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Abstract

A potential avenue for organizational learning is frontline employees' experience with internal supply chain problems. However, extensive research has established that employees rarely speak up to managers about problems. They tend to work around problems without additional effort to create organizational learning. This paper tests the premise that managerial action, via work design, can alter this dynamic. We use laboratory experiments to test the impact of three work design variables on proactive, improvement-oriented behaviors, workarounds, and errors. We find that two out of the three work design variables were effective at inducing proactive improvement-oriented behavior. Our results suggest that small changes in job design can reduce employee silence about organizational problems. Furthermore, we test the impact of the variables on risky workarounds and errors to account for unanticipated negative effects of work design to facilitate speaking up.

Introduction

Employees' proactive behaviors are critical for performance improvement programs. In particular, employee knowledge about internal supply chain (ISC) problems has the potential to be harnessed to identify improvement opportunities. An ISC is the linked set of processes within an organization that collectively provides a service to the customer (Basnet, 2012). To illustrate, in hospitals, the ISC for medical patients contains the departments and activities involved in administering medications to patients. Problems manifest when employees are unable to provide service to a customer because they are missing information, equipment, supplies, or human resources necessary to complete their tasks.

It is worthwhile to resolve ISC problems because they can frustrate employees, waste employee time, and lead to errors and low quality. Despite the potential negative impact, employees frequently remain silent, making it likely that the problems will recur (Burris, 2012, Detert and Treviño, 2010, Kish-Gephart et al., 2009). In addition, relying on workarounds can circumvent standard procedures, introducing variability and errors into the process.

Prior research has identified personality traits, such as felt responsibility, as necessary antecedents for proactive behavior (Frese et al., 1996, Morrison and Phelps, 1999, Pearce and Gregersen, 1991). This suggests that managers who wish to develop successful improvement programs must first hire employees who possess proactive personality traits. However, in some companies, such as Toyota, most employees routinely speak up about problems that interfere with their work, and this communication drives process change (Spear, 2004). Given the unlikely probability that a company as large as Toyota could restrict itself to hiring only proactive individuals, we propose that specific work circumstances that managers manipulate can increase employees' willingness to speak up about problems. This paper thus asks, "Can managerially-influenced conditions cause employees to speak up about internal supply chain problems?"

Specifically, we investigate three work design variables found to be associated with proactive behavior in prior research. We use a series of laboratory experiments to test whether these variables spark proactive behavior independent of individual proactive traits. The three variables are (1) the opportunity to earn charity payments based on the work group's future performance, which motivates people who want to project an image as a good person (*image motivation*); (2) a *broad role orientation* where workers consider improvement activities as part of their job responsibilities; and (3) deliberate *work-flow blockages* designed to force employees to speak up about problems. We also consider the impact of these conditions on how employees work around problems and the quality of their work. This research thus advances our understanding of the influence of work design on two important employee behaviors—improvement-oriented action and risky workarounds that may harm customers.

We found that participants were more likely to contribute improvement suggestions when employees' role orientation was primed to include process improvement as part of one's daily work activities and when deliberate blockages made it difficult to work around problems in a policy-conforming manner. Thus, this study supports the notion that employee proactive behavior can stem from deliberate work design, which falls under managers' jurisdiction, rather than solely from self-motivated employees.

In addition, we found negative consequences associated with increasing suggestions with work blockages: Participants used risky workarounds associated with higher levels of errors. Furthermore, employees who contributed suggestions did so *after* completing the set of assigned tasks, a style that we call reflective problem solving. None of the work design manipulations increased workers' improvement-oriented communication *during* task execution. We suspect that these two results occurred because, unlike Toyota, our experiment did not provide support staff to assist with problem solving activities. Therefore, if problem-solving support is unavailable to frontline employees—which is the case in many U.S. hospitals (Tucker and Edmondson, 2003)—managers seeking to increase employees' improvement-oriented ideas should build process improvement into the daily work of employees and create designated non-production time for employees to focus exclusively on improvement. Work blockages should be used sparingly, or if used, with ample problem-solving support to minimize risky workarounds.

Antecedents of Improvement-Oriented Behaviors

Organizational scholars have studied employees' prosocial behaviors, which are discretionary activities that benefit other people or the organization rather than the individual (Bateman and Crant, 1993, Crant, 2000, Grant and Ashford, 2008, Grant and Parker, 2009, Parker et al., 2006). Improvement-oriented behaviors are one kind of prosocial behavior. Thus, this body of literature provides insight into potential antecedents of improvement-oriented responses to ISC problems.

Field research suggests that employees rarely speak up with the intention of fixing ISC problems, a behavior termed "second-order problem solving" (Premeaux and Bedeian, 2003, Tucker and Edmondson,

2003). It is theorized that employees are more likely to decide to speak up when the benefits of doing so outweigh the costs (Grant and Parker, 2009, Milliken et al., 2003). In terms of costs, employees consider the time taken away their immediate responsibilities to communicate about problems and offer ideas to remedy them (Tucker, 2007). They also account for reputational cost of raising awareness about organizational shortcomings. For example, employees are reluctant to speak up if they fear retaliation for communicating bad news or the label of "troublemaker" (Premeaux and Bedeian, 2003). Manager behaviors, such as openness to hearing about organizational problems, may lower these reputational costs (Detert and Burris, 2007, Edmondson, 2003). Similarly, managers who respond to communication by taking action to improve the performance of ISC increase the benefits of speaking up. Employees with responsive managers believe that their problem solving efforts will be successful, a concept called problem solving efficacy (Kasouf et al., 2006, Tucker, 2007). In summary, this stream of research suggests that if a specific problem is severe enough, employees may decide to speak up. The threshold can be lowered over time by supportive managers who consistently respond positively to speaking up (Burris, 2012, Detert and Treviño, 2010). Thus, this literature proposes that speaking up is determined by problem and manager-specific factors. Personality traits also impact the benefit versus cost calculation. People with high self-assurance are more likely to believe that their efforts will be successful, thus increasing improvement-oriented behaviors (Parker et al., 2001). Similarly, high levels of felt responsibility lower the benefit threshold because these people are compelled to improve performance when they see an opportunity to do so (Morrison and Phelps, 1999, Pearce and Gregersen, 1991).

The literature on improvement-oriented behaviors has several limitations. First, the current framing of proactive behavior as an individually driven response to problems and manager characteristics does not explain how organizations, such as Toyota, are able to achieve consistently high levels of improvement-oriented behaviors across all employees, managers and magnitudes of problems (Spear, 2004). Second, previous research has relied primarily on self-reports of prior behaviors (Milliken, et al., 2003) or co-worker reports about people's general behaviors (Premeaux and Bedeian, 2003). This methodology raises concerns about self-reporting and recall bias. Third, highlighting individual personality differences as the driver of improvement-oriented behaviors is not a useful tool for managers with large, pre-existing workforces (Parker, 2000). Fourth, researchers have studied employees' behaviors within organizations, which yields correlational rather than causal relationships and makes it difficult to isolate the impact of specific antecedents due to the simultaneity of multiple factors, such as organizational culture and manager responsiveness (Detert and Edmondson, 2011). As a result, recommendations for increasing improvement-oriented behaviors are often multi-faceted and present formidable implementation challenge (Ashford et al., 2009, Detert and Edmondson, 2011, Milliken, et al., 2003). There is a need to investigate managerially-driven antecedents of improvement-oriented behaviors (Parker, 2000).

We attempt to address this gap in the literature by examining workers' real-time responses to ISC problems in a series of randomized laboratory experiments. We test three managerially-actionable variables that are promising as potential drivers of improvement-oriented behaviors. We consider these variables independent of less malleable antecedents, such as organizational climate (Detert and Burris, 2007, Edmondson, 2003) or proactive personality (Parker, 2000). Thus, our study can yield levers for consistent improvement-oriented behaviors across a wide range of employees.

Increasing Motivation for Improvement-Oriented Behaviors

Managers can increase the benefit of improvement-oriented behavior by offering an incentive that increases motivation to speak up, such as offering a financial incentive for submitting improvement ideas (Gneezy et al., 2011). Research has found that helping or sharing knowledge with co-workers can be fostered by providing employees with a direct benefit for doing so (Siemsen et al., 2007). For example, companies may share the savings from a suggestion with the employee (Arthur and Aiman-Smith, 2001).

