the patient-care task, governed 92 percent of the responses to problems. As shown in Table I, only 3 percent of the problem-solving efforts observed contradicted Heuristic 1, while the other 5 percent that did not follow this heuristic were not problems that affected immediate patient care. When nurses responded using Heuristic 1, their behavior was characterized by concern for securing the information or material they need to do their jobs and not on understanding what caused the problem to occur. After the nurses were able to resume caring for the patient, they did not expend any further effort on the problem, including communicating that it occurred. Abby’s response to the missing infant security tags illustrated Heuristic 1.
<table>
<thead>
<tr>
<th>Heuristic</th>
<th>$n$</th>
<th>(%)</th>
<th>Characteristic behavior</th>
<th>Example that illustrates use of heuristic</th>
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<tbody>
<tr>
<td>1 Focus on doing what it takes to continue the care of the patient</td>
<td>110</td>
<td>92</td>
<td>Activity focuses on providing care to patient quickly, while ignoring possible root causes</td>
<td>Two patients (newborn babies) in a row are missing their security tag at discharge. Nurse searches for the tags, but does not seek to identify why the security tags had fallen off in the first place (Abby, Hospital 4, 10/20/00)</td>
</tr>
<tr>
<td>Counter-example of behavior in violation of heuristic 1</td>
<td>3</td>
<td>3</td>
<td>Activity focuses on removing root cause rather than on immediate patient care</td>
<td>Patient received a stale, inedible muffin on her food tray. Nurse informs kitchen manager about the inadequate food, but does not order replacement food for the patient (Xavier, Hospital 1, 5/12/00)</td>
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<tr>
<td>2 Involve people with whom you are most comfortable, rather than the ones who are best able to solve the problem</td>
<td>41</td>
<td>34</td>
<td>Try to solve problems on your own. If help is needed, turn to a nursing associate first, even if another person is better suited to assist</td>
<td>Kendra does not know how many days to tell the patient to wait until he can remove the bandage for showering. She asks the patient if the doctor told him and checks his paperwork. He does not know. Next, Kendra asks two other nurses if they know how many days the doctor has the patients leave on their bandages. The nurses tell Kendra four days and she uses that figure for her discharge instructions. Kendra does not call the doctor to verify the number (Kendra, Hospital 4, 7/27/00)</td>
</tr>
<tr>
<td>Counter-example of behavior in violation of heuristic 2</td>
<td>6</td>
<td>5</td>
<td>Turn directly to the person who is best able to fix the problem rather than trying to solve on your own or relying on your associates</td>
<td>Rose noticed that the ingredient listing on the “total parental nutrition” (an intravenous feeding mixture) bottle was incorrect. She called the pharmacy technician, who said that she inverted two ingredients when she printed the label, but the mixture was correct. The pharmacist wanted Rose to make the correction to the label. Rose refused and had the pharmacy technician come up to the floor to change the label (Rose, Hospital 1, 5/13/00)</td>
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**Note:** Each problem-solving event illustrates 1.3 heuristics.
Heuristic 2 was characterized by choosing to ask for help from people who were socially close rather than from those who were best equipped to correct the problem. Responding to problems using Heuristic 2 involved first trying to solve problems alone and, if that failed, asking a nurse colleague, particularly one who was a friend, for help. If it was necessary for patient care, nurses requested help from hospital staff outside of the nursing department. Used only as a last resort and when all the other options had been exhausted, the final call for help was to a physician. The nurses followed this heuristic for 41 (34 percent) and deviated from it for only six (5 percent) of the problems (e.g. contacting a physician or other hospital personnel rather than attempting a first-order solution on their own).

**Antecedents of first-order problem-solving behavior**

Our data suggested two factors that contribute to the predominance of first-order problem solving: lack of time for second-order problem solving and nurses' low status compared to doctors and managers.

First, nurses did not have slack time to engage in activities outside their immediate patient care responsibilities. We observed nurses often had more tasks to perform than they could complete. Nine of the ten nurses whom we observed for an entire shift continued working – some even after they were no longer being paid – for an average of 42 minutes (range: 0-90 minutes) because they were unable to finish their regular duties in the allotted time.

Second, doctors and managers often failed to provide necessary information or attention to address nurses' concerns. Status differences between nurses and physicians are well documented in the literature (Chambliss, 1996; Wicks, 1998), and in this study we found that doctors, at times, treated nurses as low status workers. For example, we observed behavior such as ignoring nurses’ insight into patients’ conditions and neglecting to communicate about patients’ treatment plans. Similarly, front-line managers and other hospital staff often required nurses to “prove” that they had indeed encountered a problem and were not just personally incompetent. For example, we observed a nurse call the pharmacy three separate times to request delivery of missing medications. For each instance, the nurse had to validate her request to the pharmacy by answering a series of questions about what she had already done to search for the medication.