However, studies on incentives for prosocial behaviors suggest that explicit incentives may be counterproductive because direct monetary compensation can crowd out the altruistic and image-enhancing motivations that are primary drivers of this behavior (Ariely et al., 2009, Frey and Oberholzer-Gee, 1997, Gneezy, et al., 2011). Altruistic reasons may be part of the motivation for solving ISC problems because if employees reduce problem occurrence, customers will receive better service in the future (Hall et al., 2010). In addition, the employee should face fewer problems on future work shifts. Conversely, if employees do not fix poorly functioning ISC, problems may harm customers (de Leval et al., 2000) and make their own jobs more stressful. Thus, workers can be motivated to engage in improvement-oriented behaviors to improve outcomes for other people as well as for themselves. It is plausible that image-enhancing motivation is also an important driver of improvement-oriented behavior because expending effort to improve outcomes for customers would raise one's image as a good person. Research has found the highest level of prosocial behavior occurs when this action is visible and benefits others, creating a signal of "goodness" (Ariely, et al., 2009). We hypothesize that being able to earn money for charity through improvement-oriented behaviors should lead to higher levels of such actions.

Hypothesis 1 (H1): Workers are more likely to engage in improvement-oriented behaviors about ISC problems when doing so increases the probability that they will earn money for a charity.

Flexible Role Orientation (FRO)

A flexible role orientation (FRO) has been shown to be associated with higher levels of proactive behaviors (Parker, 2000, Parker et al., 1997, Parker, et al., 2006). Parker defines FRO as perceiving one's job responsibilities as including activities outside of one's immediate duties, but impacting workgroup performance, such as equipment maintenance, the quality of raw materials, and co-workers' behavior

(Parker, et al., 2006). Although FRO is a cognitive-motivational state associated with a proactive personality, it has been shown to be linked with job autonomy, suggesting that it may be manipulated by job design variables (Parker, et al., 2006).

The process improvement literature also suggests a link between job design and FRO. Organizations that successfully implement improvement programs, such as lean manufacturing, expect workers to engage in improvement activities as part of their daily job responsibilities (Liker, 2004, Plsek, 1999, Spear, 2005, Toussaint et al., 2010, Victor et al., 2000). Employees are trained to consider poorly performing ISC as something managers would want them to communicate about, creating a FRO. As a consequence, improvement-oriented behaviors, which include speaking up and making suggestions, become a routine work responsibility.

Finally, the literature on decision-making biases related to inter-temporal choices provides an explanation for the link between a FRO and improvement-oriented behaviors. Research has found that despite an expressed desire to obtain positive outcomes in the future, people often fail to make investments in the short term that would benefit them in the future, such as exercising or saving money (Ariely and Wertenbroch, 2002, Laibson, 1997). The difficulty in investing today to benefit one's future self occurs because people prefer positive outcomes today over larger (after time discounting) benefits in the longer term, a phenomenon known as hyperbolic discounting (Frederick et al., 2002). We believe that the same dynamic might explain why process improvement needs to be part of today's work for employees to engage in improvement-oriented behaviors. Workers may be unwilling to make discretionary investments in the current work shift to achieve a more effective work place in the future. This can be a rational approach given the uncertainty that they will benefit from their efforts (Frederick, et al., 2002). For this reason, when employees have the mindset that process improvement is part of their daily work routine, they should be more likely to engage in improvement-oriented behaviors because these activities are not an optional investment to benefit their future self, but rather a current job requirement. Thus, we predict:

Hypothesis 2 (H2): Workers are more likely to engage in improvement-oriented behaviors about ISC problems when their role orientation has process improvement activities as part of their daily work than when they have a technical role orientation.

Using Work Flow Blocks to Prevent Workarounds

The third antecedent that we consider is a work design that—at the extreme—makes it impossible to work around problems, and hence automatically draws managerial attention to the problem. The lean production literature refers to this design principle as "jidoka", which is automatically stopping production when there is a problem so it can be identified and fixed (Liker, 2004). This strategy

deliberately creates work blockages ("blocks") that minimize workarounds and force speaking up about non-conforming situations (Kobayashi et al., 2005, Nakajo and Kume, 1985, Vogelsmeier et al., 2008). The goal of error-proofing design is to build work flow blockages into the production system to prevent defective products from being passed down the assembly line (Stewart and Grout, 2001). Employees are trained to stop the production line, which automatically sends a signal to their manager, when they encounter a problem that prevents them from completing their work. Together the employee and manager resolve the issue rather than the employee working around the problem on his own (Spear and Bowen, 1999).

Creating blocks to prevent workarounds and force speaking up may be necessary because empirical research has found that if left to their discretion, employees prefer to work around problems (Halbesleben et al., 2010, Halbesleben et al., 2008, Jimmerson et al., 2005, Kobayashi, et al., 2005, Spear and Schmidhofer, 2005, Tucker and Edmondson, 2003). There are several reasons for this. Workers do not want to be viewed as the reason that production is slowed down (Schultz et al., 1998). In addition, workers are reluctant to take time away from production tasks to communicate about problems (Tucker and Edmondson, 2003).

Making it difficult to work around problems should increase improvement-oriented behavior because the higher "cost" of workarounds increases the benefit of preventing recurrence of the issue. Thus, workers should be more likely to invest their energy to fix problems that take a lot of time to work around. In addition to this rationale, prior research on prosocial behaviors supports the notion that making workers incur a high cost for problems should increase their effort to fix the problems. A prior study found that when people involuntarily paid to engage in an initial round of prosocial behavior (charity contribution), they were more likely to engage in future prosocial behaviors than individuals who were able to engage in the prosocial behavior at no cost to themselves (Gneezy et al., 2012). The authors theorized that because the worker "paid" to signal his altruism by investing in the common good, he would leverage his payment by continuing to engage in prosocial behaviors.

One operationalization of difficulty and cost to the employee is the amount of time required to work around a problem in a manner that conforms with organizational policy. The more time it takes to gather the standard materials to do one's task, the more costly the workaround is for the employee. In addition, employees prefer to complete work tasks in a manner that conforms with organizational policy, particularly in industries that have standard procedures and the potential for lawsuits against workers who do not adhere to these procedures. Thus, we hypothesize:

Hypothesis 3 (H3): Workers are more likely to engage in improvement-oriented behaviors regarding ISC problems when it is more difficult to work around them in a policy-conforming manner.

Overview of the Present Research

We report on a series of laboratory experiments, including a pilot run, that test the conditions under which employees speak up about ISC problems. Study 1 examines whether the opportunity to earn money for a charity will induce higher levels of proactive behavior to improve the performance of the next round of participants. We test the impact of a flexible role orientation in Study 2. Finally, in Study 3 we consider the impact of work blocks on improvement-oriented behaviors, workarounds, and errors.

We tested our hypotheses using a laboratory experiment that we designed for this purpose. We used a laboratory experiment because it enabled us to isolate the impact of a single antecedent variable at a time. It effectively allowed us to remove the impact of organizational factors, such as time pressure and management's responsiveness to communication about ISC problems, which have been hypothesized to impede speaking up in organizations (Tucker and Edmondson, 2002). Thus, we were able to more precisely test whether an antecedent variable was associated with speaking up because a "non-result" was not clouded by uncertainty over whether contextual variables, such as manager responsiveness, influenced the result. We also chose a laboratory setting because it would have been difficult to create these controlled conditions in an organization, in part because we purposely created ISC problems for employees, which would have disrupted service to customers.

We conducted our experiments in exhibitor booth spaces at national nursing conventions. We used hospital nurses as our participants because this occupation provided a large population of frontline employees whose work is frequently subject to ISC problems and historically low levels of speaking up (Halbesleben, et al., 2010, Jimmerson, et al., 2005, Spear and Schmidhofer, 2005, Tucker and Edmondson, 2003, Vogelsmeier, et al., 2008). Due to the time-constrained nature of the conferences, we had a set number of hours to run our experiments, which capped our sample size per conference. Therefore, to obtain a large enough number of participants to test our hypotheses, we attended multiple conferences. To qualify for the experiment, participants had to be nurses who used needles in their daily work. They received $10 at the end of the 20-minute experiment for their participation.

The experiment task was to dispense the 11:00 am medications for three fictitious patients. Medication administration is a fruitful context for studying speaking up because failures, such as missing medications or supplies, occur frequently (Halbesleben, et al., 2010). Medication-related problems can lead to inefficiency, medication errors, and frustration (Gurses and Carayon, 2007, Hall, et al., 2010), which should motivate nurses to speak up.

An experiment "cell" consisted of two long tables in an exhibitor's 10' X 10' space at the conference. We had four medication administration stations in each cell—two per table. Each station accommodated one participant at a time and had a unique identifying color, which facilitated random assignment of

participants to stations. The two stations on the same table were on the same side of the table, but as far apart as possible so that participants worked side by side with some space in between. The tables were arranged at opposite sides of the exhibitor booth facing away from each other such that participants had their backs to the other participants.

When possible, we ran multiple participants through the experiment at the same time, one at each of the four stations. After recruiting four participants, the experimenter gave an overview of the instructions to the group. The experimenter explained that after answering a few questions, they would administer medications to three fictitious patients. Participants were told that they were co-workers and could ask each other for help just like they would on their nursing units. The experimenter used one station to show where supplies and medications were located.

To make the medication administration tasks as realistic as possible, we purchased authentic nursing education supplies from a nurse training company. The materials included three fictitious patients with the following information: patient name, date of birth, medical record with diagnoses and allergies, physician order sheets for medications, and medication administration records which documented the medication administration times. We also purchased vials of fake insulin and 20 different fake oral medications with realistic names (e.g. Practi-Digox™ instead of the real name digoxin), dosages, packaging, and appearance.

For each experiment station, we used a small plastic chest of 16 drawers as the medication cabinet. Each of the three patients had a drawer labeled with his or her name and was stocked with the patient's medications for the day. There was a fourth labeled drawer with a patient, "Art Keegan", about whom the nurses had no information, but whose drawer contained medications. In addition, each station had a plastic supply bin with syringes, needles, alcohol swabs, and two vials of insulin. The "patients" were represented by see-through, zippered pouches, which were labeled with the patient's name and date of birth to provide the two forms of identification required for medication administration. The nurses put the medications into the pouch to signify that the medication was given to that patient.

Pilot Test: Methods, Sample, and Procedures

We first piloted tested the experiment set up. Subjects waited in line to participate and were randomly assigned to an experiment station. The stations were identical except that there were two different orders in which the three patients appeared to participants, which we varied so that adjacent participants would encounter the two internal supply chain problems (described below) at different times. Each station had a computer which was used to administer the experiment questions and the medication administration tasks. Participants prepared patients' medications using the information provided by the survey scripts, of which an example is shown in Figure 1. In addition to the 11:00 am medications shown on the computer, there was a three-ring binder at each station that had each patient's complete set of medication orders,

diagnosis, and allergies, which nurses could use to verify that there were no inadvertent medication interactions, patient vital signs, or patient allergies that would have warranted withholding a medication. There were no reasons to withhold any of the patients' scheduled medications and nurses should have administered all their patients' medications. We recorded which medications were administered to the patients and which participants spoke up to the experimenter, and about what.

Insert Figure 1 about here

To create opportunities for improvement-oriented speaking up, we deliberately put two ISC problems into the medication work station that participants could speak up about and/or work around. One of the patients, Wheeler, was missing an ordered oral medication pill (.125 mg of digoxin), which was used to treat her heart condition. Participants did not necessarily have to speak to the experimenter to obtain the pill, however, because they could borrow it from another one of their patients, either Smith, whose medications they had already prepared and whose drawer had a digoxin pill that was scheduled to be administered in the evening during the next shift, or from the unknown patient, Keegan, whose drawer contained a digoxin pill. Borrowing a medication from one patient to give to another is a common workaround, although against most hospitals' policies (Holden et al., 2012). The second problem was the lack of an insulin syringe, which was required to treat patient Lopez, a diabetic who needed 8 units of insulin. Insulin is administered with a syringe marked in "units". However, the supply bin in the experiment station had only tuberculin syringes, which have mL measurement markings. Participants could workaround the lack of insulin syringes by converting the 8-unit dose into an 0.08 mL dose by dividing the number of units ordered (8 units) by the insulin concentration marked on the insulin vial (100 units/ mL). Using a non-insulin syringe to administer insulin, however, violates many hospitals' policies due to the risk of a medication error associated with converting the dose from units to mL (Cohen, 2003).

Pilot Test Outcome Measures

We had two variables to measure implicit improvement-oriented speaking up. We recorded whether the participant spoke to the experimenter about the missing medication or syringe. The variable "speaking up" was coded as a "1" if the participant spoke to the experimenter about at least one of the problems and "0" if they did not speak up about either of these problems. We also gathered self-reported data from participants in the post-experiment survey about their motivation for speaking up, if applicable. After completing the medication administration tasks and answering post survey questions that comprised our control variables (described in Study 1), we asked participants whether they spoke to the experimenter about (1) the missing medication and/or (2) the missing insulin syringe and if they did, we asked them to select the reason why they spoke up about that specific problem from a list. If a participant reported that

she spoke up to the experimenter about one of the problems with the purpose of improving future work conditions, we coded that participant as a "1" on the variable "improvement-oriented speaking up". The answers that met that condition were "I wanted the experimenter to improve the set-up of my work station so that future participants at my work station could do their job correctly" or "I wanted the experimenter to improve all workstations so that all participants could do their job correctly." Otherwise, the participant received a "0" for either not speaking up, or speaking up because "I wanted to have the proper equipment so I could do my job correctly."

Pilot Test Results

A total of 25 participants completed the experiment. There was no difference in speaking up (M = .92, SD=.28) for each of the two orders of patients, t=.05, not significant (NS). There was also no difference in improvement-oriented speaking up (M = .38, SD = .51 for participants who first encountered the missing digoxin problem, n=13; M = .25, SD=.45, n=12 for participants who first encountered the missing insulin syringe), t=.70, NS.

We had anticipated that few participants would speak up about the problems to the experimenter and that they would work around the ISC problems. However, 92% of participants spoke up about the problems to the experimenter by asking for an insulin syringe or the digoxin pill. Furthermore, 28% of the participants (n=7) refused to work around the missing insulin syringe by converting the dose and using the mL syringe. These participants instead opted to withhold the insulin for Lopez because they felt it was unsafe to use a mL syringe despite the fact that we had a conversion chart available and that Lopez needed the insulin to lower her high blood sugar level and eat her lunch. What is more, 36% of participants (n=9) drew up the wrong amount of insulin in the syringe, with 20% of participants drawing up a 10 times overdose (.8 mL rather than .08 mL). Thus, out of the 25 participants, only 9 (36%) successfully worked around the ISC problem of the hospital running out of insulin syringes. Similarly, a large number (24%) of the participants refused to administer digoxin to Wheeler, either because they refused to split the .25 mg pill to obtain the ordered .125 mg dose, or they were unwilling to borrow medication from one patient to give to another. Finally, despite the high level of speaking up, only 32% of participants spoke up with the intention of improving the medication administration system. We concluded that work blockages could force speaking up about problems, but that this communication would be in the form of requests for materials rather than an explicit improvement-oriented suggestion for system change. This experiment prompted us to take a closer look at the relationships between ISC problems, workarounds that comply with or violate standard hospital policy, and error.

Study 1 – Charity Payments to Increase the Benefit of Improving ISC Performance

We tested the impact of increasing the benefit of improvement-oriented behavior by running an experiment that offered an altruistic benefit of speaking up: the opportunity to earn money for charity.

Speaking up to remove problems from the ISC is an immediate investment that improves the performance of *future* work shifts (Carrillo and Gaimon, 2000), and therefore the charity incentive should reward workers for taking steps that improve the performance of future workers.

Study 1: Methods, Sample, and Procedures

To test H1, we recruited hospital nurses (n=79) at a second nursing conference. Participants were primarily females (91%) between the ages of 25 to 55 (73%) who had worked as a nurse for more than 5 years (90%). These percentages are similar to the population of working nurses in the U.S., where 73.4% are between 25 and 54 years old (US Department of Health and Human Services, 2009).

We rented three consecutive exhibitor booths, with the paperwork processing and recruitment activities taking place in the middle space. There was a medication experiment cell in each of the two end booths, enabling us to run a total of eight participants simultaneously. The experiment procedure was very similar to the pilot test. However, we changed the digoxin dose to .25 mg so that participants would not have to split the pill and we added a pharmacy table in the middle of each of the two experiment cells where participants could get supplies such as medications, syringes, and gloves if needed. Participants were told about the pharmacy and that they could use it. Participants were also informed that some would be randomly selected to earn $5 for a medical-related charity, which would be won if the next round of participants in their cell administered medications without error and within six minutes.

We randomly assigned participants to work stations in a cell, two of which had been pre-programmed to offer the charity payment. Random assignment was done by giving each participant in a group of four a sealed envelope from a pre-made set of four envelopes. Inside the envelope was a card with an identification number written in one of four different colors which corresponded to the color workstation they were to use for the experiment. The half of the participants (n=39) randomly assigned to the charity condition had a screen explaining how they could earn the payment for their charity. The exact wording was "If the next round of participants (in other words, not you and the people working with you now, but the next 4 participants) at all work stations ("RED", "BLUE", "GREEN", and "YELLOW") dispense all three patients' medications correctly and within 6 minutes, you will earn $5 for a charity of your choice." These participants were then asked to select one of five reputable, health-care related charities (e.g. American Kidney Fund) to receive their charity payoff. They also had a sixth option of "none of the above." We purposely had health-care charities receive the payment rather than participants to better represent the fact that patients benefit when nurses speak up about ISC problems. Similarly, we linked the charity payment to the performance of the next round of participants to mimic the fact that speaking up to fix the system benefits future workers.