**Consequences of first-order problem-solving behavior**

Our data show nurses – through well-meaning, gratifying efforts of working around problems – ironically contribute to their persistence. We found that the first order heuristics had benefits for the nurses as individuals. Quick solutions allowed nurses to continue caring for their patient, thereby overcoming the problem in an effective way. The ability to circumvent problems validated nurses' confidence in their competence and professionalism. The short-term effectiveness of first-order problem-solving behavior diminished the potential
sense of urgency to engage in second-order problem-solving behavior, and thus detracted from the organization’s ability to learn. Nurses engaged in second order problem solving on a total of only ten (8 percent) problems and their efforts were often opportunistic, weak, and unrecognized as a request for organizational improvement. We considered two behaviors as second-order: communicating about the routine exception to someone in a position to find and remove underlying causes, or attempting themselves to find and remove underlying causes. Relaying information about problems was more common than suggesting or implementing solutions. Specifically, nurses communicated to the person responsible for eight (7 percent) of the problems. (Conversely, we also observed nurses withhold information that pertained to solving six (5 percent) of the problems.) We observed only one instance where the nurses altered the system to prevent recurrence.

Furthermore, without a window of opportunity (available time, or the ability to talk with a key person), nurses did not engage in the kind of root cause investigation problem-solving experts recommend. For seven (6 percent) of the problems observed, nurses engaged in opportunistic problem communication and for only two problems in which a window of opportunity was present did nurses fail to use it. The window of opportunity appeared to be particularly important because second-order problem solving had to take place during regular working hours and on the nursing unit. Therefore, nurses needed available time, motivation, and easy access to key people to engage in problem-solving activities outside their regular scope of responsibilities.

Table II provides more detail, and illustrates that counter examples to second-order problem-solving behaviors were approximately as frequent as the second-order problem-solving efforts themselves.

The above analyses focus on the distinction between first- and second-order problem solving. We now discuss the range of outcomes associated with these behaviors. First-order problem-solving outcomes ranged from situations in which minor, but annoying problems were not prevented from recurring, to more dangerous situations with the potential for serious consequences. As an example of the former, one nursing unit ran out of towels after a three-day weekend. The nurse took towels from a neighboring unit – which also had low inventory – and had the secretary request replenishment from laundry supply. The nurse commented that laundry supply probably did not account for the extra towels that would be needed to get the unit through an additional day without laundry service. However, she did not suggest any solutions to her manager or to laundry service, making it likely that laundry shortages would recur after the next long weekend. This routine exception, while annoying and inconvenient to nurses is unlikely to cause patient harm. As an example of the latter, the first-order response to the missing security tags described above could result in a serious consequence – the abduction of a baby. Other examples include uncorrected medication mix-ups, such as a drug put in the wrong location on the shelf, which can easily cause patient harm. This study did not
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<th>Problems that followed behavior</th>
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<th>Example that illustrates behavior</th>
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<tbody>
<tr>
<td>Use windows of opportunity to address issues likely to reoccur</td>
<td>7 (6%)</td>
<td>If you have the available time and the person is available, you can relay information about the problem to the source or educate yourself</td>
<td>Jan and Katy did not know how to operate the pump that allows the patient to administer their own pain medication. They tried reading the equipment manual, but were unsuccessful. They contacted the nursing supervisor, who was able to get the pump running. Later that night, when it was “quiet” and they were caught up on their work, Jan and Katy practiced with a spare pump. They were able to use the pump the next time they needed to (Jan and Katy, Hospital 1, 4/6/00)</td>
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<tr>
<td>Counter-example of behavior</td>
<td>2 (2%)</td>
<td>Even if you have the time and the person is available, do not try to solve the problem</td>
<td>Blanche told the observer that if the patient room had a refrigerator with drinks, it would save time for the nurses as they wouldn’t have to walk down the hall to get drinks for the patients. When asked whose responsibility it was to “fix” this refrigerator problem, Blanche said it was the nurse manager’s responsibility. However, we did not observe Blanche telling the nurse manager about her idea even though the nurse manager was at the nurses’ station for the entire shift (Blanche, Hospital 4, 10/27/00)</td>
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<td>Limit responsibility for eliminating root cause to conveying or receiving information</td>
<td>8 (7%)</td>
<td>Nurse communicates to the source or receives information to help her knowledge. Nurse does not suggest, implement, or verify solution</td>
<td>When the clinical leader arrived at 7:30 a.m., Laura, the night shift nurse relayed a problem that she had that night. The second shift nurse had hung the first of two ordered units of blood five hours late, resulting in the required blood type and cross unit expiring before Laura was able to get the second unit of blood (Laura, Hospital 2, 6/6/00)</td>
</tr>
<tr>
<td>Counter-example of behavior</td>
<td>6 (5%)</td>
<td>Do NOT share information that could be used to remove root cause</td>
<td>Abby had a student nurse working under her direction. The student discharged a patient and then left for the day. Afterwards Abby commented that she knew the student could not have completed all of the discharge paperwork because she left so early. Abby did not inform the student that she did not properly complete the paperwork even though it was the student’s last day at the hospital (Abby, Hospital 4, 10/20/00)</td>
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**Note:** The nurses used second-order problem solving on a total of ten (8 percent) of the 120 problems.
find an example of these, but such contributors to medication error have been well documented elsewhere (Edmondson, 1996; Leape et al., 1995), and are similar to the kinds of problems we did observe.