This study also differed from the pilot study because it contained less risky workarounds for the missing medication and syringe. Regarding the missing digoxin, participants could go to the pharmacy

table, search for a labeled box which contained 25 mg digoxin pills, and take one for their patient. Similarly, they could work around the lack of insulin syringes at their medication station by finding an insulin syringe at the pharmacy table. However, participants could still use the risky workarounds.

Variables

Outcome variables. In addition to the two speaking up outcome measures described in the pilot study, we also included an objective measure of improvement-oriented behaviors. At the end of the medication administration tasks, the computer instructions asked participants in both conditions to write any ideas they had to improve the efficiency of the experiment's medication dispensing process. Pens and a stack of paper labeled "Improvement Opportunities" were placed between the two workstations at each table. These data serve as a measure of an employees' explicit intention to create positive organizational change. The dependent variable, "improvement-oriented suggestions" was 1 if the participant wrote an improvement slip and 0 if she did not.

We coded *risky workarounds* as "1" if the participant used the mL syringe and/or used a digoxin tablet from another patient's drawer and as "0 if the participant did not engage in either of these workarounds. We also recorded the amount of insulin in the syringe. Participants who drew up an amount different from 8 units received a "1" on *insulin error* and a "0" if they drew up 8 units or withheld the medication.

At the end of the experiment we asked participants the extent to which they agreed with three statements about their satisfaction with their performance. The scale was from 1 (strongly disagree) to 5 (strongly agree). These questions measured what we call the *hero feeling*, which is a sense of satisfaction from overcoming ISC problems and being able to administer the ordered medications despite the obstacles. The three items were "I felt proud of my ability to work around any problems that got in my way of completing my work tasks." "I was pleased with my performance on this task." "I felt a sense of accomplishment after completing this task." The Cronbach's alpha for this construct was 0.72, which is an acceptable level of internal consistency (Nunnally, 1967).

Independent Variables. We coded nurses who were in the *charity condition* with a "1" on "charity" and the other nurses as a "0" on this variable.

Control Variables. We controlled for individual differences related to self-assurance, problem solving efficacy and felt responsibility because prior research has theorized that these traits make it more likely that employees will determine that the benefits from engaging in proactive behaviors outweigh the costs (Ashford, et al., 2009, Morrison and Milliken, 2003). We measured participant's *self-assurance* at the very beginning of the experiment—before administering any medication—by asking six questions from the Positive and Negative Aspect Scale (PANAS) (Watson et al., 1988). The questions were preceded by this statement: "This scale consists of a number of words and phrases that describe different feelings and emotions. Indicate to what extent you feel this way right now (that is, at the present moment)." The 5-

point response scale was “very slightly or not at all”, “a little”, “moderately”, “quite a bit”, and “extremely”. The self-assurance construct consisted of the following adjectives: proud, strong, confident, bold, daring, and fearless (Watson, et al., 1988). Cronbach’s alpha was 0.88 (n=79). We used the mean of these six items to calculate a self-assurance score for each person.

At the end of the medication administration tasks and after filling out improvement suggestion slips, but before they answered any questions about ISC problems and speaking up, participants were asked questions to measure *felt responsibility* (Pearce and Gregersen, 1991) and problem solving efficacy (Kasouf, et al., 2006, Tucker, 2007). We asked the felt responsibility and problem solving efficacy questions at this point in the experiment for two reasons. First, we did not want the questions to influence their improvement-oriented behaviors during the medication administration tasks. Second, we did not want their answers to questions about whether or not they spoke up about the problems experienced during the experiment to influence their likelihood of filling out improvement slips or their answers to the felt responsibility and problem solving efficacy questions. For both constructs, we used a 5-point response scale ranging from strongly disagree to strongly agree, with the midpoint being neither agree nor disagree. We used the mean of three items for felt responsibility: “It is up to me to bring about improvement in processes I use for work.” “I feel a personal sense of responsibility to bring about change.” “I feel responsible to introduce new procedures to complete my work more efficiently.” Cronbach’s alpha for felt responsibility was 0.90.

We controlled for *problem solving efficacy*, which measures the extent to which employees feel that raising concerns to their managers will lead to positive change (Tucker, 2007). We took the mean of three items: “It was worth my time to communicate about problems I experienced during this experiment.” “Bringing problems to the experimenter’s attention resulted in the problem being resolved.” “It was worth my effort to resolve problems with this experiment.” Cronbach’s alpha was 0.70.

Manipulation checks. We checked whether the two problems we inserted into the medication administration system were perceived as problems by the participants. After completion of the medication administration tasks and after answering the control variable questions, we asked participants if they experienced any of the following problems: missing oral medication, insulin syringe (in units) not being readily available, other, or none; and whether they spoke to the experimenter about the missing medication or insulin syringe. Ninety-one percent of the participants reported experiencing a problem or speaking up about a problem. The other seven participants obtained the missing supplies from the pharmacy, which indicates that they were cognizant that the supplies were missing from their station. Thus, we feel that the experiment successfully created valid and recognizable internal supply chain problems that participants could choose to speak up about.

We also tested whether the charity condition successfully created a sense of responsibility for systems improvement in the charity-conditions participants. We asked all participants to respond using a 1 (strongly disagree) to 5 strongly agree) scale to the question, "Correcting problems related to my work environment is not really my responsibility." The participants in the charity condition had a lower average (M=1.5, SD=.79) than those in the control condition (M=1.9, SD=1.2), t=1.6, p=.057, indicating that the charity condition treatment did create an awareness of the need to improve the work conditions.

Study 1: Results and Discussion

As Table 1a shows, 19% of the participants in Study 1 wrote an improvement slip, while 36.7% spoke to the experimenter about at least one of the problems. Only 12.7% of participants reported that they spoke up to improve the system. The correlation between making an explicit improvement-oriented suggestion and speaking to the experimenter with the implicit intent of fixing the system was low and not significant (ρ=.11, N.S.). With regard to medication errors, 11% of the participants drew up an incorrect dose of insulin, with 1.3% of these drawing up ten times too much. Engaging in risky workarounds was correlated with insulin dose errors (ρ=.30, $p<.05$).

There was no difference between the charity-condition participants (M=3.9, SD = .92) versus the control group participants (M=3.9, SD=.85) on attentiveness before the experiment (t = -0.82, NS). There was also no difference between these two groups on felt responsibility (charity: M=4.1, SD = .9 versus control: M=4.1, SD = .89, t= -.01, NS) and problem solving efficacy (charity: M=3.9, SD = .55 versus control: M=4.0, SD = .69 t= .80, NS). Thirteen out of the 35 (37%) charity-condition participants eligible to earn the charity payment did so.

Insert Table 1 about here

As column 1 in Table 2 shows, there was no difference in improvement-oriented suggestions between the charity and non-charity conditions. Of the charity condition participants, eight (20.5%) filled out an improvement opportunity slip, while seven (17.5%) of the non-charity condition participants did so. The difference between these two groups was not significant (t=-.34, N.S.). Similarly, there was no difference in speaking up and improvement-oriented speaking up between the charity and non-charity conditions. Of the charity-condition participants, 41% spoke up about at least one problem and 12.8% engaged in improvement-oriented voice. These percentages are not statistically different from those of the non-charity condition participants (32.5% spoke up, 12.5% engaged in improvement-oriented voice).

Insert Table 2 about here

We also tested the differences between charity and non-charity conditions using logistic regression. As Model 1 in Table 3 shows, providing charity payments for participants to speak up about the internal supply chain problems was not associated with increased likelihood of written improvement-oriented suggestions (OR = 1.3, NS). The charity condition was also not associated with higher frequencies of speaking up (OR=.86, NS, Model 2) or improvement-oriented voice about the internal supply chain problems during the experiment (OR=1.31, Model 3). Thus, H1 was not supported.

Insert Table 3 about here

As Model 1 in Table 4 shows, the charity payment condition was also not associated with higher levels of engagement in risky workarounds. As shown in Table 5, Model 1, using a risky workaround was associated with higher odds of an insulin error (OR=7.53, $p<.05$). We also tested whether working around problems was associated with a hero feeling. Workarounds and error-free insulin administration were not associated with higher levels of hero feeling; however if the participant administered all five ordered medications, they had higher hero feelings. ($\beta=.37$, $p<.05$). Thus, participants were motivated to complete the assigned work tasks, even if they had to use risky workarounds (Table 5, Model 2).

Insert Table 4 about here

Insert Table 5 about here

Study 2: Methods, Sample, and Procedures

We tested H2 at the same conference as Study 1. The sample (n=53) was representative of the national nursing population with 91% working for five years or more, 77% female, and 72% between 25 and 55 years old.

The procedure was the same as Study 1 except instead of the charity manipulation; participants viewed one of two 3-minute videos. Half of the nurses were randomly assigned to the treatment condition, "improvement video," which was designed to manipulate their job responsibilities to include process improvement activities. Participants at these stations (n=27) watched a 3-minute video clip about a hospital that described the successful adoption of lean production techniques by nurses with the goal of removing ISC problems (Toussaint, et al., 2010). In the video, the hospital CEO described nurses having to search for materials as a "waste" of employee time. He emphasized that it was part of everyone's job to find and eliminate waste in hospital procedures, and the clip then showed nurses speaking to their unit

manager about problems. Nurses randomly assigned to the other condition (n=26) also watched a 3-minute video clip, but this video demonstrated the correct procedure for drawing up insulin in a syringe, which primed their technical role as a nurse.

Manipulation check. In order to check whether the improvement video created a FRO that included improvement-oriented speaking up, we first tested participants' comprehension of the videos. After watching the clip, we asked nurses to select the topic from a list of three possible answers ("Proper technique for drawing up a dose of insulin;" "Removing waste and inefficiency in hospital work systems;" and "I am not sure"). After administering the medications and answering the post experiment questions, we used a fill-in-the-blank question to ask a second time for participants to recall what video they watched. All participants were able to correctly recall what video they watched. Second, we checked whether the improvement video broadened participants' role definition to include improvement efforts. To do this, after they completed the medication administration tasks, we asked nurses two questions designed to measure FRO (Parker, 2000, Parker, et al., 1997, Parker, et al., 2006). Based on a scale from 1 (to no extent: of no concern to me) to 5 (to a very large extent: most certainly of concern to me), participants answered the extent to which the following problems would be of personal concern to them versus being someone else's concern. The items were: Essential equipment in my nursing unit is not being well maintained; the storage locations of supplies in my nursing unit means that it takes longer than it should to gather all the supplies we need to perform patient care. We selected these questions because they related to the problems experienced in our medication experiment. The two questions had a high Cronbach's alpha score (α=.84), indicating that they formed a construct. We averaged the questions together to get measure for FRO.

Study 2: Results and Discussion

There was again no difference in the pre-survey measure of self-assurance, felt responsibility and problem solving efficacy between participants randomly assigned to the improvement role stations versus those randomly assigned to the technical role station. Participants who observed the improvement video had a higher score on FRO (M= 3.65, SD = 1.07) than participants who watched the insulin technique video (M = 3.21, SD = 1.17, t= -1.42, p=.08), confirming the successful manipulation of FRO with the improvement video. Table 1b shows the means, standard deviations, and correlations for improvement-oriented behaviors and errors. Writing out an improvement slip was negatively correlated with engaging in an against policy workaround (ρ=-.31, p<.05), and positively correlated with watching the improvement video (ρ=.48, p<.05).

We tested H2 by conducting t-tests and a logistic regression of the impact of watching the improvement role video on improvement-oriented behaviors. As column 2 in Table 2 shows, 17 out of the 27 participants (62.5%) who watched the improvement video wrote an improvement suggestion, whereas

only four of the 26 participants (15%) who watched the technical video wrote a suggestion. This difference was significant ($t = -3.97$, d.f. = 51, $p<.0001$). Forty-five percent of the participants (n=24) spoke to the experimenter about the missing medication or insulin syringe. However, only 8 people (33% of those who spoke up and 15% of the total participants) did so with the intention of improving the medication system for future participants. The remainder (67%) of those who spoke up did so to obtain materials they needed to do their job. There was no difference between the two groups of participants with regard to speaking up and improvement-oriented speaking up.

We also ran logistic regressions in which we controlled for self-assurance, felt responsibility, problem solving efficacy and FRO. As shown in Model 4 in Table 3, the odds ratio (OR) for viewing the process improvement video was significant in predicting written improvement suggestions (OR = 11.47, $p<.01$). Providing support for H2, nurses who observed the improvement video were 11.5 times more likely to write down suggestions for improving the work system than nurses who watched the technical video on drawing up insulin. With regard to individual differences, felt responsibility (OR = 5.9, $p<.01$) was associated with improvement-oriented suggestions, but problem solving efficacy (OR = 0.60, N.S.) and self-assurance (OR = 1.02, N.S.) were not.

Model 5 shows that the improvement-video variable was not associated with speaking up (OR=1.88, NS). As Model 6 shows, it was also not significant in explaining improvement-oriented speaking up (OR=1.44, N.S.). Thus, the improvement video does not appear to have impacted participant's improvement-oriented verbal communication.

There was a marginally significant, negative association between watching the improvement video and engaging in a risky workaround (OR= -1.29, $p<.10$), as shown in Model 2 in Table 4. There was a positive association between risky workarounds and insulin errors (Model 3, Table 5, OR=4.29, $p<.05$).

Study 3: Methods

To test H3, we rented three exhibitor booths at a final national nursing conference. All participants (n=70) had worked for a year or more, 64% were between 25 and 55 years of age, and another 31% were over 55. The method of Study 3 was similar to those of Studies 1 and 2 except that participants did not receive any charity-payment opportunities or watch any videos. Instead, we operationalized the difficulty of working around problems by varying the distance of the participant's station to the pharmacy that contained the missing insulin syringes and oral medication. Unlike the previous two experiments, there were only two stations in each exhibitor's booth, but each station had different orders of patients. One booth contained the pharmacy and served as the control condition. Two stations were located in the adjacent booth and did not have a pharmacy. However, participants in this booth were told that they could access the pharmacy in the adjacent booth, making the roundtrip travel distance to obtain the missing supplies approximately 30 feet. These stations were coded as "medium distance." The final two stations

were located in a booth in an aisle adjacent to the aisle with the control booth. These participants were out of sight of the experimenter, and had a roundtrip travel distance of approximately 160 feet to the pharmacy in the control booth. These stations are coded as "furthest distance." The experimenters were located in the "medium distance" booth.

Study 3: Results and Discussion

There was no difference in self-assurance, felt responsibility and problem solving efficacy between participants randomly assigned to the medium and far distance stations versus those randomly assigned to the control station. Furthermore, three logistic regressions that controlled for distance from the pharmacy found that the order of patients was not significant in predicting writing improvement slips (OR= -.53, NS), speaking up (OR = .13, NS), or improvement-oriented voice (OR=-.47, NS).

Table 1c shows the means, standard deviations, and correlations for improvement-oriented behaviors and errors. Being in the furthest distance station was positively associated with writing an improvement slip (ρ=.57, p<.05) as well as engaging in a workaround that is typically against policy (ρ=.52, p<.05), which in turn was positively correlated with making an error with the insulin dose (ρ=.28, p<.05), including a 10x overdose of insulin (ρ=.40, p<.05).

As Model 7 in Table 3 shows, H3 was supported because the odds of filling out an improvement slip were 25.55 times greater when participants were from the "furthest distance" station than when they were from the control station (OR=25.55, p<.0001). The odds of medium distance participants writing an improvement slip were no different from the odds of the control condition participants (OR=2.11, N.S.). Participants with one point higher score on the pre-test self-assurance scale had 3.06 higher odds of filling out an improvement slip (OR=3.06, p<.05). No other control variables were significant.

With regard to speaking up, as Model 8 shows, participants in the medium distance condition had 9.2 times higher odds of speaking up than the control condition (OR=9.2, p<.01), and the furthest distance station participants' odds of speaking up were 3.83 times greater than that of the control condition (OR=3.83, p<.05). We believe that participants in the medium distance spoke to experimenter more frequently than the further distance participants because the experimenter was located in the medium distance booth. Finally, as shown in Model 9, there was no difference in any of the conditions among the odds of speaking up with the intention of fixing the system.

Model 3 in Table 4 shows the positive association between being at the furthest distance station, which made engaging in the safe workarounds more time consuming, and engaging in a risky workaround (OR= 3.26, p<.01). There was a positive association between risky workarounds and insulin errors (OR=18.5, p<.01), as shown in Model 4, Table 5. A summary of the three experiments and their conditions is shown in Table 6.