Second-order problem solving had outcomes ranging from unsuccessful attempts to remove root causes to successful prevention of problem recurrence. Engaging in second-order problem solving did not guarantee positive results, but at times did seem to improve current conditions. For example, two night shift nurses did not know how to operate a patient-controlled analgesia pump, which caused a substantial delay in requested pain-relief medication. After the supervisor got the pump operating, the nurses practiced on a spare piece of equipment until they were comfortable with the procedure. Two weeks later they received another patient that had such a pump and they were able to start the medication without delay.

The consequence of the observed predominance of first-order problem solving was that organizational systems got worse or stayed the same. First, organizational learning was limited by a lack of communication about problems. We observed many situations that — if the nurse had given feedback to the responsible person — could have been used as platforms for improvement. Second, many first order solutions created problems for other people. We frequently observed nurses responding to missing equipment or linen by getting supplies from other storage locations, depleting their stocks, such that future shortages could arise for others. Third, when nurses solved problems on their own, cumulative information about occurrence was lost. This information would help justify that the problems were severe enough to be fixed. In sum, nurses used first-order problem solving in an attempt to navigate through the stream of problems that they encountered during their day but in so doing, contributed to the force of the stream working against them.

Discussion
In these data, two first-order problem-solving heuristics characterized the vast majority of responses to organizational system problems. Efforts to identify or remove underlying causes were relatively rare. In discussing these results, we speculate about factors that make second-order problem solving almost non-existent among the front-line workers studied. In contrast to the notion that people resist change owing to anxiety about the unknown, we found that nurses tended to derive a sense of competence and well being from their ability to engage in first-order problem solving. They were proud of their independence and ability to ensure care for patients. Thus, organizational resistance to change may also arise owing to individual workers’ sense of personal competence in coping with current systems. This phenomenon provides an individual-level analog to the organizational competency trap discussed by Levitt and March (1988), who argue that organizations fail to learn because of a flawed tacit assumption that current organizational competencies are preferable to alternatives. More generally, we propose that competence is intrinsically rewarding, such that both individuals and
organizations are likely to favor familiar routines and skills over new (potentially unsuccessful) behaviors.

Not only was it personally gratifying for these skilled workers to maneuver competently in the existing system, they were rewarded for doing so. We identified three factors, embedded in psychological, organizational, and institutional features of the work environment that reinforced an emphasis on first-order over second-order problem solving. First, the nurses we observed had a heroic attitude about their ability to take care of and protect their patients. That is, first-order problem solving provided psychological gratification to the worker, who – through creativity and persistence – stoically “solved” the problem alone, demonstrating independence and competence. Moreover, these behavioral guidelines appeared to be reinforced by a work context that encouraged nurses to work as independently as possible, not diverting their attention from the primary task of caring for patients, and using quick solutions to work around system aberrations. Not engaging in first-order problem solving was uncomfortable because it often required waiting and increased the worker’s dependence on others to correct the situation, resulting in uncertainty about whether the nurse’s request would be performed correctly, if at all. However, such individual problem-solving efforts worked against the notion that diagnosing and fixing underlying root causes is typically a collective undertaking in organizations (e.g. Deming, 1986).

Second, nurses’ jobs, as observed in this study, were structured to foster first-order problem solving. These workers – as is typical of front-line workers – rarely had time in their work cycle to resolve problems. They did not have easy and convenient methods for communicating about these setbacks and they lacked access to other human resources who could assist them with difficulties. In these time-starved situations, nurses prioritized their tasks and less urgent system improvement efforts were low priority. The lack of resources and standard, quick procedures for communicating about problems with other functional groups made second-order problem solving efforts time-intensive and thus prohibitively costly to nurses. This study thus suggests that negative cycles of problem-solving behavior – addressing symptoms rather than causes (Senge, 1994) – may be reinforced by the front-line context, in which immediate responsibilities supersede potential future benefits of improvement efforts.