Insert Table 6 about here

General Discussion and Conclusions

We ran three experiments to determine whether managers could directly manipulate workers' improvement oriented behaviors. We found that it was possible to foster this behavior independent of individual traits, such as felt responsibility and self-assurance. The odds of contributing improvement ideas were 25 times greater when the work system was designed to make it difficult for participants to engage in a policy-compliant work-around to obtain the missing materials. However, participants were more likely to use a risky workaround to complete their tasks, which was associated with higher odds of making a medication error. We found that employees who administered all ordered medications had higher levels of satisfaction with their performance on the experiment. Thus, our research suggests that workers will engage in risky workarounds because they feel forced to, due to their desire to complete assigned tasks. When problem solving support is not available, installing work blockages to prevent workarounds may backfire because people may use creative, but error-prone ways to accomplish tasks.

The odds of filling out an improvement suggestion slip were 11.5 times greater when participants had their role-orientation primed to include improvement activities rather than to focus on technical aspects of medication administration. However, a FRO did not increase the odds of engaging in a risky workaround and was not associated with insulin errors. Thus, in setting with low managerial support available to assist in overcoming obstacles, it may be preferable to enlarge employees' job responsibilities to include improvement activities and deepen technical abilities so they can successfully overcome ISC problems. Finally, earning money for charity was unsuccessful at evoking improvement-oriented behaviors.

We used data from the charity experiment to develop a framework of problem solving responses because participants had access to both policy-compliant and risky workarounds and the manipulation did not create different responses between the control and treatment groups. As Table 7 shows, there were four possible problem solving responses to the ISC problems and four levels of communication. We first discuss the problem solving responses.

Most participants engaged in either a policy-compliant (66%) or a risky workaround (14%). Participants preferred to use standard equipment, but when it became less accessible in Study 3, participants shifted to risky workarounds. Most participants were able to complete the risky workaround without making an error, but 1% of participants did make an error with the risky workaround. Finally, 20% of participants exhibited rigidity by refusing to work around the problems. In these situations, patients did not receive ordered medications, which may have jeopardized their health.

These results highlight the tension between fostering the safe, but rigid, response of not working around problems and workarounds, which are creative responses that enable customers to receive service,

but which may lead to errors and variance from standard procedures. On the one hand, managers can try to prevent workarounds by stocking fewer supplies on units. On the other hand, if ISCs break down employees may resort to risky, error-prone workarounds. Toyota seems to avoid this negative consequence by providing high levels of manager support so that when workers encounter a problem, they can easily signal for and receive help resolving the issue (Liker, 2004). This suggests that a tightening of inventory on nursing units, either due to space or cost pressure, should be accompanied by an increased support system for resolving problems. Alternatively, fostering competent, safe workarounds will require slack equipment and supplies so that workers can obtain what they need, as well as a deepening of expertise so that they have the capability to safely circumvent problems.

With regard to communication, 52% of participants remained silent about the ISC problems. The dominant response to ISC problems was "firefighting" (37%), which was silently working around the problem. Twenty percent spoke up to obtain missing materials, but that communication was not intended to improve ISC performance. Thus, if organizations seek to learn about ISC problems, requests for missing materials need to be recognized by the receiving unit as indications of breakdowns. Improvement-oriented voice, which occurred while participants were completing their medication administration tasks, was relatively rare, constituting only 9% of the responses. This highlights the challenge of frontline staff simultaneously engaging in routine work and process improvement, as has been highlighted by previous research (Victor, et al., 2000). It may be beneficial to have designated staff to assist frontline employees with real-time problem solving, such as investigating causes of problems and experimenting with solutions (Spear, 2005). A more common improvement-oriented response (20%) was suggestions written during reflection time. This supports prior research which found that managers can increase improvement-oriented responses by explicitly soliciting employees' ideas and providing reflection time, such as the U.S. Army's "After Action Review" (Garvin et al., 2008). However, there may be a tradeoff between real-time problem solving versus written suggestions. Real-time problem solving enables identification of underlying causes of a specific problem (e.g. "Why was Wheeler's 11:00 am Digoxin not in her medication drawer?") while relevant information is still available (Shannon et al., 2007, Thompson et al., 2003). Over time, information decays and problem solving effort may shift to solving a category of problems, which may have multiple underlying causes (Spear, 2005).

To investigate their value, we coded each individual suggestion (n=100) and created a histogram. Our goal was to determine whether the written suggestion data would reveal the two known problems of missing insulin syringe and digoxin. As Figure 2 shows, the missing insulin syringe (n=23) and digoxin (n=15) were among the most frequently mentioned issues, suggesting that reflective problem solving would reveal the issues. However, of the 199 people who experienced these problems, only 8% reported the digoxin issue and 12% reported the insulin syringe problem. Our study thus suggests that for every

reported occurrence of an ISC problem, the actual frequency could be ten times greater. Twenty other improvement opportunities were identified, highlighting the benefit of soliciting ideas from frontline staff.

Insert Figure 2 about here

Implications for Research. Our study answers the call for additional research on proactive behaviors that controls for individual differences while testing antecedents that can be influenced by managers (Parker, et al., 2006). We also make a contribution by extending findings about proactive behavior to employees in service organizations (Grant and Parker, 2009), generalizing the research beyond managers (Morrison and Phelps, 1999) and frontline employees in manufacturing organizations (Parker, et al., 2006). Our research also provides support for prior studies that found that employees' work-related goals are an important driver of proactive behavior (Crant 2000, Parker et al 2006). Having a broad role definition that includes long-term goals makes workers more motivated to engage in proactive behaviors (Parker, 2000, Parker, et al., 2006). Our study expands on this theory by finding that short-term goals, such as fulfilling one's immediate job responsibilities, can also motivate proactive behaviors. Furthermore, we demonstrate that improvement role definition can be easily manipulated by managers. Showing subjects a short video clip of nurses engaging in improvement-oriented voice primed them to consider speaking up about ISC problems as part of their routine work. This is an important finding because prior studies (Parker, et al., 2006) have examined role definition antecedents, such as proactive personality and co-worker trust, which are more difficult to manipulate. From a research design perspective, our results highlight the importance of measuring how employees' view their job responsibilities in addition to collecting data on intrinsic motivation for proactive behaviors (Parker, et al., 2006).

Our methodology also makes a contribution. We developed a laboratory experiment that created conditions that warranted, yet did not mandate speaking up. This enabled us to gather objective measures of improvement-oriented behaviors close in time to when they occurred rather than having to rely on recollections about past actions (Morrison and Phelps, 1999, Parker, et al., 2006). By using an experiment with random assignment to conditions, our study answers the call for research that isolates the impact of antecedent variables on proactive behaviors (Parker, et al., 2006). Specifically, we were able to gauge the impact of FRO, work design that prevents workarounds, and charity payments independent of organizational-level variables (e.g. job autonomy, co-worker trust, and supportive supervision) that often confound research on employee voice in organizations.

Implications for Practice. Our findings suggest that employees' proactive behaviors can be manipulated by job design variables that managers can control. Role definition, which can be influenced with little cost, may be a more viable strategy for increasing proactive behaviors than financial payments, which can

be complicated and expensive to implement. Our study also suggests that providing employees with time to reflect on opportunities for improvement may be a more productive vehicle for improvement-oriented voice than expecting employees to speak up about problems while they are completing routine work. In all three experiments, improvement-oriented voice during task execution occurred infrequently. To illustrate, only 13% to 15% of participants spoke up during task execution with the intention of fixing the system. This level of improvement-oriented voice is similar to prior empirical studies of proactive behaviors. For example, Parker et al.'s (2006) study of 282 production employees in a wire-manufacturing plant found that fewer than 30% of the employees engaged in proactive problem solving for ISC problems. Thus, if an organization's goal is to use improvement-oriented speaking up as a method for gathering comprehensive information about ISC problems, this approach might fall short.

Our results suggest that managers may be better served by a two-part strategy of (1) designing time for reflection into employees' daily work; and (2) training employees in supply departments to consider non-routine requests for supplies as signals of improvement opportunities that could be investigated. We believe that in addition to having a flexible role definition that includes improvement as part of one's routine work, employees should also be trained to work collaboratively to eliminate ISC problems that their department causes for downstream internal customers.

Limitations and Future Research. Our paper has several limitations that should be addressed in future research. Our study may be an upper bound on improvement-oriented behaviors because nurses were not embedded in an established organization and did not have to provide care to actual patients. It is possible that providing care to patients and having a history with an organization would dampen improvement-oriented behaviors. The experimenter was readily available, which may have increased speaking up, whereas in a hospital context, the nurse manager might not be available (Tucker and Edmondson, 2003).

The charity condition was not significant in increasing improvement-oriented behaviors. This may have been because of how we operationalized the payment. We were trying to simulate the altruistic nature of the hospital environment where speaking up benefits patients by enabling nurses to provide more timely care in the future. For this reason, we chose that the payment for improving the system would go to a charity rather than the nurse, which may not have been sufficient motivation to increase the perceived benefit of improvement-oriented behaviors. A personal benefit, such as directly receiving payment for improvement ideas, may be more effective at inducing improvement-oriented speaking up. However, prior research suggests that even a direct payment may not produce the desired behavior. An experimental study testing effort to earn money for charity found that publicly viewable efforts to benefit a good cause—which would be the case for improving patient care systems—where highest when participants did not personally gain from their efforts (Ariely, et al., 2009). This suggests that personal incentives for improvement-oriented behaviors to improve a hospital work system may be less effective at

generating the desired effort levels than the patient-centered incentive that we tested. Thus, future research could examine whether stronger altruistic incentives, such as a more visible assignment to the charity condition could generate improvement-oriented behavior.

Conclusions

In competitive environments, it is essential that organizations develop techniques that increase employees' willingness to engage in proactive behaviors to improve organizational performance. This is especially important in complex service organizations, such as hospitals, where employees have a wide range of discretionary activities that they can perform and lower levels of supervision. We believe that designing work that considers the natural responses of employees when they encounter internal supply chain problems will be helpful in creating improvement programs.

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Figure 1. Experiment Script for the Insulin Patient's Medication Administration Task

Patient #3: Martina Lopez
Date of Birth: 5/2/1961
Diagnosis: Diabetic Ketoacidosis/ Type I diabetes
Physician: Victor Peacock

11:00 medications
Practi-Regular Insulin (U-100)

Martina Lopez is a 50-year old, newly-diagnosed, insulin dependent diabetic.
Her blood glucoses have been ranging from 150mg/dl to 350mg/dl.

The lunch tray for Martina Lopez has arrived on the floor and is the correct diet. She is hungry and wants to eat lunch and can eat within the next 15 minutes.

You just checked her blood glucose level it was 270 mg/ dL. Please use the standardized sliding scale provided below to draw up the correct dose.

Standardized Sliding Scale (for Practi-Regular Insulin U-100)

0-60	Initiate Hypoglycemic Protocol
61-150	No Insulin
151-200	3 units SQ
201-250	5 units SQ
251-300	8 units SQ
301-350	10 units SQ
351-400	12 units SQ
>400	15 units SQ and call MD

Write your ID number in the box below to signify that you gave the ordered dose, or enter the letter "W" if you would like to withhold the medication dose.

Figure 2. Number of Improvement Suggestions by Category (n=100)

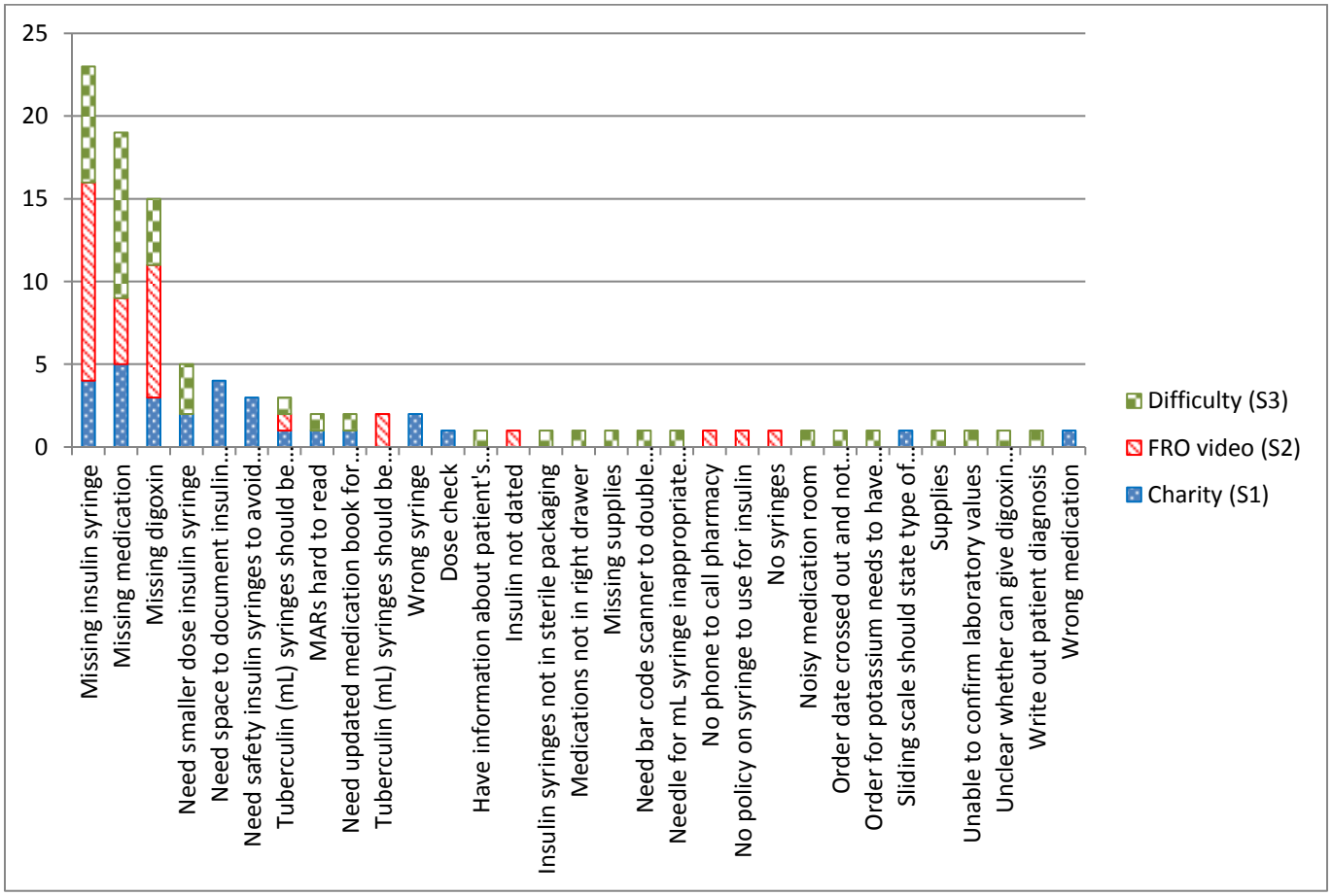

Table 1. Mean, Standard Deviation, and Correlations for Speaking-Up and Errors in the Experiments

1a Experiment 1**:** Charity Payments (n=79)

	Mean (SD)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Wrote improvement slip	.19 (.39)							
2. Speak up about problem	.367 (.49)	.10						
3. Implicit improvement-oriented speaking up	.127 (.33)	.11	.42*					
4. Insulin dose error	.11 (.32)	.23*	.22*	-.02				
5. 10X overdose of insulin	.013 (.113)	-.05	.15	-.04	.32*			
6. % medications omitted	.04 (.11)	.04	.17	-.01	.15	-.4		
1. Against policy workaround	.22 (.41)	-.02	.11	-.01	.30*	.22	.02	
2. Charity condition	.49 (.50)	.04	.09	.005	.12	.11	.07	.10

* = p<.05

1b Experiment 2**:** Flexible Role Orientation (n=53)

	Mean (SD)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Wrote improvement slip	.40 (.49)							
2. Speak up about problem	.45 (.50)	-.19						
3. Implicit improvement-oriented speaking up	.15 (.36)	-.13	.46*					
4. Insulin dose error	.23 (.42)	-.07	.05	.15				
5. 10X overdose of insulin	.075 (.267)	.06	-.12	-.12	.53*			
6. % medications omitted	.04 (.11)	-.25	.22	.03	.21	.29*		
7. Against policy workaround	.32 (.47)	-.31*	-.22	-.06	.30*	.42*	.27	
8. Improvement condition	.51 (.50)	.48*	.06	-.008	-.01	-.005	-.11	-.22

* = p<.05

1c Experiment 3**:** Difficulty of Working Around the Problems (n=70)

	Mean (SD)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Wrote improvement slip	.33 (.47)							
2. Speak up about problem	.44 (.50)	-.13						
3. Implicit improvement-oriented speaking up	.14 (.35)	.24*	.29*					
4. Insulin dose error	.14 (.35)	-.02	.13	-.05				
5. 10X overdose of insulin	.09 (.28)	.003	-.07	-.13	.75*			
6. % medications omitted	.05 (.14)	-.25*	.08	-.15	.20	.03		
7. Against policy workaround	.37 (.49)	.28*	-.09	-.14	.28*	.40*	-.15	
8. Far Distance	.48 (.51)	.57*	.21	.08	.02	.01	-.19	.52*