A third factor that may contribute to first-order problem solving behavior is the lower status of nurses relative to doctors and administrators. Research has shown that even a small amount of negative response, as is commonly experienced by nurses during interactions with doctors (Chambliss, 1996), makes a substantial impact on future interactions and willingness to engage in helpful behavior (Heilman, 1974; Rogers, 1973). Therefore, it is not surprising that in the hospital setting, nurses are often reluctant to intrude upon a physician’s time, even when the physician may have caused the problem or have valuable information that would help resolve the situation (Edmondson, 1996).
One wasteful consequence of this vicious cycle of first-order problem solving is that the organization misses opportunities to improve and learn and workers continue to face disruptions and complications that are frustrating and make it difficult to complete their work. When second-order problem solving on the front line does occur, it is often an opportunistic, weak attempt by workers to signal that they have encountered difficulty. This gives rise to a system that continues to generate problems, fails to alter underlying causes, and thereby precludes organizational learning. In sum, organizational factors, such as work norms and nurses’ status in the organization, reinforce a task structure that includes enormous time constraints and limited forums for group discussion, both of which contribute to the persistence of first-order problem solving and an inability to produce real change.

Although understanding how to change this phenomenon is beyond the scope of this observational study, we can speculate that efforts to encourage second-order problem solving will require addressing psychological, organizational and institutional factors, rather than any one of these in isolation. This viewpoint is consistent with other researchers who have found that organizational improvement efforts require attention to multiple aspects of organizational life (Keating et al., 1999). In the next section, we develop implications of our findings for facilitating positive organizational change through encouraging second-order problem solving on the organizational front line.

Conclusions
Increased communication about problems and the use of preferred problem-solving methods have been advocated in the literature as essential to problem-solving effectiveness. This study investigated how the context of the front lines affects workers’ responses to routine problems. Some of these conditions may be unique to hospitals while others, such as a lack of time or pride in one’s competence, are also characteristic of front-line workers in other service and manufacturing contexts. Our research suggested that a lack of available time and norms that valued quick, self-sufficient solutions contributed to a pattern of front-line workers rarely engaging in root cause removal. When they did, it was usually only to communicate that they had experienced a problem. Therefore, only a small percentage of the problems encountered were revealed to others within the organization, dramatically reducing the potential for organizational learning and improvement.

For many organizations, improvement will require addressing how work is actually conducted at their front lines, and so more care needs to be paid to workers’ problems and the conditions needed to ensure second-order problem solving and organizational learning. We propose several necessary conditions for enabling organizational learning on the front lines. First, if workers are to engage in root cause removal, this activity must be an explicit part of their job and enough time allocated for improvement efforts. Second, there needs to be frequent opportunities for communicating about problems with individuals who
are responsible for supplying front-line workers with materials or information. We only observed front-line workers surfacing problems with others when they were able to communicate easily. Encouraging people to communicate and creating a psychologically safe environment (e.g. Edmondson, 1999) is not sufficient. There must be convenient opportunities in the course of the day for workers to give feedback. Ideally, this feedback would be immediate, while the information required for root cause analysis was still available. Third, when the signal is given that there is a problem, proper attention must be paid to it. We must recognize communication as a valid step in the direction of improvement. Often the best that the worker could do was to merely raise the issue, but too often this worker ran the risk of being considered a "complainer". We did not observe any instances where the nurse contacted someone about a trivial or insignificant exception. In fact, we observed several occasions where we were surprised that the nurse did not raise awareness around a problem that we felt could have serious consequences. Fourth, we observed two hospitals' units that had a dedicated person who served as a system improvement resource for the nurses. This person helped to address the nurses' concerns, particularly for those situations that required more time away from their front-line duties than the nurses could spare. Fifth, once the other conditions are in place, we can begin to encourage solution generation, experimentation, and consideration of the longer-term consequences of actions. Sixth, publicizing successful system problem solving will further encourage people to recognize the potential benefits of engaging in this kind of "extra" work.

This research has implications for other front-line workers who face an unpredictable and demanding environment, in which customers are individuals and have different reactions to situations and unique requests. Service workers such as airline crews, air traffic controllers, hotel clerks, teachers, and waitresses also face a work environment where institutional factors encourage them to solve problems on their own. Emphasis on reducing costs through minimizing the number of workers and pressure to satisfy the immediate needs of customers is present in all of these situations, superseding worker motivation to engage in longer-term improvement efforts. It is in precisely these situations that the productivity of the workers is crucial, and so difficult to improve.

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