* = p<.05

Table 2. Comparison of Improvement-Oriented suggestions, Speaking Up, and Improvement-Oriented Voice Across and Within Experiments on Medication Administration

	Study 1 Charity Payments	**Study 2 Video of nurses' role**	**Study 3 Difficulty**
Total no. participants	79	53	70
% Spoke up about at least 1 problem	**36.7%**	**45%**	**44.3%**
Treatment condition / control condition Speak up	41% (charity) 32.5% (no charity) t= -.78	48% (improvement-role) 42% (technical-role) t=-.42	45.5% (furthest distance) 62.5% (medium distance) 25% (control) t=-1.46^ (furthest distance versus control)
% Spoke up to fix system	**12.7%**	**15%**	**14.3%**
Treatment condition / control condition engage in improvement-oriented speaking up	12.8% (charity) 12.5% (no charity) t=-0.04	14.8% (improvement-role) 15.4% (technical-role) t= 0.06	18.2% (furthest distance) 12.5% (medium distance) 12.5% (control) t=-0.53
Wrote improvement opportunity slip	**19%**	**40%**	**32.8%**
Treatment condition / control condition engage in improvement-oriented suggestions	20.5% (charity) 17.5% (no charity) t=-0.34	63% (improvement-role) 15% (technical-role) t=-3.97***	68% (furthest distance) 21% (medium distance) 12.5% (control) t=-4.6*** (furthest distance versus control)

*** p<0.001, ** p<0.01, * p<0.05, ^ p<0.10

Table 3. Odds Ratios from Logistic Regression to Predict Proactive Behavior with Robust Standard Errors in Parentheses

Experiment	**1. Charity Payment**			**2. Video of Nurses' Role**			**3. Difficulty**		
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Dependent Variable	Wrote Improvement Slip	Spoke Up about Problem	Improvement-oriented speaking up	Wrote Improvement Slip	Spoke Up about Problem	Improvement-oriented speaking up	Wrote Improvement Slip	Spoke Up about Problem	Improvement-oriented speaking up
Self-Assurance	0.95 (.35)	.94 (.33)	0.95 (.36)	1.05 (.78)	0.84 (.37)	0.81 (.58)	3.06* (1.67)	0.31* (.16)	0.54 (.27)
Felt Responsibility	0.50* (.15)	1.50 (.38)	0.90 (.22)	0.56 (.43)	1.98 (1.13)	3.25^ (2.09)	1.10 (.29)	0.74 (.21)	1.02 (.46)
Problem Solving Efficacy	1.49 (.5)	5.07** (2.43)	3.82* (1.84)	6.30** (3.72)	0.43^ (.22)	.45^ (.21)	1.02 (.56)	1.63 (.81)	1.32 (.86)
Experimental Condition									
Charity Payment (H1)	1.29 (.78)	2.02 (1.11)	1.31 (.98)						
Improvement Role Video (H2)				11.94** (9.17)	1.57 (.97)	1.33 (.97)			
Difficulty (H3) (medium distance)							2.11 (2.09)	9.20** (7.08)	1.76 (1.71)
Difficulty (H3) (furthest distance)							25.55*** (22.0)	3.83* (2.62)	2.58 (2.33)
Constant	.77 (1.71)	.0001 (.0004)	.001 (.002)	.0005* (.001)	2.76 (5.99)	.07 (.25)	.0009* (.003)	8.07 (24.9)	.26 (.65)
Wald chi^2	5.58	13.21*	10.5*	20.2***	2.85	4.76	19.6**	11.19*	3.02
Degrees of freedom	4	4	4	4	4	4	5	5	5
Observations	79	79	79	53	53	53	67	67	67
Pseudo R^2	.08	.16	.08	0.31	.05	.06	.29	.16	.04

*** p<0.001, ** p<0.01, * p<0.05, ^ p<0.10

Table 4. Logistic Regression to Predict Risky Workarounds

	Model 1		**Model 2**		**Model 3**	
	Odds ratio	**Robust SE**	**Odds ratio**	**Robust SE**	**Odds ratio**	**Robust SE**
Self-Assurance	-0.10	0.39	0.49	0.60	0.24	0.47
Felt Responsibility	-0.15	0.32	0.50	0.52	0.13	0.38
Problem Solving Efficacy	0.82	0.52	-0.60	0.65	0.17	0.64
Experimental Condition						
Incentive (H1)	0.72	0.61				
Improvement Role (H2)			-1.29^	0.70		
Difficulty (H3) (medium distance)					-0.03	0.78
Difficulty (H3) (furthest distance)					3.26**	0.97
Constant	-4.16	2.78	-3.69	3.08	-6.69^	3.52
Wald chi^2	5.50		10.91		26.18**	
Degrees of freedom	7		7		8	
Observations	79		53		67	
Pseudo R^2	0.07		0.16		0.29	

*** p<0.001, ** p<0.01, * p<0.05, ^ p<0.10

Table 5. Regressions on the Relationship Between Risky Workarounds and Errors in Insulin Administration

	Model 1	**Model 2**	**Model 3**	**Model 4**
Type of Regression	Logistic	Regression	Logistic	Logistic
Outcome variable	Error in insulin dose	Hero feeling	Error in insulin dose	Error in insulin dose
	Odds ratio (RSE)	β(SE)	Odds ratio (RSE)	Odds ratio (RSE)
Self-Assurance	5.79* (4.5)	.14 (.1)	2.16 (1.4)	.55 (.4)
Felt Responsibility	1.41 (.8)	.13^ (.1)	.84 (.4)	.53 (.2)
Problem Solving Efficacy	1.13 (.8)	.40*** (.1)	.94 (.7)	.76 (.6)
Risky Workaround	7.53* (6.8)	.009 (.2)	4.29* (3.2)	18.5** (19.2)
Experimental Condition				
Incentive (H1)	1.29 (1.1)	.004 (.1)		
Improvement Role (H2)			1.18 (.9)	
(H3) medium distance				1.9 (2.1)
(H3) furthest distance				.27 (.3)
Insulin dose error (1=yes)		-.23 (.2)		
Administer 5 medications		.37* (.2)		
Constant	7e-06** (3e-05)	1.17^ (.6)	.02 (.1)	13.6 (47.6)
LR chi^2	15.40**	F=4.04***	6.99	12.66*
Degrees of freedom	5	7, 71	5	6
Observations	79	79	53	67
Pseudo R^2	.27	Adj. r^2 = .21	.12	.24

*** p<0.001, ** p<0.01, * p<0.05, ^ p<0.10

Table 6. Experiment Details from the Three Studies

Experiment Condition	**Study 1: Charity Payment**		**Study 2: Video of nurses' role**		**Study 3: Difficulty of Workaround**		
Hypothesis	H1		H2		H3		
Date	September 13-15, 2012		September 13-15, 2012		October 4-5, 2012		
Location	Emergency Nurse Association, San Diego, CA		Emergency Nurse Association, San Diego, CA		Association of Medical and Surgical Nurses Conference, Salt Lake City, UT		
Condition	**Charity**	**No Charity**	**Improvement as part of nurses' role**	**Technical insulin procedure**	**Control**	**Medium Distance**	**Furthest Distance**
No. participants	39	40	27	26	24	24	22

Patient	**Medication ordered**
Martina Lopez	***8 units of Insulin***
Jack Smith	75 mg Persantine
	250 mg Keflex
Sarah Wheeler	8 mEq KCL
	0.25 mg Digoxin

*Problem medications in italics & bolded

Table 7. Framework for Workaround Response and Communication about ISC Problems using Data from Charity Study only (n=79 participants)

	Response to Problem				
Communication	**Rigidity**	**"Safe" Workaround**	**Against-Policy Workaround**		**Total**
			Error	**No Error**	
Silent	Silently omit tasks	Fire-fighting	Lack of psychological safety may inhibit voice because non-standard procedure used		
Overall %, #	8%, n=6	37%, n=29	1%, n=1	6%, n=5	**52%, n=41**
Speak Up	Attempt to adhere to standard	Organization needs to recognize communication as opportunity for improvement			
Overall %, #	6%, n=5	10%, n=8	0%, n=0	4%, n=3	**20%, n=16**
Real-time Improvement Oriented Voice	Whistleblowing	Real-time problem solving will require resources, common methodology			
Overall %, #	1%, n=1	8%, n=6	0%, n=0	0%, n=0	**9%, n=7**
Reflective (after task completion) suggestions	Whistleblowing	Quality of information may be lower because of decay over time or aggregation		Highly competent and motivated employees	
Overall %, #	5%, n=4	11%, n=9	0%, n=0	3%, n=2	**19%, n=15**
Total	**20%, n=16**	**66%, n=52**	**1%, n=1**	**13%, n=10**	**n=79**